NSW HEALTH

ENGINEERING SERVICES

AND

SUSTAINABLE DEVELOPMENT

GUIDELINES

TS11

DECEMBER 2005

Version 1.1

NSW Health
Level 5
73 Miller Street
NORTH SYDNEY NSW 2060

Disclaimer

Whilst every attempt has been made to provide accurate information in this document, no liability attaches to the NSW Health Department, or to any other organizations or individuals concerned with the preparation of the document, for any consequence of inappropriately using the information in this document.

Access

The guidelines can be accessed electronically via the web site at the following address:

URL: http://www.healthdesign.com.au/nsw.hfg/

Access follows a simple on screen registration process.

First published 2003.

Last updated on 21st December 2005.

Please Note:

As this document is in Final Draft form; pagination, typographical and other formatting anomalies may be apparent. Please report typographical, pagination, spelling or other formatting anomalies through the comments section of the web site.

The following Sections and/or technical content have not been reviewed in this revision.

4. Communications
5. Security Systems
9. Lifts
10. Appendix 1
11. Appendix 2
12. Appendix 3
13. Appendix 4
14. Appendix 5
15. Appendix 6
16. Appendix 7
17. Appendix 8
18. Appendix 9

Environmentally Sustainable Design
Life cycle costing
NSW Health – 'Process of Planning', and other technical, policy and information publications.
References to External Industry documents, e.g. ASHRAE.
References to General technical publications and articles.

SAA references however have been updated throughout the document.

INDEX

1. ENGINEERING SERVICES - GENERAL

Introduction

1.1.00 Engineering services account for approximately 35-40% of the capital costs in the construction of health care facilities. Given the significance of this investment, NSW Health is seeking to improve the delivery of these services by adopting a more innovative approach to engineering services design.

These Engineering Services and Sustainable Development Guidelines are intended as a handbook to be used during the briefing and design process.

Objective

1.2.00 The objectives of this document are:

- To allow the flexibility to facilitate creative/lateral thinking and innovation rather than adopting a prescriptive approach to design
- To continually achieve better ways of delivering engineering services and sustainable development taking advantage of advances in technology
- To drive cost efficiency in the provision of engineering services to achieve better value for money
- Integration of service streams to achieve common outcomes.
- To allow for the use of alternative/innovative materials and forms of service provision or designs, rather than being driven by the use of a prescriptive methodology. This then allow designs to be tailored to a particular building.

Structure of the Guidelines

1.3.00 This document contains a section entitled Design Process, generally covering all engineering disciplines, followed by sections for each individual discipline - Mechanical, Electrical, Communications, Lifts, Hydraulics and Fire Services.

The section for each discipline defines the provisions for the service and, in addition, the criteria and process for justifying departures.

Where a standard or code governs the design the reference will be placed in a text box as below.

- BCA (Building Code of Australia)
- AS/NZS 3000:2000 - Electrical Installations

Location Considerations

1.4.00 In providing engineering services for health care facilities, designers need to be cognisant of the following:

1. The need to consider the ongoing servicing (including availability and the cost of parts) of equipment in rural/remote locations in selecting the type of equipment.
2. Standardisation of equipment types across an Area Health Service or Health Service.
3. Geographical/environmental variances across the State.

4. The complexity or otherwise of equipment to meet the service need. This is linked to Point 1.

Uniform Reporting

1.5.00 These Guideline provide NSW Health with a means of making useful comparisons between projects by providing a uniform format for:

- Life Cycle Costing
- Scheme Design Reporting, and
- Elemental Cost Reporting.

The proposed Elemental Cost Breakdown, for example, isolates and quarantines what have been called 'special equipment items' (climatic location will vary the result). These are significant cost items such as sterilisers and operating room shadowless lights that may or may not appear in each project and thus skew the results of any cost analysis. By separately identifying these items, the remaining items - lights, power, air conditioning etc - can be expected to be common to most projects and to therefore provide a realistic basis for comparison.

Project Definition Plan (PDP) Reporting

1.6.00 This report is submitted as part of the Project Definition Plan. It aims to identify the major decisions which will affect the services budget in the final project, such as the inclusion of air conditioning or the need for a new substation or substantial upgrade of existing site services to suit the new conditions, etc.

Schematic Design Report

1.7.00 Scheme Design is the first significant stage of the Process of Facility Planning.

The report produced at this stage sets the foundations for the whole project and this document requires a more in-depth analysis and comprehensive report than has traditionally been provided at this stage of a project.

The aim of the Scheme Design Report is to provide a concise summary of the decisions made so far, to identify areas where these decisions depart from the Guidelines, and document the reasons for such departures.

Considerable emphasis is given to reporting the consequences of those decisions imposed on the Services Engineers by others, e.g. inappropriate plant room placements, inadequate reticulation space, so as to provide an opportunity - and the necessary information - for reviewing those decisions at an early stage of the project.

Regulatory Control of Health Projects

1.8.00 The Building Code of Australia (BCA) and its accompanying set of administrative provisions describe the NSW Local Government requirements on buildings in the interests of safety, health, and amenity.

It is mandatory for all health building projects to obtain building approval from the local council.

The Public Health Act 1991 for NSW requires that all projects that include the design, installation, commissioning and maintenance of air handling and water systems in building projects comply with the requirements of the Act and Regulations 1991. There are no exemptions from these requirements under the Public Health Act.

Submissions to regulatory authorities are required for:

- New buildings – covers building designs incorporating either:

- Air handling systems and/or
- Cooling towers serving either air-conditioning plant, or
- Cooling towers serving process cooling system plant

- Existing buildings involving mechanical upgrade/refurbishment projects where:
  - The footprint of the building/plant changes or
  - New air handling units are provided or
  - Existing air handling units are relocated or
  - Existing cooling towers are relocated or
  - New cooling towers are provided.

The following need to be submitted:

For Air Handling Systems:
Submission of the following plans to regulatory authorities (local councils) for approval.
- Site survey including:
  - Proposed locations for cooling towers, air intakes and exhaust outlets;
  - Existing locations for cooling towers, air intakes and natural ventilation openings of buildings adjacent to or facing the proposed new installation.

For Air Handling and Water Systems:
- The approval by the relevant public authorities for drainage or liquid discharge from any component of the system/s to be discharged into a waste water system or otherwise disposed.

Overarching Objectives

1.9.00 INFECTION CONTROL

Handwashing - Refer to Part D of the NSW HFGs (Health Facility Guidelines).- Infection Prevention and Control.

Traffic patterns - The design of a building should ensure that work traffic flows in clinical, service and general areas take into account the clean and dirty flow patterns throughout the facility.

Cleaning - Refer to Part D of the NSW HFGs (Health Facility Guidelines). - Infection Prevention and Control.

Ventilation - Ventilation system designs should meet the appropriate Australian Standards and national and state requirements. Appropriate pressure differentials between rooms are to be used to ensure that air movement is from 'clean to dirty' areas. Refer to Mechanical Section - Infection Control for more details.

1.9.05 OCCUPATIONAL HEALTH & SAFETY (OH&S)

Refer to Part C of the NSW HFGs (Health Facility Guidelines).

1.9.10 WHOLE OF LIFE

In selecting a system / material, the long term service requirements / cost benefits (Whole of Life) are considered and not necessarily from a short term perspective.

For engineering services, 'Whole of Life' means to consider the capital cost of an installation together with operating, maintenance and component replacement costs during the life of the service or facility. (The initial capital expenditure is often quickly overtaken by recurrent costs; any additional installation costs are soon realised early in the life of the facility).

The key objective for 'Whole of Life' is that an optimum service installation for a specific facility, is identified and that facility managers have confidence in the system selected.

It should be noted however that 'Whole of Life' cost studies are part of a larger decision-

making process. As well as the physical and economic aspects of engineering services, designers and operators will need to consider functionality, technological changes, health operational changes, together with social and legal implications.

The cost and energy performance of a facility must be able to be monitored and facility managers must be able to control energy usage and plan effective maintenance/replacement programs.

1.9.15 ACOUSTICS

Functional requirements of the health facility described in other documents may dictate the form and shape. The purpose of this document is to integrate the health facility's internal and environmental acoustic requirements in order to achieve an acceptable acoustic environment.

Due to noise-sensitive issues within new buildings, the requirements contained within this document will be the primary consideration when considering finishes and acoustic isolation.

1.9.20 INTER – OPERABILITY

In developing design solutions, the consultant is to ensure information can be transferred to systems established by NSW Health e.g. Health AMMS (Asset, maintenance and management system). .

Sustainable Development

1.10.00 GENERAL

The NSW Government is committed to sustainable development and to advancing sustainable practices in the design, construction and operation of buildings across the commercial, residential and industrial development sectors.

It aims to make buildings healthier and more affordable. It also aims to reduce the impact of buildings on the environment by reducing the demand on non-renewable resources such as energy and water, and reducing pollutants and greenhouse gas emissions.

NSW Health requires sustainable development principles and strategies to be applied to health facilities in accordance with Premier's Memorandum No 2003-2 High Environmental Performance for Buildings and the requirements of the Environmental Performance Guide for Buildings (EPGB).

The Government Energy Management Policy (GEMP) has set a target to reduce the State-wide total energy consumption of government buildings (both government-owned and leased) by 25% from 1995 to 2005. The policy requires new buildings and accommodation to be energy-efficient and cost-effective.

NSW Health is committed to achieving these targets.

All the sustainability issues and associated strategies described in the EPGB are to be addressed in the design, construction and operation of the works. The EPGB sustainability issues and associated strategies are available in detail on the website: http://asset.gov.com.au/environmentguide/.

All the performance areas and associated strategies described in the EPGB are to be addressed in the Design of the Works.

NSW Health wishes to leverage its significant achievements in energy management to be a best practice energy management agency.

1.10.05 OBJECTIVES

The key sustainable development objectives are:

- Comfortable and healthy indoor environment (in terms of thermal comfort, visual comfort and indoor air quality).

- Minimised non-renewable resource consumption (e.g. energy, water) and environmental impacts (e.g. greenhouse, other air and water emissions, solid waste).

- Cost-effectiveness over its whole life cycle.

1.10.10 SUSTAINABLE DEVELOPMENT DRIVERS

These objectives are underpinned by a number of sustainable development drivers including:

- The Government Energy Management Policy (GEMP).

- The objectives of the NSW Government's Sustainability Advisory Council.

- The NSW Water Conservation Strategy.

- The NSW Government's Waste Reduction and Purchasing Policy (WRAPP).

1.10.15 SUSTAINABLE BUILDING DESIGN

Some specific issues and requirements include:

- In conjunction with the functional requirements, the building form shall incorporate passive design considerations to minimise the capacities and operation of engineering services, and to minimise energy use.

- The building's passive design and engineering services shall complement each other through an integrated design process involving all disciplines right from the beginning, to achieve the sustainable design outcomes for the whole building.

- The required sustainable design outcomes include thermal comfort, visual comfort and acoustic comfort for the building users, as well as ensuring good indoor air quality.

- The building form (including the shape, size, depth and orientation of the floor plates, etc.) shall be optimised to minimise solar heat gain, maximise natural daylight benefits and optimum access to diffuse natural light, and provide optimum HVAC outcomes.

- The mechanical services and building passive design shall complement each other in design and operation to jointly achieve the functional outcomes for the building, including providing an energy-efficient, healthy, thermally comfortable and acoustically acceptable indoor environment.

- Water conservation and water cycle management are to be considered in the design (e.g. rainwater reuse, stormwater management, water recycling).

- Only environmentally-sound materials (with minimal impact on the environment, minimised use of non-renewable resources, non-hazardous substances, minimised impact on indoor air quality and high recycled/recyclable content) are to be used wherever possible.

- Renewable energy systems to be incorporated wherever possible.

1.10.20 ENVIRONMENTAL OUTCOMES AND PERFORMANCE REPORTING

The applicable environmental principles, performance areas, strategies and objectives are described in the EPGB.

The required environmental outcomes to be achieved must be developed, identified and adopted in the development of the design to suit the strategies outlines in the EPGB.

Consultants need to demonstrate how the design, including the proposed building services, will achieve the environmental outcomes required.

The consultant must provide a specific Environmental Performance Report (EPR) at the

completion of the part of the design for each milestone in the form of electronic Excel files or included in the EPGM. The scope of the EPR reporting will be advised in the brief.

The specific project requirements will be contained in the architectural and sub -consultant brief.

Responsibility

1.11.00 GENERAL

This document aims to achieve greater definition of engineering services at an earlier stage of the project and to clearly define the responsibilities of both user groups/briefing teams and the engineering designers.

The briefing team, in consultation with the user groups, are required to justify (in terms of clinical service need) any engineering service that are not in accordance with the Guidelines.

The designers are required similarly to justify any decisions not in accordance with the Guidelines and to demonstrate the logic (through life cycle costing analysis) of the systems proposed.

Engineering designers are also required to report their costs in a set cost format that requires a close focus on the actual design, rather than relying on per square metre rates or other broad bases of cost estimation.

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.

1.11.05 RISK MANAGEMENT

An important role of engineering services is controlling specific risk factors within a particular Health Care Facility. Engineering services become part of the complex risk management environment that includes many other factors such as maintenance and management. The optimal solution is the structuring of risk management to suit the potential risks specifically for the facility and financial circumstances (that will vary among projects).

This document cannot 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.

As energy efficient solutions are becoming increasingly important further requirements are proposed for inclusion in the BCA in the near future. Some energy efficient solutions based on good engineering and general project development approach do not necessarily increase capital costs.

The provision of most energy recovery equipment does increase capital costs of the project, therefore life cycle cost analysis will be required to justify additional expenditure and application of this equipment will depend on budget

Services, or their loss, shall not cause any unacceptable hazard. The particular risks involved with patients and healthcare procedures shall be considered. Where loss of service could cause unacceptable risk (including post disaster function), services shall be continuously available and provide reliable operation.

1.11.10 All services shall satisfy the facility's specific healthcare procedural requirements and patients' and other occupants' needs. All services shall be designed and installed in a manner that will minimise the opportunities for patient self-harm.

2. DESIGN PROCESS

Introduction

2.1.00 SCHEME DESIGN STAGE

Many opportunities for cost savings occur in the sharing and co-planning of plant and reticulation systems e.g. co-operation between disciplines in scavenging waste heat etc and co-ordination of plant room space.

Schematic design stage is, in many ways, the most important stage of the project where major decisions are made determining the overall form and configuration of the building, floor to floor heights, plant room locations etc.

Therefore the opportunities for cost savings through the sharing and co-planning of plant and reticulation systems need to be encouraged and pursued. These decisions are not readily changed as they represent 'the foundation' upon which the rest of the design is built. Interestingly, Scheme Design is often the shortest phase in the design process.

The opportunity for user group demands to inflate project costs has been well documented; the briefing and Scheme Design stage represents the best opportunity to control this input. For this reason considerable emphasis is placed upon briefing in this document.

2.1.05 OBJECTIVES & APPLICATION

The aims of this document is:

- To ensure adequate, appropriate and complete briefing occurs at each stage
- To ensure appropriately timed and formatted design reviews occur during Scheme Design
- To ensure informative and consistent cost reporting of Engineering Services
- To ensure a consistent and straightforward Life Cycle Costing method is applied to plant and equipment decisions on all projects.

This document will apply to all health building projects.

The Brief

2.2.00 The project brief must be completed before design work commences. Engineers will be engaged at the briefing stage to ensure services requirements are adequately defined.

For Design and Construct type projects, engineering input will be required for brief formulation and for the assessment of proposals. For traditional delivery methods, engineering input into the brief will be required for either the preparing or reviewing of the final document.

Room Data Sheets

2.3.00 Room Data Sheets are to be finalised and approved before commencement of detailed design. The engineers' engagement is to include input into Room Data Sheet briefing.

Engineers are to certify briefing information is complete and adequate before Room Data Sheets are finalised.

Compliance

2.4.00 Engineering services installations must comply with the relevant provisions of the Building Code of Australia (see Introduction Clause 1.8). Where compliance with the BCA is considered onerous, unreasonable or unduly expensive, NSW Health should be approached to seek a dispensation from compliance with the particular clause(s). (It may be that this will lead to a modification of the BCA, if the arguments presented are sound and have broad application.)

Engineering services shall similarly be designed in accordance with this document and the standards set out in the NSW HFG (Health Facility Guidelines).

In some cases (e.g. air-conditioning), provision of an engineering service needs to be justified on the basis of the services provided within the unit. Departures from the Guidelines or HFGs must be justified.

Scheme Design

2.5.00. REVIEW TIMING

The timing of design reviews shall be decided on a project-by-project basis with the aim of confirming the proposed design as being the optimum solution. Generally two Design Reviews will be required, large projects may require three or more.

The first Design Review of Scheme Design proposals shall be at an early stage while several schemes are still being considered. Engineering design issues and their interaction with the overall project and consequential costs shall be important agenda items. These reviews shall include all disciplines and appropriate client and Departmental representatives.

The second design review, late in the Scheme Design process, will be conducted to ensure the proposal has not drifted away from the objectives agreed in the first review.

2.5.05. REVIEW FORMAT

Scheme Design Reviews shall include all disciplines and review all aspects of the design. For the review conducted in the early (formative) stages of scheme design, the engineering services portion of the review shall focus on the interaction between the proposed building design and the resultant services configurations. In particular the following should be addressed:

- Shutdown parameters
- Planning decisions leading to services costs
- Sub-station location
- Mains route onto site
- Emergency generator location
- Sub-mains reticulation routes
- Main switchboard location
- Appropriate plant room sizing/location
- Appropriate plant room configuration
- Riser shafts
- Planning of A/C and non A/C spaces in associated clusters
- Services reticulation allowances especially floor to floor heights.
- Review of number of lifts

The review held late in the Scheme Design process should include all of the above and follow the structure of the Scheme Design Report. Particular attention should be paid to:

- Proposed departures from the guidelines
- Consequential costs resulting from sub-optimal plant configurations plant and equipment subject to life-cycle costing

Costings

2.6.00 REPORTING

Engineering services cost estimates are to be prepared in the cost format (as described within the guideline for each discipline) and included as part of the Project Definition Plan and Scheme Design Reports.

2.6.05 MONITORING

Engineering services cost estimates will be monitored throughout the design process in the cost format included in the Scheme Design Report. Consultants will submit a cost report at each design stage.

2.6.10. LIFE CYCLE COSTING

Life cycle costing shall be carried out to justify plant and equipment selection for items as required in Scheme Design Reports. Where it is required, life cycle costing shall be carried out in accordance with the method described in Appendices of this document.

Departures from Guidelines

2.7.00. Any departure from the guidelines are to be referred to NSW Health 'Asset and Contract Services'.

Future Expansion

2.8.00. Other than as described in individual guidelines, future expansion allowances will only be permitted in accordance with the requirements approved in the Project Definition Plan.

Post Occupancy Evaluation

2.9.00. The post-occupancy evaluation of each project shall include an assessment of all engineering services. The review shall be conducted 12-24 months after commissioning and include such issues as:

- User satisfaction
- User understanding and acceptance of systems
- Operating costs
- Maintenance issues (accessibility, reliability and cost)
- Appropriateness of service

Definition of Critical Care Areas

2.10.00. To assist in clarification of services needs, the term 'Critical Care Areas' has been defined as those areas where acute resuscitation procedures occur on a regular basis and will include:

- Resuscitation bays in the Emergency Department. In a Level 5 and 6 facility this may also extend to several treatment bays
- Operating rooms, Anaesthetic Bays and the Recovery area of the Operating Suite
- Day Procedures Rooms
- Coronary Care Unit
- Intensive Care Unit
- Neonatal Intensive Care Unit
- Cardiac Catheterisation Rooms
- Some areas of Medical Imaging.

Other areas, such as High Dependency, will require assessment at the Design Briefing Stage of the planning process to determine if they qualify to be included in this classification.

Critical Care Areas, once defined, will qualify for a higher concentration of services. Although these service needs will change over time because of evolving clinical management trends, the minimum service provision per bay shall comply with the minimum requirements provided in Part B - NSW HFG - RDS e.g. Level 5 / 6 ICU Bays re. Gases and power.

The briefing team should designate Critical Care Areas early in the briefing stage to assist in clear definition of engineering services provision and to minimise subsequent debate.

Because of their high level of service provision Critical Care Areas have the potential to generate significant capital costs. Briefing teams should exercise considerable restraint when identifying these areas.

3. ELECTRICAL SERVICES

Electrical Performance Outcomes

3.1.00. OBJECTIVES

To provide electrical services that deliver safe, reliable and flexible energy sources within the facility that provide the expected lighting levels for comfort and functionality, using cost effective solutions that achieve an optimal balance between capital, operating and maintenance costs over the life of the service.

3.1.05. OUTCOME STATEMENT:

Achieve objective through the use of energy efficient building and services design, low whole-of-life costs while meeting OH&S requirements and achieving occupant satisfaction with the internal environment.

Components	Performance Outcomes	Performance Criteria	Measurement Mechanism
General power and lighting energy usage	Minimise energy consumption	Energy input per square metre of floor area per annum Average 120 kWH/m^2 pa Clinical Areas 140 kWH/m^2 pa Administration 65 kWH/m^2 pa Wards 95 kWH/m^2 pa	Energy used in functional areas and the whole building
Power distribution flexibility	Spare capacity for future load changes	Spare capacity provision in mains and switchboards Consumers Mains: Matched to maximum capacity of transformers Submains light & power: 30% Switchboards: 30% spare poles Mechanical Plantroom S/B's: X%	Spare capacity as supplied on installed equipment
Communications system flexibility	Spare capacity for future change	Structural Cabling: Copper 50% Optical Fibre 50% Comms Cupboards & hub equip: 50%	
Lighting efficiency	Maximise the lumens output per watt of energy used in lamp selection Maximise luminaire efficiency Minimise luminaire energy consumption	Lumens per watt for lamp selection General lamps >50 lumens/watt Luminaire Light Output Ratio>70% <4.0 Watts/m2/100 lux generally <6.0 Watts/m2/100lux for wards	Lumens output for lamp selection.
Lamp life/Maintenance	Maximise lamp life and minimise luminaire maintenance costs	Lamp life – Linear Fluorescent tubes >15,000 hrs PLC Lamps > 5000 hrs	

Occupant comfort	Occupant satisfaction with lighting conditions in occupied spaces	80% satisfaction rating	
	Maintain lighting levels and colour rendering in functional areas to agreed levels	In accordance with AS/NZS 1680 and other directives	Actual quantities measured against AS/NZS 1680 requirements
Whole of life costs	Lowest system cost over it's operating life considering: capital cost; operating cost; and maintenance and replacement costs	Life cycle costing analysis	Life cycle costing analysis complying with AS 4536
Infection control	Prevent intrusion of dust in operating theatres and other defined clinical areas through lighting fittings. Minimise dust collecting surfaces in general		
Ecological Sustainability			

Introduction

3.2.00. GENERAL

The cost of lighting installation and power distribution cabling systems are major contributors to the cost of electrical services and are significant items in the overall engineering services cost for the refurbishment or construction of new health facilities.

There is a perception in the health industry that the current design practice is not as efficient as it should be and consequently over-design and over-provision for unsupported future requirements are seen to be prevailing.

Significant aspects of the electrical services design are governed by statutory requirements contained principally in the following codes and standards:-

- BCA (Building Code of Australia)
- AS/NZS 3000:2000 Electrical Installations

These regulations together with the referenced Australian Standards cover the following major elements of electrical services for hospital buildings:

- Power supply and distribution systems
- Wiring for all electrical equipment
- Emergency lighting and exit signs and
- Emergency warning and intercom systems.

It is recognised that approval for departures from the statutory requirements is difficult and time-consuming to achieve. Notwithstanding, this document identifies some areas of the statutory regulations which should be challenged and modifications to suit hospital projects be sought by NSW Health.

There are, however, other aspects of the electrical design which are not subject to regulations and are normally carried out in accordance with the following criteria:

- Recommendations of Australian Standards
- Requests by hospital user groups and
- Designer's office design practice.

This document is primarily targeted at those areas where opportunities exist for cost efficiency improvements.

3.2.05. OBJECTIVES

The primary objectives of the design guidelines for electrical services are to:

- Focus on areas where cost efficiency in design could yield construction cost savings;
- Provide better defined design parameters and future provision requirements in the selected areas for designers to achieve industry-wide cost efficiency, and energy savings;
- Provide a catalyst for further improvements and individual design innovation;
- Ensure important electrical services design issues which have significant impact on the building design are properly addressed with appropriate solutions adopted at the early scheme design stage of the project development; and
- Ensure cost reduction measures do not reduce the level of required servicing and safety standards.

3.2.10. APPLICATION

This document will be used for the design of electrical services for all Health Care buildings.

The following selected, cost-significant items of electrical services have the greatest potential for capital and recurrent cost savings:

- Mains supply provision;
- Mains and sub-mains;
- Power distribution equipment;
- Emergency supply provision;
- Interior lighting provisions; and
- Protected wiring systems in patient treatment areas.

Main Electrical Supply Requirement

3.3.00. GENERAL

The mains electricity supply capacity is normally assessed jointly by the designer and the supply authority based on the calculated value of the maximum demand of the new electrical installation, adjusted (normally) downwards to an assessed value comparable to the recorded values of similar installations.

The method of determining maximum demand on the electrical installation and therefore on the consumers' mains is prescribed in AS/NZS 3000

Assessment of maximum demand using AS/NZS 3000 may be conservative and therefore may result in a gross over-design of supply systems.

However, the opportunity for over-design and therefore ineffective provisions lies in the following areas:

- Assessment of spare capacity for future requirements, and
- Provision of dual supplies which does not maintain true supply integrity because of non-automatic changeover operations and/or lack of full capacity on the standby feeder.

This document addresses these areas.

Electrical Supply Demand

3.4.00 PRESENT REQUIREMENT

The assessment of electricity supply demand for the purpose of determining the capacity of the substation or supply service shall be carried out in accordance with the following procedures:

- Calculate maximum demand of the various load groups of the new electrical installation in accordance with AS/NZS 3000 or other relevant demand assessment basis.
- Forward the calculated maximum demand together with the following information to the Supply Authority for a joint assessment of the demand requirement.
- When initially communicating with the Supply Authority, known and established w/m2 figures instead of SAA calculations should be used as the number of socket outlets and 3 phase outlets (which we regard as largely irrelevant to the maximum demand calculation) are not usually known when initially talking to the Supply Authority.
- The gross area of the new or refurbished building,
- The supply demand of the existing electricity installation proposed to be de-commissioned as part of the refurbishment project.
- The number of GPOs and three-phase outlets allowed for in the calculations and their likely usage rate (loading diversity factor).
- The number of standby equipment/motors and their loading requirements. Note: Supply demands of these standby motors are to be excluded from the demand calculations. Details of loadings are to be given to the Supply Authority for their information only.
- The number of lifts and their individual supply demand, and
- Actual supply demands of similar installations and their locality for fine-tuning of the demand assessment by cross-referencing.

3.4.05 PLANNED SPARE CAPACITY

Consideration shall be given to the appropriate allowance for the space / capacity (either in equipment or accommodation space) for additional requirements of future budgeted new equipment or budgeted new building development being planned for implementation in the near-term (within 5 years).

No planned spare capacity shall be provided unless the future new development is included in the budget.

When appropriate, the planned spare capacity shall be assessed based on the anticipated power requirement of the future development. However if the information is not readily available then the capacity shall be assessed based on the following per unit area allowance.

Building Categories:	VA per sq.m	kVA per sq.m.
Air-conditioned with non-electric heating	100	0.10
Air-conditioned with electric heating	120	0.12
Air-conditioned (Reverse Cycle)	110	0.11
Electric heating with no cooling	100	0.10
Non-electric heating with no cooling	60	0.06

3.4.10. CONTINGENT SPARE CAPACITY

In the absence of any known future requirements, a contingent spare capacity of not more than the following allowances shall be included:

Air-conditioned buildings: 20%
Non-air-conditioned buildings: 35%

3.4.15. TRANSFORMER AND CAPACITY

The transformer capacity shall be sized to include the assessed present requirement and the planned spare capacity or the contingent spare capacity (Refer to Electrical Supply Demand), whichever is greater. The supply authority will normally determine the size of the transformers where it owns and supplies the transformers.

As far as possible, one transformer shall be provided for the required aggregate capacity subject to maximum transformer size available from the relevant supply authority.

Provision of a spare transformer or a second transformer to improve supply availability is not required unless specifically requested and funded by the supply authority.

For medium capacity requirements (e.g. up to 750 kVA), pad-mounted outdoor kiosk-type transformers (substations) are preferred subject to supply authority availability and access requirements. Multiple pad-mounted kiosk-type substations are preferred over indoor substations where available.

Where chamber (indoor) type substations are required, they shall be in a fire-rated enclosure within the main building or in an outbuilding.

3.4.20. SUBSTATION ROOM

The substation room shall be sized to accommodate the required number of transformers and the associated switchgear to satisfy the present supply requirement.

Spare space in the substation room for additional transformers will not be required except when the aggregate (present plus spare) capacity is equal to or greater than:

- 1000 kVA for a single transformer installation, or

- 75% of the total capacity of a multiple transformer installation.

Priority planning consideration should be given to the provision of more space for substitution of the initial transformer(s) by larger size transformer(s) than for additional transformers.

3.4.25 HIGH VOLTAGE SUPPLY

It should be anticipated that even in the most reliable situations a loss of the electricity supply can occur. Given also the current trend to minimise maintenance costs on the external infrastructure, the risk of loss of supply is increased. Therefore do not rely on external energy sources only.

Where hospitals cannot function for a time with loss of the external supply, standby power generation regardless of the form of the normal power supply shall be provided.

In considering the provision of dual supplies to ensure electricity supply reliability, consider the following factors:

- Large teaching hospitals and hospitals spread over large campus areas will have multiple high voltage power supplies and preference should be given to ring main reticulation from separate power supplies where practical. Automatic transfer switched should be employed.

- Hospitals with multiple transformer installations with immediate access to ring main feeders at the site boundary should be connected to form a ring main supply connection. Such connections allow for routine maintenance of the equipment, and loss of supply on one feeder due to environmental conditions such as lightning strikes, bush fires, motor vehicle accidents and fault trip conditions. The cost benefit should be weighed in regard to automatic transfer switching versus manual switching of the ring main feeders including consideration of any standby emergency generation capacity.

- Where practical, feeders should emanate from two independent network circuits and from two different street reticulation routes.

- Ring main dual supplies should not be considered for small hospitals and generally not for single transformer sites where the supply is considered highly reliable.

- Where dual supplies to hospitals are not readily available and are subject to substantial costs, provide single HV site connections (spur connection).

- Whether automatic transfer from the duty feeder to the standby feeder is permitted by the Electricity Distributor.

- Whether the street reticulation systems are prone to interruptions due to inclement weather conditions or prevailing vandal problems.

- Where spur connections to hospitals are being considered and the reliability of supplies are known to be questionable, a cost benefit study should be carried out on either moving to dual supplies or increasing the capacity of standby emergency generation.

- Where a standby supply feeder does not have full capacity available, a cost benefit study should be carried out on either utilizing the standby feeder with a standby generator or using only a standby emergency generator of increased capacity. In such cases manual switching between the HV supplies will be necessary and site switching of hospital loads will be necessary to reduce the connected load and co-ordinate the loads connected to the emergency generator.

- The total life cycle cost (i.e. initial capacity cost of the installation, authority charges and recurrent standby charges if applicable).

3.4.30. TARIFF SELECTION

Detailed analysis of the likely demand and consumption of the new electrical installation shall be carried out to determine the most cost-effective tariff.

The health building user shall carry out a further tariff study approximately 12 to 18 months post-occupancy to verify the tariff selection.

The main switchboard and the metering facilities shall be designed to enable tariff selection changes without the need to modify the switchboard busbar system.

In general, Three Part Time-Of-Day low voltage demand tariff (if available) is the most cost effective option particularly where high power consumption is envisaged during weekends and night hours from 10:00 p.m. to 7:00 a.m.

Subject to detailed analysis of the demand and consumption, Three Part Time-of-Day High Voltage Demand may be suitable provided that the extra over capital cost of the substation equipment can be off set by energy cost savings in not more than 3 years.

For installations subject to kVA demand charges, power factor correction equipment shall be provided to improve the power factor of the electrical installation to 0.98 or better to minimise the demand charge.

Standby Power

3.5.00 GENERAL

In accordance with the Building Code of Australia (BCA) requirements, the provision of emergency supply for the following services is mandatory:

- Emergency evacuation lighting,
- Fire alarm system, and
- Emergency warning and intercom system.

Provision of battery supply as emergency supply is deemed to satisfy.

In addition, the BCA. also requires that emergency supply be provided for a lift installation comprising two or more lift cars but only when standby generator supply is already available.

Apart from the above, there are no other statutory requirements for emergency supply.

The need for emergency supply for other essential services and critical care areas and the extent of its reticulation shall be evaluated for the hospital taking into account the following factors:

- The procedures which are regularly undertaken and which involve patients that are susceptible to interruption of the electrical supply,
- The frequency at which such procedures are undertaken,
- the frequency at which areas are used for their designated function,
- The availability of battery-operated or gas-operated equipment,(including lighting) to continue critical procedures or to resuscitate a patient,

Most hospitals will require an emergency power supply regardless of the nature of the normal electricity supply.

Once the need for an emergency supply is established for the hospital, the preferred supply source is a standby generating plant comprising one or more diesel-fuelled, engine-driven generator(s) with automatic start and changeover. Alternatively, where piped natural gas is available to the site, natural gas engines may be considered.

AS/NZ 3009 does not require that standby driven generators be fuelled from site stored fuel supplies where the electricity supply on the site (normal and standby) is available from dual offsite energy sources (i.e. electricity and natural gas).

Where co-generation using waste heat from natural gas fuelled engines running normal plant is a design consideration, the engine may be used in a dual operating mode to run a standby generator during loss of electricity supply to the site.

This guideline covers the extent of provision that should be included.

3.5.05 EMERGENCY SERVICES

The following services shall be provided with emergency electrical supply from a diesel generating plant in accordance with the recommendations of AS 3009 and as modified herein. Lighting or power provided with less than 100% supply may be distributed through the department in any pattern to suit Departmental needs. (See Clause 3.10.35).

Area/Facility	Lighting	Power
Angiographic Laboratory - Angio Equipment	100%	100% 100%
Blood bank refrigerators	30%	100%
Blood bank type and cross matching areas	30%	100%
Cardiac catheterisation room - Cath Lab equipment	100%	100% 100%
Computer Centre Cooling Systems	100%	100% Policy decision
Coronary Care Unit • Acute beds • Elsewhere	 100% 50%	 All GPOs per bed Note1 50% GPOs
Critical Care Areas (see DP14)	50%	100%
Diagnostic laboratories	30%	30%
Emergency department treatment rooms	100%	All GPOs per bed Note1
Food preparation (Cooking)	30%	30%
Intensive Care Unit • Beds • Elsewhere • Ventilation	 100% 50%	All GPOs per bed Note 1 50% GPOs Ventilation System
Labour and delivery suite	30%	All GPOs
Nurses station and work area	30%	NIL
Obstetrical recovery rooms	30%	All GPOs
Post-operative recovery room	50%	All GPOs
Renal units	30%	100%
Specialist neonatal	50%	100%
Surgical suite - Operating Rooms - Anaesthetic Rooms - Elsewhere - Ventilation System	 100% 100% 30%	 All GPOs All GPOs Nil Full ventilation
Inpatient Beds Isolation Rooms – Negatively Pressurised	25%	All GPOs per bed Exhaust Fans
High dependency beds	50%	All GPOs
Inpatient treatment rooms	30%	30%
Lifts	NIL	One car in each node Note 2
Smoke exhaust fans	NIL	Nil
Essential communications facilities	30%	100%
Fire alarm system	NIL	Nil
Security alarm system	NIL	Nil
Medical suction and air system	NIL	100%
Offices	30%	Nil
Toilets/bathrooms	30%	Nil
Change rooms	30%	Nil
Therapy rooms	30%	Nil
Reception/Waiting	30%	Nil
Dirty Utility	30%	Nil
Clean Utility	30%	Nil
Tutorial Room	30%	Nil
Consultation Room	30%	Nil
Engineering Workshop	30%	30%
Air Conditioning Refrigeration Plants	Nil	Nil
General Corridors	25%	Nil

Note 1:
The quantity of power outlets to be connected to the emergency supply system has negligible impact on the generator capacity requirement. However the wiring for power outlets will be simplified significantly and hence cost-reduced if all outlets are on the same system.

Note 2:
Power will be made available to bring all lift cars down to the ground level sequentially. When all cars are brought down, only one selected car will be provided will standby power.

3.5.10 SYSTEM CAPACITY

The capacity of the standby generating plant shall be sized to match the diversified demand of the connected loads using the calculation method as per AS/NZ 3000 and as modified herein. Note utilising the AS/NZ 3000 calculation methods will result in over sizing of capacity as it is too conservative:

- The loading diversity factor for mechanical ventilation equipment is to be 100%, the diversified demand of general purpose power outlets is to be 40 watts each; and

- The diversified demand of 3 phase outlets is to be the actual rating of the equipment or appliance connected to the outlet.

No spare capacity is to be added to the assessed capacity.

Unless it can be justified on the basis of clinical or supply reliability needs, the standby generating plant capacity must not exceed 30% of the total normal mains supply demand requirement.

Should the assessed generating plant capacity exceed the prescribed limit, the extent of essential services loads proposed to be connected to the emergency supply system must be reduced to suit.

The generating plant capacity may exceed the prescribed limit, where:

- In upgrading a facility to incorporate a new generator, the cost to modify a main switchboard to split the load between normal and emergency load exceeds the cost of providing 100% standby capacity, then the higher capacity plant should be incorporated
- Studies have been undertaken to compare the advantages and disadvantages between dual power supplies and higher capacity emergency supply plant and this has favoured increased generator capacities, then the higher capacity plant should be incorporated
- The normal electricity supply is known to have reliability problems and a decision has been made to increase the capacity of the emergency generator plant to improve the hospital power supply, then higher capacity plant should be incorporated.

The generating plant selection should meet the following criteria:

- Generators should be rated for continuous duty
- Load should not exceed 80% of the set's capacity
- Generators should be able to meet the lighting and general power load on start up without stalling
- Motor loads should incorporate delay start up where necessary to diversify the start up currents over time in lieu of a peak current condition to allow the set to reach satisfactory operating conditions without stalling.

3.5.15 PLANT CONFIGURATION

When the assessed generating plant capacity approaches or exceeds 750 kVA, the configuration of the generating plant will depend on the load diversity, such that large generating plant is not required to provide supply to small hospital loads.

Plant configuration should be assessed on capital and recurrent east considerations as well as diversity of range of output. Generally, one generating set is preferred.

Where load diversity, set size or other justifiable considerations determine the need for multiple generating sets, the sets shall operate in synchronous mode.

Sets should generally be of equal size, but mixed sizes are permissible, if existing plant is reused or load diversity has justification.

3.5.20 SYSTEM CONTROL REGIME

The operation of the standby generator(s) shall be automatic upon mains supply failure. Consideration should be given to the sequential connection of essential services motor loads to the standby supply system to avoid stalling of the generator engines.

3.5.25 LOAD TESTING OF GENERATORS

The power distribution system shall be designed to permit testing of the generators on load without the need for dummy loads (heat banks).

The preferred method of load testing generators subject to approval of the supply authority is to use the emergency/essential hospital load as the test load and to connect and disconnect the load by synchronising the generator(s) with the normal electricity supply.

The essential supply distribution system shall be arranged to permit the operating of mechanical services equipment on standby generator supply without disturbing the lighting and general purpose power circuits of the building.

The operation of the mechanical services (ventilation only) equipment may not provide adequate load.

Emergency generation plant should be regularly tested to a scheduled testing program that checks the system for maintenance or fault problems such that the system is in readiness for use in the event of an electricity supply failure.

At regular intervals, not exceeding an annual event, the electricity supply to the hospital should be turned off and the emergency generation plant tested under an actual supply failure condition to verify its readiness to satisfactorily work.

Where such events are considered unsatisfactory due to risks to patients, then emergency generation plant should be designed for synchronous operation with the mains power supply.

3.5.30 FUEL STORAGE

The diesel fuel storage capacity for the standby generating plant shall be assessed by the designer taking into consideration the following factors:

- Full load fuel consumption rate of the generating plant;
- Locality of the hospital and its proximity to a fuel supply depot *(time needed to refill tank*);
- The role of the hospital as a medical service provider in the region, and
- Average fuel level in the tank prior to tank refill; and
- Quantity of fuel stored in the tank and its turnover time (diesel fuel stored for long periods of time 'goes off').

Generally, a fuel storage capacity based on 12 hours of full load operation will be sufficient. Larger storage capacity may be provided based on justifiable clinical needs or local factors as noted above.

3.5.35 EARTHQUAKE PROTECTION

The design and installation of the diesel generating plant including any remote engine cooling plant shall comply with the seismic constraint requirements in accordance with the AS 1170.4 - Earthquake loads.

3.5.40 CONNECTION OF MOBILE GENERATOR

For hospitals without the provision of a permanent diesel generating plant, consideration shall be given to the provision of a quick connection facility (i.e. 'socket outlet connection or busbar cable connection facility) for linking the emergency services loads to a temporary (mobile) generator set, should the need arise.

3.5.45 UNINTERRUPTIBLE POWER SUPPLY (UPS)

UPS is generally not required. However, should UPS be considered necessary for a particular computer system or medical diagnostic or treatment system, the provision for the UPS system shall be funded from the special equipment budget.

However, where a number of SOCKET OUTLETS are required to be connected to a UPS requiring a distributed wiring system, then consideration should be given to the provision of a central UPS with final sub circuit wired to the outlets.

Submains

3.6.00. GENERAL

The method of determining the maximum demand and therefore the capacity of submains is prescribed in the AS/NZS 3000 Electrical Installations. The prescribed calculation method accounts for all items of electrical equipment connected to the submain circuits together with the appropriate diversity factors for different types of loads.
This method of assessment is generally used by designers and normally yields a cost-effective result. Alternative maximum demand methods based on hospital design experience is also acceptable.

Maximum demand in a submain can also be determined by assessment or by limitation. However these methods are not practical and not normally applicable to the electrical services loadings in hospital buildings.

Notwithstanding, the opportunity for over-design and therefore ineffective provisions lies in the following areas:

- Assessment of spare capacity for future requirements, and
- Type of conductors for different types of electrical services.

This document covers these two aspects of submain selection.

3.6.05 TYPES OF SUBMAINS

The types of submains for distribution of electricity supply from the main switchboard to light and power distribution boards and building services switchboards in various parts of a hospital building can broadly be categorised into the following groups:

Group A - Essential Services (SAA defined)
Group B - Critical Care Services (Health Department defined)
Group C - General Services (Remainder)

3.6.10 GROUP A – ESSENTIAL SERVICES

The AS/NZS 3000 Electrical Installations define essential services, some or all of which will be required in the hospital design. Submains for the essential services require special provisions to ensure integrity of supply in fire and other building emergency situations.

Examples of essential services include;

- fire hydrant booster pumps, automatic fire sprinkler pumps, fire detection and alarm system, air handling equipment for control of spread of fire and smoke;
- emergency warning and intercom system (inter-fire zone cabling);
- centralised battery supply system for emergency evacuation lighting; and
- lifts.

Submains for the above SAA defined essential equipment shall have fire and mechanical protection ratings as specified in the respective Australian Standard having jurisdiction over the system or installation.

3.6.15 GROUP B – CRITICAL CARE SERVICES

Standby lighting and power systems to AS/NZS 3009 shall be provided in critical care areas.

Submains for lighting and general purpose power outlets in critical care areas require special consideration to ensure continuous availability of power supply.
As defined by NSW Health, critical care areas are those areas where acute resuscitation procedures occur on a regular basis. These areas include:

- Resuscitation bays in the emergency department,
- Treatment bays in the emergency department in Level 5 and 6 facilities,
- Operating rooms, anaesthetic bays and recovery area,
- Day procedures rooms,
- Coronary care unit
- Intensive care unit
- Neonatal intensive care unit
- Cardiac catheterisation rooms and
- Selected areas of medical imaging unit.

Light and general purpose power outlets in critical care areas shall have dedicated submains originating from the main switchboard. The switchboard and submains shall be configured to ensure continuous availability of electrical supply by means of an essential section on the switchboard.

Two dedicated submains circuits shall be provided for each critical care area. At least one of the circuits shall be connected to the emergency generator supply where installed. Critical care submains cables are not required to be fire rated. Protection against mechanical damage shall be provided.

Emergency power shall be connected to all critical patient equipment involved in invasive subcutaneous procedures. This will allow clinical personnel time to complete or finalise an invasive procedure without risk to the patient.

3.6.20 GROUP C – GENERAL SERVICES

The remaining submains for services and equipment not listed in group A and B comprise the following:

- General light and power throughout the buildings
- Mechanical services systems
- Medical imaging system
- Computer (main frame) system and
- Hydraulic services system.

Light and power submains for non-critical care areas may either be dedicated or shared circuits via suitably protected tee-offs.

Light and power submains to be provided with emergency generator supply shall be separate from the normal supply submains. They may be either dedicated or shared circuits.

Submains for small mechanical and hydraulic services plants may either be dedicated or shared circuits via suitably fused tee-offs. Submains for major mechanical plants should be dedicated.

Submains for main frame computer system and medical imaging system shall be dedicated. They may be used for lighting and general purpose power sub circuits in the same department.

All of the above submains need not have fire and mechanical protection ratings. The least cost cable type is to be selected.

3.6.25 ASSESSMENT OF SUBMAIN CAPACITIES

The submain capacities shall be assessed in accordance with the permitted methods as prescribed by AS/NZS 3000 Electrical Installations.

Submains for mechanical service, fire services and lifts shall be sized to match the rated duties of the equipment. No spare capacity is required to be allowed for these submains.

Submains for lighting and general purpose power circuits shall be assessed by calculation method using the permitted diversity factors in accordance with AS/NZS 3000 Electrical Installations (Note).

In addition to the assessed capacity for the present requirement, normal (mains) supply submains for light and power circuits shall include spare capacities not exceeding the following percentages:

Circuit Designation	Dedicated Circuit	Shared Circuit
Pathology Light and Power	50%	25%
Kitchen Power	30%	15%
Imaging Light and Power	50%	25%
Inpatient Wards	30%	15%
Administration	30%	15%
I.C.U.	30%	-
C.C.U.	30%	-
Operating Suite	30%	-
Other areas	15%	10%

Note:
The permitted diversified loading for power outlets are 1000 watt for first outlet and 100 watt for each additional outlet. In many areas of the hospital, high concentrations of power outlets are provided for clinical reasons. The loading requirement for outlets would average to much less than 100 watt each. According to the present assessment criterion, the capacity of submains would be higher than needed.

This is one area of the statutory regulations that should be challenged and modifications be sought by NSW Health.

3.6.30 SWITHCHBOARDS

Switchboards (main and main and distribution boards) shall be provided for the submains as described above.

For light and power submains at least one distribution board shall be provided for each fire compartment to minimise the number of small penetrations through the fire wall.

Distribution boards shall be fitted with circuit breakers and RCDs where required for all final subcircuits to be fed from them. In addition to the present circuit requirement, distribution boards shall be sized to allow space for connection of future circuits as follows:

- Normal supply distribution boards – 30%
- Emergency supply distribution boards – 30%

3.6.35 EARTHQUAKE PROTECTION FOR SWITCHBOARDS

The main electrical switchboard and distribution switchboards design and installation shall comply with AS 1170.4 – Earthquake loads, for seismic constraint requirements.

Lighting

3.7.00. GENERAL

Design of interior lighting for hospital buildings is generally carried out based primarily on the recommendations of the following Australian Standards with AS/NZS 1680 as the principal reference document.

AS/NZS 1680.1 – General principles and recommendations
AS/NZS 1680.2.5 – Hospital and medical tasks

The recommendations contained in these standards are not mandatory. However they are generally accepted as codes of good practice. In particular AS/NZS 1680 is being referenced in draft Occupational Health and Safety Regulations for Safe Work Places.

AS/NZS 1680.2.5 provides the recommended illuminance (lighting levels) for specific tasks and interiors.

The recommended values contained therein are generally slightly less than those expressed in the previous standard. However the new values assume that designers will make due allowance for light losses in service during the period in-between lamp replacements.

This document focuses on the following areas where cost efficiency could be achieved:

- Identify areas where the recommended illuminance could be further reduced
- Design parameters for illumination calculations and use of energy efficient light source.

Maintenance Illuminance

3.8.00 GENERAL

The recommended maintenance illuminance for a range of tasks contained in AS/NZS 1680 are as follows:

CLASS OF TASK	**RECOMMENDED MAINTENANCE ILLUMINANCE Lux**
Movement in orientation	40
Rough intermittent	80
Simple task	160
Ordinary or moderately easy task	240
Moderately difficult task	400
Difficult task	600
Very difficult task	800
Extremely difficult	1200
Exceptionally difficult	1600

The normal ranges of visual tasks in work places fall between simple to very difficult requiring illuminance between 160 lux to 800 lux.

Workplaces within a hospital building generally would involve visual tasks from simple to moderately difficult requiring illuminance between 160 lux to 400 lux.

Notwithstanding the general requirements, in selected clinical areas supplementary examination lights are deployed to satisfy clinical needs.

In addition, the general (ambient) illuminance in operating rooms is required to be sufficiently high as to reduce the contrast between the high intensity light source from the surgical lights and the ambient illuminance. This document recommends 800 lux instead of 1200 lux as

recommended by AS 2502 – The Lighting of Operating Rooms.(superseded)

Examples of related activities within a hospital building for the various classes of visual tasks are summarised as follows:

3.8.05 VISUAL TASKS AND RELATED ACTIVITIES

(a) Movement and Orientation (40 lux)
- corridors and walkways
- stairwells

(b) Rough Intermittent (80 lux)
- staff change rooms and locker rooms
- storage of bulky materials
- loading bays

I Simple Task (160 lux)
- waiting rooms
- occasional reading for short periods
- staff rest rooms
- staff cafeteria
- clean and dirty utility rooms

(d) Ordinary and Moderately Easy Task (240 lux)
- moderately easy visual tasks with high contrasts or large detail
- food preparation
- reception counters
- consulting rooms (with examination lights)
- staff stations
- seminar rooms

(e) Moderately Difficult Task (400 lux)
- moderately difficult with small detail or with low contrast
- clinical procedure rooms
- routine office work
- laboratory testing work

(f) Difficult Task (600 lux)
- visual tasks with very small detail or with very low contrast
- drawing offices
- proof reading
- fine machine work
- fine painting and finishing

Most of the work-related activities within a hospital would fall in between simple and moderately difficult tasks.

For areas where regular clinical procedures or routine office works are carried out the recommended illuminance is 400 lux.

For areas where non-routine office work is carried out and where visual tasks with medium contrast or medium detail are involved, the recommended illuminance is 300 lux. These areas would include offices for clinical staff and managers.

The remaining work areas should have illuminance between 160 to 240, appropriate to the class of pre-dominant visual tasks being carried out in the area.

Design Parameters

3.9.00 GENERAL

The illuminance recommended in the AS/NZS 1680 and as above are not design values. For

design purposes, it will be necessary to select an initial illuminance and to allow for light loss factor as outlined in the standard. The design factors to be used are as required by AS/NZS 1680.

3.9.05 COLOUR RENDERING

The colour rendering properties of a light source are dependent upon its special energy distribution. The desired colour appearance of an illuminated object will only be obtained if the light source contains all necessary special components in suitable proportion.

Colour rendering index of a light source is a measure of the degree to which the perceived colours of objects illuminated by the source conform to those of the same objects illuminated by a reference light source. The index is expressed on a scale of up to 100.

The higher the index number, the better the colour matching properties the light source possesses.

Australian Standard AS/NZS 1680.2.5 deals with 'Light Service Colour' i.e. dealing with visual task requiring discrimination of colours. The standard gives three examples:

- Examination of patient's skin condition to detect conditions such as cyanosis and jaundice
- General examination for dermatological conditions
- Colour based diagnostic tests.

For cyanosis observation, special lamps meeting AS/NZS 1680.2.5 are required. The standard suggests that medical staff decide upon those areas where provision should be made for the usual detection of cyanosis. Hospital designers are to seek advice from health care teams as to what areas are to be designed for cyanosis detection.

For the other areas and usual tasks, the standard recommends a colour measuring index of at least 85 with continuos spectral energy distribution.

This document recommends where colour rendering of light sources is required and the type of fluorescent lamps is to be used.

3.9.10 LOCATIONS WHERE SPECIAL COLOUR RENDERING IS REQUIRED

As recommended by AS/NZS 1680.2.5, the following are examples of areas in which the requirement for special colour rendering apply.

- Intensive care Units
- Observation Units
- Anaesthetic Rooms
- Operating Rooms
- Recovery Units
- Resuscitation areas
- Pathology departments
- Patient investigative imaging areas
- Emergency Department Treatment Rooms
- Birthing and Obstetric Rooms
- General and Paediatric Inpatient Units
- Corridors and lifts used for the transfer of patients between the operating rooms, emergency department and inpatient units.

The requirements also apply to areas such as pathology laboratories where observations of biological solutions and pathological specimens take place.

This document recommends that all patient remedial or diagnostic treatment and accommodation areas are to be illuminated with good quality light source having a high colour rendering index.

Standard high efficiency fluorescent lamps with a rendering index between 60 and 80 are to be used in offices and industrial type functional areas within the hospital.

Notwithstanding, the same special colour rendering lamps for the patient areas could be extended to the remaining areas if demonstrated to be more cost effective over the life cycle of the building.

3.9.15 ACCEPTABLE LIGHT SOURCE

Australian Standard AS/NZS 1680.2. 5 sets out specific design parameters for lamps required to usually detect cyanosis. Only lamps meeting these criteria are to be used in areas nominated by the medical staff.

In accordance with the requirements of AS 1765 (superseded), the colour temperature and colour rendering of the light source shall lie within those recommended limits.

For other areas requiring usual identification of medical conditions, lamps shall have a colour rendering index of at least 85. The standard also recommends a substantial continuous spectral energy distribution.

With respect to the few fluorescent tubes which comply with both the colour temperature and colour rendering requirements, the light output of these lamps is significantly lower than the standard tubes (approximately 66% of the normal output). Therefore, to achieve the same required illuminance, significantly more luminaries are required. Because of the high lamp replacement cost, these special lamps also impact on recurrent costs.

To avoid the high capital and recurrent costs of complying with the Standard's Colour Temperature and Colour Rendering requirement, NSW Health has adopted the fluorescent tube TLD 84 (or equivalent) as their standard. The characteristics of this type of tubes are as follows:

- Colour Temperature: 4000 degrees Kelvin
- Colour Rendering: 85

The colour rendering properties of TLD 84 tubes do not quite comply with AS/NZS 1680.2.5 in their continuous spectral energy distribution.

The colour rendering properties of TLD 84 tubes do not quite comply with AS/NZS 1680.2.5 in their continuous spectral energy distribution.

Nonetheless, the performance of TLD 84 has been generally found satisfactory except for cyanosis discernment.

The TLD 84 (or equivalent) lamps are very energy efficient. Therefore lighting systems utilising this type of light source would yield good quality performance at reasonable initial capital costs.

This document recommends the use of TLD 84 (or equivalent) lamps for all patient treatment and accommodation areas where cyanosis discernment conditions are not required.

Note: New lamp types meeting AS/NZS 1680.2.5 for hospital use are in their initial stages of release. When available they are to be assessed to the TL84 lamp and if favourable be the preferred lamp.

3.9.20 NIGHT LIGHTING

Night lights shall be installed in all patient care areas and exit passages where normal lighting levels will decrease at night. Night lights shall be mounted at a low level and shall be low intensity and diffused. Night light levels shall not interfere with patients' sleep.

3.9.25 CLINICAL LIGHTING

A clinical observation light shall be provided where clinical observation is required. A patient reading light shall be mounted at each bed head. If the clinical observation light is not required to be colour-corrected, clinical observation lighting and patient reading lighting can be

incorporated into one fitting

Patient Electrical Protection Systems (Body and Cardiac Patient Areas)

3.10.00 GENERAL

Patient treatment areas where electro-medical equipment may be used for procedures classified as either body-type or cardiac-type as defined by AS/NZS 3003, shall have electrical installations installed to comply with AS/NZS 3003 'Electrical installations – patient treatment areas of hospitals and medical and dental practices'.

AS/NZS 2500 provides the guide to the safe use of electricity in patient care areas. It outlines the different protected wiring systems recommended for various types of medical procedures to be carried out in patient treatment areas.

Areas where cardiac protection systems are required are usually nominated by user groups.

3.10.05 LIST OF AREAS TO BE PROVIDED WITH BODY PROTECTED WIRING SYSTEM

All patient-occupied areas are to be provided with a minimum Body Protected Wiring System.

3.10.10 LIST OF AREAS TO BE PROVIDED WITH CARDIAC PROTECTED WIRING SYSTEM

Definition: Cardiac-Type Procedure

A patient is considered as undergoing a cardiac-type procedure when an electrical conductor is placed within the heart or is likely to come into contact with the heart and such conductor is accessible outside the patient's body. In this context an electrical conductor includes electrical wires such as cardiac pacing electrodes, intracardiac ECG electrodes, intracardiac catheters or insulated tubes filled with conducting fluids.

Department	**Location**
All Departments	Critical Care Areas as defined in 2.10 00. Only where cardiac procedures are to be undertaken.
Emergency	Resuscitation bays and critical care areas. Only where cardiac procedures are to be undertaken.
Imaging	Vascular Angiography Cardiology Angiography Screening rooms where cardiac invasive procedures are to be performed.
ICU / CCU	Beds only when cardiac invasive procedures are carried out.
Operating Suite	Operating Rooms, Anaesthetic Bays, Recovery Bays only where cardiac procedures are to be performed.

3.10.15 PROTECTION FOR BODY AND CARDIAC PROCEDURES

Body and cardiac procedures are to be carried out in areas specially wired for the procedure or where medical equipment is designed to type BF or CF to be used without the need for special wiring.

AS/NZS 3003 requires all patient areas to be wired to minimum body protected standards.

3.10.20. PROTECTIVE DEVICES

In accordance with AS/NZS 3003 , the wiring to power outlets and electrical equipment within the cardiac or body protected patient areas must be protected by either:

- Residual Current Devices (RCDS) or
- Isolation transformer and Line Isolation Monitors

RCDs (previously referred to as ELCBs) are more cost effective than the alternative transformer isolated supplies. Therefore they shall be used for all listed body and cardiac protected areas.

Transformer isolated supplies may be used in selected cardiac protected areas provided that it can be justified on the basis of clinical needs.

3.10.25. WIRING SYSTEM TO GPO CIRCUITS

AS/NZS 3000 currently require the installation of 30mA RCDs on all final sub-circuits in residential type areas of hospital buildings.

Ward Areas generally
All final sub-circuits in hospital ward areas shall be wired to body protected standards. to body protection wiring standards.
Where areas are wired to AS/NZS 3003 no 30mA 30 mA RCDs's (as per AS/NZS 3000) are required in the local electrical distribution switchboard for the BP circuits for the BP circuits, the 10mA 10 mA RCDs being installed in the protected area.

The residential area shall apply to the whole ward area and includes bed area, bathrooms, en suites, lounge, office and service areas.

Remaining Hospital Areas
The AS/NZS 3000 residential area requirement for RCDs does not apply to the remainder of the hospital. AS/NZS 3000 requires that 30mA RCDs be installed where there is considered an increased risk of electrical shock to the users.

AS/NZS 3003 requirements would generally apply to significant medical treatment areas in the remainder of the hospital i.e. operating theatres, ICU, CCU, birthing areas. RCDs should only be installed in areas where there is considered an increased risk of electrical shock.

3.10.30. PROTECTION OF WET AREAS AND TRADE AREAS

30mA RCDs should be installed where users function in a wet area or trade areas in the repair of electrical equipment. Wet areas would generally comprise laboratories where electrical and conductive fluids exists, in x-ray dark rooms, kitchen and mortuary areas.

Trade areas would generally comprise biomedical engineering, electrical and mechanical maintenance areas.

3.10.35 E6.8 ELECTRICITY SOURCE TO POWER OUTLETS IN PATIENT AREAS

Two general practices currently apply from designers in sourcing power to socket outlet circuits in patient areas - either the majority of outlets are connected to the emergency power circuit or an even mix of outlets is connected to the emergency and normal power circuits.

The rationale for the latter is a 'belt and braces'approach, i.e. if one of the circuits fails then there is a significant number of outlets available on the other circuit to enable functionality to continue whilst the failed power supply is repaired and returned to use. This approach is in consideration of a fault occurring in the supply of electricity to the patient area.

The objective of the design should be to minimise the cost in the provision of power outlets and to provide a reliable source of supply to the functional areas.

Mixed supplies to every patient bed or point of service, which is dual electricity supplies (emergency plus normal supply circuits), cannot be supported on the basis of cost as it requires duplicate circuits and RCD devices. A cost-neutral design whereby normal and emergency power circuits in body protected areas are spread over several beds may be acceptable or where the number of power points at a bed location requires two circuits (outlets exceeding 12 in numbers). In cardiac protected circuits, the circuit must be confined to the one patient location.

The Area Facility Table 3.5.05 indicates the number of socket outlets that should be connected to the emergency circuit. The mix of circuits over emergency and normal supplies affects the recommendations of this table. Generally, mixed circuits should not be provided and all socket outlets be provided from the one power circuit.

As background, emergency supply generators are being provided solely on the basis of a standby power supply in the event of a failure to the hospital's normal power supply from the supply authority. The emergency generators do not act as a backup power source to a failure of equipment within the hospital electrical distribution system. The cost and complexity to control generators for internal equipment failure is not supported in this document.

This document has set guidance that critical care areas shall generally be supplied by separate submains from the main switchboard or main distribution board for the building, thereby limiting the effect of other circuits and areas in the building from disconnecting the supply to the critical care area. Accordingly, submains to critical care areas should be conservatively designed to eliminate loss of supply from overloads or minor faults and maintenance should be regular to avoid the occurrence of faults from poorly maintained equipment and cable connections. The loss of a submain in normal service is a very rare occurrence and should not be a reason for duplication of supply to circuits in patient care areas.

The purpose of providing emergency power to outlets is to provide power in the circumstances of loss of power to the hospital site and to maximise the available outlets usable in this circumstance.

Provision of Power Points

3.11.00. INTRODUCTION

A frequent excessive cost is the number of general purpose outlets requested by the users. In many instances these requirements far exceed the normal needs of the room and are subsequently left untouched in every day use.

3.11.05. POWER POINTS

Scales of provision of socket outlets should be in accordance with the Room Data Sheets in the NSW HFGs (Health Facility Guidelines) and the end users must be required to justify each additional socket outlet with a corresponding item of equipment. This exercise should be carried out for each room.

Outlets & Switches

3.12.00. All RCD protected outlets provided under AS/NZS 3003 shall be identified and labelled in accordance with the Standard. All other outlets and switches shall be labelled in accordance with AS/NZS 3000 and colour coded to AS/NZS 3003.

Outlets in nurseries and children's wards shall be fitted with safety shutters.

Security

3.13.00. Health care facilities need to provide a safe and secure environment for staff, patients and visitors. Health facility planners and hospital staff are to identify security risk areas and environments requiring the provision of security and central access systems.

Where staff, patients or visitors within health care facilities are considered vulnerable to security risks, designers are to give consideration to the provision of a secure environment by providing satisfactory security lighting, central access to identified environments and access systems that allow identification of people seeking entry into the facility, particularly during night hours, i.e. CCTV, intercoms, electronic security doors, fixed and personnel duress alarms. In high risk areas staff motion detection may need to be provided as well as internal access control and duress systems i.e. Mental Health Facilities.

3.13.05 DESIGN REQUIREMENTS

NSW Health has a security guideline for health care facilities. Designers are to adhere to the guidelines in the design of security and access control systems.

3.14.00. COMPLIANCE

Departures from the above are to be justified on an objective basis. Security shall be agreed with user groups and others such as Hospital Watch. Changes to planning and operational policies can often minimise the need for active security systems.

Battery Back-up

3.15.00 Battery back-up is required to provide a standby power source to mains power equipment considered to provide essential, or to important services within the hospital environment should main power fail and which cannot tolerate the loss of power during the start-up period of any emergency generation plant.

Generally non-fixed equipment provided will include, or be supplied with, standby power sources such as battery back up or UPS systems.

Designers will need to provide standby power sources for fixed equipment identified or requiring standby power. Examples of equipment or systems requiring battery back up are:

- Essential Services:
  - Fire systems and EWIS (AS/NZS 3000 defined)
  - Emergency and evacuation lighting
- Operating Theatres Shadow-less Lighting Systems
- PABX Telephone Systems (usually provide as part of the PABX system)

Clocks

3.16.00 Clocks in health care facilities take two forms:

- Individual battery operated clocks or
- Master clock systems.

Master clock systems comprise slave clocks in functional areas hardwired back to the master clock. Generally these clock systems are expensive to install and are only to be used in limited areas of the hospital.

Individual battery-operated clocks are highly reliable and relatively inexpensive and are the preferred clock option.

Master/Slave clocks are only to be installed in areas where access to clocks is difficult or where time - for legal reasons - is required to be accurate over a number of similar rooms and where individual battery-operate clocks are considered unsatisfactory. Examples of such areas are operating suites and delivery rooms.

4. COMMUNICATIONS

Introduction

4.1.00. GENERAL

In a health care facility, a range of communication facilities are provided to meet the various functional needs of staff and patients. The primary objectives of providing the various communication facilities include the following;

- to improve work efficiency;
- to assist all staff in their duties by making clinical and other information more readily available; and
- to assist with the patient post-treatment recovery process by providing telecommunication facilities to access relatives and friends and television entertainment facilities.

The types of communication facilities available in a health care building generally include the following:

- Communications cabling system
- Telephone system(s)
- Intercom system(s)
- Dictation/Transcription system(s)
- Data communication system(s)
- Nurse call system
- Emergency Warning and Intercom System (EWIS)
- Public Address System(s)
- Pocket Paging System(s)
- MATV signal distribution system

Some of the above facilities are subject to regulatory control. These include:

EWIS: Required as a mandatory requirement of the BCA (Building Code of Australia) for health facilities exceeding a minimum area. The technical requirements are specified in the Australian Standard AS 2220.1, AS 2220.2. and EWIS guidelines are not covered in this document.

Communications cabling for voice and data systems, security panels and fire panels connected to the public networks. These are covered by the Austel Technical Standards.

Telephone systems and data equipment connected to the public networks. These are to conform to Austel Technical Standards. Public address, paging and MATV signal distribution systems are not covered in this section of the guidelines.

In addition to the above mandatory requirements, NSW Health has issued an Interim Standard for a structured cabling system for all new and renovated buildings based on AS 3080 - Telecommunications installations – Generic cabling for commercial premises

This document is not intended to negate statutory requirements but to target areas of the prevailing standard practice where cost efficiency could be improved. They are also targeted to refine the current NSW Health Interim Standard for a structured cabling system.

Communication systems in health care facilities are subject to considerable change over the lifetime of the building. Designers are to plan flexibility into the communications infrastructure, i.e. space and capacity to expand, change and upgrade the communications system. In planning communications cupboards or rooms, generous space is to be provided for change and communications designers need to allow for easy upgrade of the cabling system between communications cupboards and outlets

4.1.05 GLOSSARY OF TECHNICAL TERMS

A Glossary of Technical Terms is in Section 10 Appendix 1 of this document.

4.1.10 OBJECTIVES

The primary objectives of the design guidelines for voice and data communications facilities are to:

- Provide a uniform basis for the determination of the extent of voice and data communication facilities and type of equipment appropriate for health care buildings,
- Provide refined design parameters and future provision requirements for designers to achieve industry wide cost efficiency,
- Provide a catalyst for further improvements and individual design innovation,
- Ensure important communication facilities design and planning issues which have impact on the building design and other building services design are properly addressed, with appropriate solutions adopted at the early scheme design stage of the project development, and provide a better defined delineation between the building construction budget and equipment budget.

4.1.15 APPLICATION

This document will be used for the planning and design of a structured cabling system for all health care buildings.

Voice and Data Outlet Density per HPU

4.2.00 GENERAL

Refer to the Health Briefing System (NSW Health Facility Guidelines) when preparing Room Data Sheets and Room Layout Sheets.

This document provides a summary requirement on a HPU (Health Planning Unit). basis for the purpose of quantifying the scope and extent of future provision that may allowed for in the planning and design of the structured cabling system for new and refurbished buildings.

Room Data Sheets generally exclude information on the overall communications systems. Designers should clarify the communications systems requirements and have a communications brief prepared by the users which fully describe the communications systems requirements.

4.2.05 VOICE (TELEPHONE) OUTLET DENSITY

Includes systems such as intercoms, facsimile machines, dictation/transcription systems, data systems that use low speed connections (e.g. modems, ADSL lines), security and fire panel connections to the public networks.

The provision of telephone services in hospitals is generally via the hospital's PABX system to individual telephone outlets located at various parts of the hospital building(s). The majority of telephone extensions are assigned for staff use.

Because of high community expectations together with the availability of efficient telephone call cost accounting systems, many hospitals are now offering bedside telephone service for patients. Therefore from the planning view point for the structured cabling system, a system capacity for one telephone outlet per ward bed should be allowed for.

Patient telephone services are normally provided on a cost recovery basis. Individual hospital management normally determines whether this facility is to be provided and how the cost is to be recovered.

The locations where voice outlets are required would include:

Inpatient Units / ICU/CCU
- Patient beds (paediatric and psychiatric facilities need to be considered as to whether or not voice outlets are required)
- Staff Station
- All Offices
- Patient Lounge
- Staff Room

Operating Suites
- Operating rooms (via reception or nurse station)
- CSSU
- Staff Station
- Reception
- Offices
- Staff Room
- Relative/Interview
- Anaesthetic Workroom
- Recovery

Day Procedure Unit
- Reception
- Staff Station
- Interview Rooms
- Consultation/Examination Rooms
- Recovery
- Assembly/Work Area
- Offices
- Issue

Delivery Suite
- Birthing Rooms
- Reception
- Staff Station
- Staff Room
- Offices

Medical Imaging
- Staff station
- Staff room
- Reception
- Offices
- Waiting room
- Report room
- All imaging rooms
- Film processing area

Emergency Department.
- Reception / Triage
- Relative Interview
- Resuscitation
- Procedures
- Staff Station
- Offices

Other Areas
- Offices
- Bulk stores
- Engineering workshops (internal only)
- Plantrooms (internal only)
- Foyer near Emergency (Pay phones)
- Public waiting areas (Pay phones)

Based on the above voice outlet allocation criteria, the number of outlets and density per hospital unit will be as set out in the room data sheets (project specific) and the HFGs or as

set out in the Table below. The capacities of the PABX system and the backbone cabling system are to be planned for the present requirement and the recommended spare capacity as indicated. The outlet density is expressed in terms of square meters of nett briefed area per outlet point.

In conjunction with the data requirements, when all outlets needs have been identified, the outlets can then be grouped into single, dual and triple 'communication outlets' as required in each location.

4.2.10 TABLE

H.P.U.	DEPARTMENT	NETT AREA	TELEPHONE OUTLETS			
			QTY	SPARE CAP %	TOTAL QTY	m2/pt
INP	Medical / Surgical Ward (3O beds)	690	35	35	40	17
ORT	Orthopaedic Ward	650	35	15	40	15
KID	Paediatric Ward	547	10	10	12	50
ONS	On-call accommodation	64	4	15	5	10
REH	Rehabilitation Ward	738	31	15	36	20
ALL	Allied Health Unit	1484	20	30	26	40
PSY	Psychiatric Ward	645	22	15	25	20
PGE	Pschogeriatric Ward	962	11	15	13	70
ONC	Oncology Unit	212	12	12	14	15
BIO	Biomedical Engineering	62	1	0	1	50
XRA	Medical Imaging	591	10	25	13	40
CAS	Emergency	838	10	50	15	40
MRD	Medical Records	143	3	33	4	30
PHA	Pharmacy	210	3	25	4	50
NUC	Nuclear medicine	190	4	25	5	30
LAB	Pathology	153	6	25	8	20
RED	Blood Donor Unit	210	5	15	6	20
LIB	Medical Library	156	1	0	1	150
DAY	Day Procedure Unit	223	5	25	6	30
CUT	Operating Suite	920	12	25	15	60
CSS	Central Supply Department	276	2	50	3	90
ICU	Intensive Care Unit	573	15	25	20	30
MCR	Mortuary	130	2	0	2	60
LIN	Linen Handling	162	1	0	1	150
STR	Regional Store	73	2	0	2	30
SAM	Engineering Maintenance	136	2	50	3	40
KIT	Kitchen	544	3	33	4	150
EAT	Staff Cafeteria	189	2	50	3	60
EDC	Education	229	4	50	6	30
ACH	Main Entrance & Foyer	346	1	100	2	150
ADC	Admission/Discharge	48	4	25	5	10
ADM	General Administration	532	26	25	33	15
STF	Staff Amenities	172	0	-	0	0
ENV	Environmental Services	177	1	0	1	150
HOS	Hospital Control	47	1	0	1	50

4.2.15 DATA OUTLET DENSITY (Outlets for DTE - Data Terminal Equipment)

The primary function of data outlets in a hospital is for the connection of DTEs in various hospital units to the hospital network.

DTEs will generally comprise the following:

- Computer terminals
- PC. computers connected to the network
- Distributed file servers installed throughout the hospital connected to the network.

- Outlets for imaging equipment from Medical Imaging Departments
- Engineering control systems
- Photocopiers, facsimile machines and printers
- Other equipment or systems requiring interconnections via the network which carry digital signals.

Due to the high quality imaging requirements for medical imaging, the signals will generally require high speed, high band width and high noise immunity requirements. In considering the application of these systems onto the network, close liaison is necessary with the equipment supplier in regard to the network requirements. Category 5 outlets will generally be sufficient although some systems may require optical fibre facilities.

The provision of data outlets shall be as per room data sheets (project specific).

In conjunction with voice requirements, when all the outlet needs have been identified, they can then be grouped into single, dual and triple Communications Outlets' as required at each location.

4.2.20 HEALTH DEPARTMENT BUILDING STANDARD

The provision of voice and data outlets shall be as per room data sheets.
The structured cabling system shall be planned and provided based on the respective voice and data outlet density recommended in Room Data Sheets for each HPU.

Backbone and Horizontal Cables

4.3.00 GENERAL

The generic cable system comprises a structured backbone comprising both copper and optical fibre cables and a horizontal cable system generally of copper cabling. The generic cable systems will carry all communications services including voice and data.

Generally, all health care facilities will require both copper and optical fibre cabling systems. Health care facilities will vary widely in size and structured cable system requirements from very small having a single Campus Distributor (CD) and star topology from this single point, to large campus facilities comprising the CD, BDs (Building Distributor) and FDs (Floor Distributor).

The type of backbone and horizontal cables and performance specifications for voice and data outlets are specified in the Health Department Building Standard for Telecommunications Pathways and Spaces and in AS/NZS 3080 – Telecommunications installations–Generic cabling for commercial premises.

Token Ring
Ethernet
Low Rate
Token Ring
Cable Type
Data 100 ohm UTP
Data 100 ohm STP
Data 150 ohm STP
Optical Fibre
Data
Data
Data
100 ohm UTP
100 ohm STP
150 ohm STP
Coax 50 ohm
Data 100 ohm UTP
Data 100 ohm UTP
Voice 100 ohm UTP
Voice 600 ohm UTP/STP Voice 120 ohm STP

4.3.05 COPPER BACKBONE CABLING UNIT - GENERAL

The function of the backbone cabling is to provide interconnection between the distributors CD, BD and FD comprising the cabling system.

The backbone wiring shall use a hierarchical star topology where the CD is connected to each BD and each BD is connected to the relevant FDs.

Note the systems such as PABXs, intercoms etc can be attached at any distributor. Campus-wide systems would generally be attached to the CD.

The cabling system will be installed and commissioned in accordance with the Australian Communications Authority Technical Standards (mandatory) and the Australian Standards on premises cabling and vendor standards to achieve a 15 year certification of the installation.

The backbone wiring consists of transmission media (cables), intermediate and main cross-connect. (distribution frames) and mechanical terminations.

The backbone wiring shall use the conventional hierarchical star topology wherein each telecommunication closet is wired to the building's main cross-connect.
For a multi-building campus with a central PABX system individual building main cross-connect is wired to the campus main cross-connect also using star topology.

All cables shall be terminated in an approved manner and tested in accordance with the recommendations of AS/NZS 3080, as well as the Australian Commission Authority Technical Standard, and Australian Standards on Premise Cabling. All back bone cables shall be installed in a suitable and readily accessible location and shall remain accessible after completion of the initial installation.

4.3.10 COPPER BACKBONE CABLING UNIT - VOICE BACKBONE

The type of cable for copper backbone wiring shall be as follows:

Cat 3, voice 100-ohm UTP multipair copper cable.

The number of pairs of backbone cables shall be determined by the outlet density plus 30% spare for the future requirement.

4.3.15 OPTICAL FIBRE BACKBONE NETWORK

The function of the backbone cabling is to provide interconnection between the distributors CD, BD and FD comprising the cabling system.

The backbone wiring shall use a hierarchical star topology where the CD is connected to each BD and each BD is connected to the relevant FDs.

Note that systems such as Computer Rooms, distributed PABX systems, file servers, routers etc can be attached at any distributor. Campus-wide systems would generally be attached to the CD.

The cabling system will be installed and commissioned in accordance with the Australian Communications Authority Technical Standards (mandatory) and the Australian Standards on premises cabling and vendor standards to achieve a 15 year certification of the installation.

The type of cable for the optical fibre backbone will generally be 62.5/125 micron multi-mode optical fibre. The use of 9 micron single mode optical fibre shall be restricted to campuses where the distances require this cable to support Gigabit Ethernet and other high speed protocols such as fibre channel.

The number of fibres to be included in a bundle should be a minimum of 6 for multi-mode and 4 for single mode. Quantities above this should be subject to a needs analysis.

4.3.20 HORIZONTAL CABLING NETWORK - GENERAL

The horizontal wiring is the portion of the telecommunications wiring system that connects the voice and data outlets in the work area to the assigned CD, BD or FD's. The horizontal wiring shall also be a star topology with each outlet connected to the assigned CD, BD or FD.

All cables shall be terminated in an approved manner and tested in accordance with the recommendations of AS/NZS 3080, Australian Communications Authority Technical Standards and the Australian Standards on Premises Cabling.

4.3.25 HORIZONTAL CABLING NETWORK - HORIZONTAL CABLE TYPE

The type and number of pairs of cable for data horizontal wiring shall be as follows:

Cat 5, data 100-ohm UTP, 4-pair copper cables.

Cable requirements including Cat 5 should be justified on a needs analysis.

Cross Connection Equipment

4.4.00 GENERAL

The backbone and horizontal wiring connection hardware is used to provide a means of:

- Connecting and cross connecting wiring systems.
- Connecting the building wiring system to equipment and to the public telecommunications network.

The type of connection equipment to be used should induce minimum impairments to the signals passing through the connecting hardware.

The connecting hardware for horizontal and backbone wiring shall meet the physical and electrical requirements of AS/NZS 3080, the Australian Communications Authority Technical Standards and the Australian standard on Premises Cabling.

4.4.05 DISTRIBUTOR EQUIPMENT - GENERAL

The type of hardware used to terminate the horizontal and backbone cables shall be of the insulation displacement contact (IDC) type.

Connecting hardware based on modular jacks shall be provided for terminations of horizontal cables and copper backbone cables in two separate groupings.

Interconnection between the horizontal and backbone cabling shall be by means of patch cables. The capacity of termination hardware shall be as follows:

The numbers of required horizontal cables for the specified communications outlets plus 30% spare capacity.

The number of required backbone cables plus 30% spare capacity.

Interconnection between horizontal cabling and local communications equipment shall be by means of patch cables.

The interconnections between backbones cables at a CD or BD shall be by means of cross connect jumper wires.

The capacity of the termination equipment shall be the number of required copper backbone cables plus 50% spare.

4.4.10 DISTRIBUTOR EQUIPMENT - OPTICAL FIBRE CABLES

Optical fibre breakout and termination frames will be required to terminate all cores of the installed optical fibre backbone cables.

The interconnection shall be provided by 'SC' type connectors unless an existing 'ST' connector regime exists in the Health Service.

Patch leads shall be provided to provide interconnection between backbone cables and to local communications equipment.

The capacity of the optical fibre termination equipment shall be the number of planned backbone cores plus 50% spare.

Outlet Connectors

4.5.00 GENERAL

Communications outlets shall be securely mounted on wall plates at planned locations. Communications services shall be grouped together in common wall plates. Wall plates will comprise one, two or three outlets depending on the requirements.

All outlets shall be identified with an indelible number.

Generally, Health Services will have in place outlet numbering regimes which will be incorporated in the design. Where no numbering regime exists, the outlet should be numbered in a way which identifies the Telecommunication Cupboard (TC) to which the outlet is connected and the location on the distributor equipment e.g. 12RA24. This would show that the outlet is connected to TC 12 and to room outlet distributor A position 24.

4.5.05 OUTLET CONNECTOR TYPE (VOICE)

All communications services should use 8 pin modular plug/jacks as specified in the Australian Standards for Premises Cabling and which comply with the Australian Communications Authority Technical Standards.

The Australian Standard allows for two pin/pair arrangements.

Health facilities should use the pin/pair arrangement defined in Figure 13 (a) Preferred (T568A; RJ545 or similar).

Telecommunication Closet / Cupboard (TC)

4.6.00 GENERAL

Telecommunications cupboards (TCs) or rooms are areas within a building specifically for the use of communications and other equipment used in the area. They shall be planned in the early stages of a building design for the accommodation of distributor equipment and a range of communications equipment including central intercom equipment, nurse call, MATV, engineering data and other digit systems that may use the network.

One or more TCs will be required in each building, the quality and spatial allowance for each TC being in accordance with this guideline. In all instances, sufficient room shall be provided to allow access to all technical equipment for maintenance and operation.

4.6.05 MAIN CROSS CONNECTION TC

The TC containing the CD or BD will be required to house a number of items. These will include:

- The distributor to terminate the carriers' connections. Allowance should be made as there is often more than one carrier providing services to a premises. Carriers can connect using both optical fibre and copper underground and/or aerial cables or via microwave radio equipment. Quite small sites can require a substantial amount of space for carrier termination.

- The distributor to terminate the telephone equipment. The TPF may also be incorporated in the distributor. The TC may also have to house the telephone equipment and

associated customer administrator terminal equipment if a separate PABX room is not provided on the premises.

- The distributor to terminate the copper and optical fibre backbone cables.
- The distributor to terminate the local horizontal cables.
- The housing of data communication equipment.
- The housing of file server(s) if there is no dedicated computer room on the premises.

Note: For premises that only have one distributor, this room will be required to house all communication equipment, including MATV, nurse call, duress alarm, security panels and intercom systems as well as the equipment mentioned above.

In laying out the room the mandatory clearances required by the Australian Communication Authority Technical Standards shall be maintained.

For larger premises where a CD and BD/FDs exist, the non-CD TCs shall be sized appropriately. Allowance for technicians undertaking maintenance work shall be made. If the TC is arranged as a cupboard i.e. the technician has to work in the corridor, then allowance shall be made for the fact that the TC doors may be open for a significant period of time. Staff and public access along any corridor should not be hindered by the open doors.

To comply with the Australian Standard, the maximum distance from the distributor to the wall outlet (i.e. the link) must not exceed 90 m.

Therefore, one TC shall be established to serve communications outlets within a radial distance of not more than 75 m to allow for the cable run.

For multi-storey buildings, telecommunications closets should be vertically aligned and connected by a fire-isolated riser which is used to provide backbone cabling vertically through the building. Consideration can be given for the provision of one TC for 2 floors. However the telecommunications cupboard will need to be enlarged to accommodate the additional termination equipment.

Cable tray having ample spare space for additional future services shall be used to support horizontal and vertical cable systems. The cable tray system needs to be fully accessible.

For single storey buildings, TCs shall be located in a readily accessible position.

With the exception of the main cross-connect TC, other TCs could be provided in a form of a cupboard with suitably sized doors.

The telecommunications cupboards shall be used for housing cross-connect hardware and active hubbing devices.

For planning purposes, the internal dimensions of the cupboard should be 1800mm x 900mm deep. The ceiling space above the cupboard shall be free of other building services, in particular free of pressurised water piping and drainage piping.

The equipment within the cupboard, rack or cabinet shall be arranged into their logical functional grouping. All items of equipment shall be wall mounted. The cupboard doors shall be of size and be arranged so that they do not impede access to the equipment. Doors shall be lockable by master keying system.

Separate physical areas within the cupboard shall be allocated for:
- incoming cables (backbone)
- horizontal cables
- optical fibres (if provided)
- active devices (hubs) and patch panels.

Adequate natural or mechanical ventilation shall be provided to remove heat generated by the active devices inside the TCs. The ventilation provision shall be capable of limiting the ambient temperature inside the cupboard to not more than 35^{o} Celsius.

Devices

4.7.00 GENERAL

The backbone and horizontal cable networks follow a star topography and allow for flexible connection of equipment and services on the network. Equipment and services can be connected at any point in the network to provide a campus-wide service.

4.7.05 CAMPUS DISTRIBUTOR (CD)

The Campus Distributor (CD) is the source node of the cable network but does not need to be the connection point of campus-wide systems or services. Equipment and services that would normally be connected to the CD include:

- Carrier Services - the services provided from internal service providers such as Telstra, Optus. These generally are voice (telephone) and ISDV facilities.
- Alarm Facilities - these are monitored services providing direct connection to the monitoring providers and include fire alarm, security and equipment maintenance, and modem facilities.
- PABX facilities
- External microwave links services.
- Wide Area Networks (WAN) external to facility.

4.7.10 INTERNAL DISTRIBUTOR (Building & Floor - BDs and FDs)

These distributors provide communication nodes throughout the campus network as part of the star topology. Major equipment and services can be connected to any of the network nodes to provide campus-wide communications facilities and would generally include:

- Central dictation services
- Digital Service Encoding data networks, LANs
- Intercom services
- Serial data services
- Nurse call systems
- Paging
- Text terminal networks
- Security systems
- Access central systems
- Contact closure services
- Duress alarms
- Pager interface
- Video systems – campus wide
- Internal microwave system
- Fire alarm, security, equipment maintenance modem source signals to CD for external line connection to providers.

Nurse Call and Emergency Call Systems

4.8.00 Nurse call systems shall be hard wired and designed and installed in accordance with AS 3811 – Hard-wired patient alarm systems. It is highly recommended that nurse-activated emergency call buttons are separate from the patient call button.

Paging System

4.9.00 A paging system may be used to supplement the hospital telephone system for contact with key staff members. This facility may include arrangements for assistance call and other emergency signals. Automatic interface with the fire alarm system and hospital emergency calls is recommended.
Paging may be of the self-contained radio frequency type which produces full alpha/numeric

message information.

Paging facilities shall be maintained in the event of a major power failure in accordance with AS/NZS 3009 - Electric installations - Emergency power supplies in hospitals.

5. SECURITY SYSTEMS

General

5.1.00 GENERAL

Security systems shall comply with requirements of NSW Health Policy Directive PD2005_339 - Protecting People and Property: NSW Health Policy and Guidelines for Security Risk Management in Health Facilities

Generally security systems shall be in compliance with the project brief.

5.1.05 MINIMUM STANDARDS

The minimum requirements for provision of security systems in Health Care Facilities shall comply with AS 2201.1 to AS 2201.5 - Intruder alarm systems.

5.1.10 ACCESS AND EGRESS CONTROL

Building/s exteriors shall be capable of being secured against unauthorised entry.

5.1.15 AFTER HOURS ACCESS

After hours access points shall be CCTV-monitored with intercom, and, where necessary, electronic door control to allow staff to control entry into the hospital.

5.1.20 DURESS ALARMS

Duress alarm points shall be installed in the following positions:

- Front entrances
- Emergency Unit triage & reception
- Staff and nurse stations
- Mental health counselling rooms
- Pharmacies
- Cashier areas
- Any area where staff are regularly alone with patients or the public.

Personnel duress alarms are to be worn by staff considered at risk in the performance of their duties.

5.1.25 SECURITY LIGHTING

External lighting shall be configured to take into account security requirements.

6. MECHANICAL SERVICES

General

6.1.00 In the health building context, mechanical services extend beyond the conventional 'HVAC' (heating, ventilating and air conditioning) to include the following:

- HVAC systems
- Medical gases systems
- Ancillary mechanical services and specialized equipment and services:
  - dental
  - sterilizers
  - steam generation systems
  - mortuary equipment
  - pneumatic transport systems
  - compressed air systems for industrial use
  - refrigeration plant (e.g. cool rooms)

Heating, Ventilation and Air Conditioning Systems

Performance Outcomes

6.2.00 PERFORMANCE OBJECTIVE

To provide mechanical services that deliver the expected levels of comfort and functionality using cost-effective solutions that achieve an optimal balance between capital, operating and maintenance costs over the life of the service.

6.2.05 OUTCOME STATEMENT

Achieve objectives through the use of energy efficient building and services design, low whole-of-life costs while meeting OH&S requirements and achieving occupant satisfaction with the internal environment.

Component	**Performance Outcomes**	**Performance Criteria**	**Measurement Mechanism**
Air conditioning energy usage	Minimise energy consumption	Energy input per square metre of air conditioned floor area per annum Whole Building 750 MJ/m^2 pa Clinical Areas 800 MJ/m^2 pa Administration 400 MJ/m^2 pa Wards 700 MJ/m^2 pa	Energy used in functional areas and the whole building
Energy used in functional areas and the whole building Air conditioning thermal load	Minimise thermal load on air conditioning system	Watts of refrigeration per square metre of air conditioned floor area (average for whole building) 120 Wr/m^2	

Component	Performance Outcomes	Performance Criteria	Measurement Mechanism
Occupant comfort	Occupant satisfaction with thermal conditions in occupied spaces	80% satisfaction rating	
Ventilation	Adequate quantities of outdoor air and exhaust air	In accordance with AS 1668.2	Actual quantities measured against AS 1668.2 requirements
Whole of life costs	Lowest system cost over it's operating life considering: capital cost; operating cost; and maintenance and replacement costs	Life cycle costing analysis	Life cycle costing analysis complying with AS 4536
Infection control	Prevent the spread of microbial contamination by the mechanical services systems	Systems complying with relevant codes and standards	Compliance with BCA, AS 1668.2, AS/NZS 3666 AS 1432, AS 4260

Note:
Energy targets shown above are for guidance only. Actual targets will need to take the following factors into consideration:

Climatic Zone	Different parts of the state have different climatic conditions which will affect air conditioning load estimation and plant selection. Main climatic elements are: • ambient dry bulb temperature • ambient wet bulb temperature • solar radiation • cloud cover • wind speed
Functional Areas	Different functional areas such as clinical and ward areas have different cooling loads and energy consumption
Operating Hours	Plant operating time will have a significant affect on energy consumption, ie, 12 or 24 hours.
Building Construction	Type of construction, ie, light-weight, heavy-weight, single storey, multi-storey, insulation, affects both plant capacity and energy consumption.
Orientation/ Fenestration	The angle and direction of the sun together with shading devices can significantly influence plant capacity and energy consumption.
Landscaping	For low rise buildings trees, plants and adjacent structures can shield buildings from wind and shade the building from the sun to reduce both plant capacity and energy consumption.

General

6.3.00 APPLICATION

This document applies to all HVAC systems in hospitals and includes:

- Air conditioning
- Heating
- Ventilation
- Piped services for heating and cooling systems.

For health building projects in New South Wales, this document provides a uniform basis for the selection of these systems and their equipment.

6.30.05 GLOSSARY OF TECHNICAL TERMS

A Glossary of Technical Terms is presented in Section 10, Appendix 1 of this document.

6.3.10 OBJECTIVES

A principal purpose of the Guidelines is to provide acceptable levels of comfort and functionality while creating more-cost effective solutions. The Guidelines emphasise the questioning of assumptions about the way in which these functions are achieved and place the onus on the design team to prove the decisions made in an objective, rather than subjective, manner. The Guidelines also emphasise the need to view the mechanical services from a whole life perspective and to take into consideration all associated costs including energy, maintenance and operating costs.

This document is intended to provide a standard for the provision of mechanical services in New South Wales hospitals and to provide, in a convenient form, data specific to hospital applications for use as a reference by designers and others involved in the health building process.

By bringing this data together in one place it is expected that it will replace much of the guesswork that often applies to the specific needs of health care facilities. For example, Section 13 Appendix 4 – Minimum Outdoor Airflow Rates, contains an expanded version of Table A l from AS 1668.2 giving outdoor air rates for a wider range of health care occupancies than in the original Standard. In addition the Guidelines provide a framework for reporting the design in a standardised format to simplify understanding of systems proposed and comparison between projects. They also emphasise the need to make critical decisions early in the design process and, through the Scheme Design report, provide a format for showing that the correct decisions have been made.

The emphasis in the Scheme Design report is on a systems approach as it is recognised that, at this stage, the design is not normally refined to a degree that permits analysis of components. Nevertheless it is expected that, at the scheme design stage, decisions that cannot easily be reversed later will be made. These would include system types, plant configuration, location of plant rooms, riser space, required ceiling heights and the like.

As these are decisions that have significant capital and operating cost implications, there is some emphasis given to timely decision making in the early stages of the project. Occasionally this may lead to the decisions being substantiated earlier than is commonly the case but the savings that flow from bringing such decisions forward more than outweigh the additional early effort.

6.3.20 BUILDING ENERGY MANUAL

Designers and users are urged to make use of the Building Energy Manual which provides extensive data about engineering services and is specifically aimed at applications in New South Wales. Reference to the manual is made at a number of points in this document.

6.3.25 STANDARDS AND CODES

Design requirements are to be in accordance with relevant Australian Standards, building codes and regulations. The list of applicable standards is provided in References and Further Reading of this document.

Infection Control

6.4.00 GENERAL

In addition to the comments made in 1.9.00 and Part D of the NSW HFGs - Infection Prevention and Control, mechanical services design principles shall comply with infection control requirements.

6.4.05 AIR HANDLING AND SUPPLY

Room pressurisation will frequently require air quantities in excess of the minimum scheduled in AS 1668.2, and this document.

Positive flow at adequate rates is preferred to the defining of pressure differentials between areas. In some circumstances, flow may be required only on opening of doors and the system shall have adequate flexibility to accommodate this requirement.

Provision shall be made to ensure adequate air supply with varying filter resistances in areas requiring high levels of airborne contaminant control. Typically this will be in Operating Rooms, Set-Up Rooms, Isolation Rooms and High Infection Risk Areas.

Rooms or booths specifically designed for sputum induction, aerosolized pentamidine treatments and other high-risk cough-inducing procedures shall be provided with local exhaust ventilation in addition to infection control requirements.

Fans in systems serving areas requiring airborne contaminant control shall be operated 24 hours per day to maintain airflow patterns from clean to less clean areas.

Energy conservation design shall not compromise infection control systems. The requirements of AS/NZS 4187 shall be maintained in respect of ambient conditions for sterile stock.

Provision of Cooling and Heating

6.5.00 INTRODUCTION

This document sets out the criteria for cooling and heating. Air conditioning is the most costly single building service currently provided in hospitals and refrigerated cooling is the second largest energy consumer after lighting. In this situation it is essential that air conditioning be only provided if no adequate alternative exists.

Until the mid 1970s it was not the practice in New South Wales to provide air conditioning to such areas as hospital inpatient units. Many examples can be cited where quite satisfactory comfort is achieved in older style buildings without the need for mechanical cooling. Factors that affected this were siting and orientation of the building, high ceilings, effective natural ventilation and heavy building mass. Similarly, there are many hospitals in the west of the State where evaporative cooling has provided adequate comfort for patients and staff for many years.

The change to deep plan buildings, modem, lighter-weight construction and community expectations have brought us to the point where air conditioning for comfort throughout the hospital has become the norm.

It must be recognised that with rare exceptions, the provision of air conditioning is not required by law and therefore is not mandatory. This document addresses the circumstances to be considered when deciding whether to air condition, evaporative cool or heat a space. The essential difference between these options lies in the degree of temperature humidity (and sometimes pressure) control that is achieved in the space served. It is the degree of control, or rather the extent to which the space goes outside acceptable limits, that dictates the choice of appropriate solution.

6.5.05 FACTORS INFLUENCING THE CHOICE OF COOLING AND HEATING

For capital and recurrent cost reasons it is preferred to limit the amount of air conditioning to those areas where it is essential for one of the reasons listed below. In areas where air conditioning is considered for 'comfort' purposes only, preference shall be given to the use of passive cooling techniques instead of air conditioning.

Passive cooling techniques include:

- Proper siting and orientation of the building.
- Selective shading of windows to prevent solar penetration in summer but permit it in winter.
- Suitable building mass and insulation combinations.
- The use of natural ventilation.

In order to achieve this objective, there needs to be early involvement of the mechanical engineer in the design process and for the design team to have, as a high priority, minimisation of the amount of air conditioning while achieving a comfortable building.

6.5.10 CRITERIA

The following criteria have been applied in determining what type of mechanical system should be applied.

1. Statutory Requirements:
   Examples include WorkCover Authority regulations or Local Government Act (BCA) regulations. Such regulations relate only to the provision of mechanical ventilation and limits on temperatures. They do not prescribe air conditioning or any other means of achieving temperature control.

2. Patient Safety:
   Examples of such areas are Recovery, ICU, CCU and HDU. In these areas a controlled environment reduces stress on patients and permits observation of them with only limited bed covering.

3. Infection Control:
   In areas such as Post-Mortem Rooms and Operating Rooms, mechanical systems air conditioning provides a means for reducing the spread of airborne infectious organisms from one space to another.

4. Essential for Activity / Equipment: Examples include:
   - Pathology where stable conditions are required for consistent results.
   - Parts of Medical Imaging containing heat sensitive equipment.
   - Mainframe computers.

6.5.15 SUMMARY OF AREAS

The principal areas within a hospital have been divided into three categories on the basis of the permissible variation in temperature in the space concerned. It should be noted that these are not control tolerances but rather limits on the amount of time during which unacceptable conditions will occur:

Category 1:
Areas where temperatures must be kept within close limits most of the year to meet criteria 2, 3 and 4 in clause 6.5.10. Normally this would be achieved using refrigerated air conditioning and heating.

Category 2:
Areas where a wider range of temperatures is acceptable. In these areas, cooling and heating is provided for the comfort rather than safety of staff and patients. In these areas air conditioning is acceptable only when the design team is unable to achieve comfortable conditions by passive means. Heating would normally be provided in these areas.

Category 3:
Areas where the usage is such that an upper limit on temperature is not appropriate although

a lower limit (and therefore heating) is required for occupant comfort. Where it would cost more to provide separate systems for a single room or small group of rooms to comply with the above categories a system which combines different categories may be used.

6.5.20 CATEGORY 1

Redefine performance

Category 1 Areas:
- Emergency Department (whole unit)
- Cardiac Catheterisation rooms
- Coronary Care Unit
- Operating Suite
- Day Procedure Rooms
- Delivery Rooms
- Intensive Care Units (including Neonatal, Coronary etc.)
- Isolation rooms within inpatient units.
- Medical Imaging Rooms
- Mortuary/Post-Mortem Units
- Library (Only)
- Main Frame Computer Room
- Recovery
- Pharmacy Unit
- Pathology Unit
- Sterile Supply Unit
- Stores for temperature-sensitive goods.

6.5.25 CATEGORY 2

Where mechanical cooling is proposed, the design team shall demonstrate that they have examined the alternatives and explain why they are unable to apply passive cooling. Heating would normally be required in all instances.

Evaporative cooling should be restricted to locations west of the Great Dividing Range.

Category 2 Areas:
- Biomedical Engineering Unit
- Blood Donor Unit
- Dental Unit
- Main Entrance and Public Areas
- Medical Records Unit
- Occupational Therapy
- Offices (All units including offices in engineering, stores etc.)
- Outpatients
- Residential Accommodation
- Rehabilitation Units
- Physiotherapy
- Staff Cafeteria
- Tutorial/Meeting Rooms (All units)
- Waiting Areas (All units)
- Inpatient Units
- Nurseries
- Kitchen

6.5.30 CATEGORY 3 :

For Category 3 areas, temperature shall be above 20 ºC on all but 10 days per year. Normally heating will be required. For small rooms such as dirty utilities, toilets and en suites, where exhaust air is required, this condition may be deemed to be met if the make-up air is drawn from a space provided with some form of heating.

Evaporative cooling may be proposed for Category 3 areas provided it can maintain an inside temperature of less than 27 ºC throughout the year.

Category 3 Areas:
- Change / Locker Rooms
- Cleaner's Rooms
- Dirty Utility Rooms
- Disposal Rooms
- Engineering Unit
- Hydrotherapy Pool (Refer to 6.615 for special conditions)
- Hygiene Unit
- Linen Handling Unit
- Store Areas for non-temperature sensitive goods
- Toilets

Offices located in the above Category 3 areas are classified as Category 2.

Kitchens require special attention to deal with high internal heat load and fresh air rate for hoods.

Special cooling is required for plating areas and preparation areas for Cook-Chill Kitchens.

Evaporative cooling should be considered where climatic conditions are suitable Refer 6.6.55

Plant and Equipment

6.6.00 INTRODUCTION

The purpose of this document is to set out the methods and basis to be used when calculating heating and cooling loads for hospitals and when selecting the appropriate size of equipment.

The document does not present itself as a comprehensive document and designers are referred to the standard design guides such as ASHRAE [2] and AIRAH [7] for further design data and methods.

This document refers to the Building Energy Manual - NSW PWD to which designers should also refer.

The methods in this document are to be used for all air conditioning and heating load calculations.

Heating load calculations shall be based on the relevant sections of this document adjusted as set out in Mechanical Services, Air Conditioning Heating Load.

Innovative approaches to plant configuration may be proposed provided the life cycle cost advantage can be shown. These would include:

Heat Recovery Systems:
- Ice Storage
- Co-generation

Details of the systems, including life cycle costs, are to be included in the Scheme Design Report.

6.6.05 AIR CONDITIONING COOLING LOAD

Cooling load calculations shall be performed by computer software based on the data in Section 14, Appendix 5 of this document.

The software shall be a commercial package that has been validated by a recognised benchmarking test. The package shall have good technical support.

6.6.10 OUTDOOR DESIGN CONDITIONS

Outside design conditions shall be based on the most accurate climatic data available for the location of the proposed project.

Great care is required in selecting this data as two locations separated by only short distances can have markedly different climatic patterns. The consequence of error in selecting the most appropriate data can result in both excessive plant capacity and unnecessary capital cost. For example - using 24º C instead of 23ºC for wet bulb temperature can add 8% to a typical hospital cooling coil and central plant capacity.

Outside design conditions shall be selected as follows:

1. For the locations listed in AIRAH: Application Manual DA09a 'Load Estimation & Psychometrics' [2]

   For Operating Theatre plants use the 'Critical Process', 24 hour data if available for the location, otherwise use the 'Comfort or Non Critical' data with the dry bulb temperature increased by 2 ºC or the wet bulb by l ºC.

   For all other plants use the 'Comfort or Non Critical Process Installations' data.

2. For locations not listed in AIRAH, use data for the nearest listed location having similar climatic characteristics. Figure 15.12 of the Building Energy Manual [3] may be used as a guide in selecting a suitable location.

The data in reference [2] has been prepared by the Bureau of Meteorology (Computer data now available from Met Bureau) from their archives for hundreds of locations in Australia and as such it represents a significant increase in the accuracy of data compared with what was available previously. Data is also available directly from the Bureau of Meteorology.

6.6.15 INDOOR DESIGN CONDITIONS (ROOM DESIGN CONDITIONS)

TEMPERATURE AND HUMIDITY

Inside (room) design conditions are summarised in following Table. They are to be used for plant sizing purposes and do not imply that the plant is to be controlled to maintain the values stated nor do they represent recommended set points or tolerances for controls.

Area	Summer Design Dry Bulb ºC	Summer Design Relative Humidity %[3]	Winter Design Dry Bulb ºC
Operating Rooms	23	50	21
Category 1 Areas	24	50	20
Category 2 Areas	24	50	20
Other Areas	27	50	20
Hydrotherapy Pool[4]	Space conditions to comply with AS 3979		

NOTES

1. Special surgical procedures, such as paediatric and neurosurgical, may require other conditions between 15ºC and 25ºC. Design shall be based on other values only when there is a demonstrated clinic need.
2. Rooms housing heat sensitive equipment such as main frame computers, linear accelerators, MRI equipment and the like, shall have conditions according to the equipment manufacturer's recommendations.

3. Humidification shall not be provided except as required in Note 2. Humidity may be permitted to rise to 65% if appropriate to the design or operation of the systems.

4. These depend on pool water temperature and require that air temperature will be not more than 10 ºC lower than pool water temperature and relative humidity not more than 75%. Pool water may be in the range 28 to 35 ºC.

5. Control set points shall be selected to suit occupant preferences consistent with energy conservation.

6.6.20 TEMPERATURE DIFFERENCE WITHIN ROOMS

The temperature at 1.5 m above the floor in a room shall not vary by more than 1º C. The temperature difference between rooms on the same zone shall vary by not more than 3º C. The temperature difference between floor level and 1.5 m above the floor shall be not more than l.5º C. The temperature of the floor shall be within the range 19º C to 26º C.

Zoning of air handling plant shall be provided to the extent required to limit the temperature difference between rooms served by the same zone to a maximum of 3 degrees Celsius.

6.6.25 AVERAGE AIR VELOCITY IN THE ROOM

Average air velocity in the room shall be between 0.1 and 0.15 metres per second. Particular care with the design of air distribution is required in Operating Theatres and rooms where patients are on beds or trolleys such as Patient Bed Rooms, Recovery, Emergency and Critical Care. Under no circumstances shall the supply air rate be less than 4.5 ACHR in any room any time. It should be noted that this applies to minimum air quantities on variable air volume systems as well as to constant volume systems.

Evaporative cooling shall be designed to maintain acceptable indoor comfort conditions, based on heat stress index or similar criteria.

6.6.30 SOLAR GAIN THROUGH GLASS

For glazing that is not always fully shaded, the glazing system shall be selected and the air conditioning plant sized for an overall shade coefficient of not more than 0.6.

6.6.35 HEAT GAIN FROM LIGHTS AND EQUIPMENT

Heat gain from lights shall be calculated from the lighting designers' plans. (Refer Guideline Electrical Section -Lighting).

For preliminary calculations before the completion of the lighting design based on gross HPU areas, the following approximate values may be used. They are based on lighting levels in the Electrical Section.

Heat gain from electrically powered equipment shall be based on the actual equipment to be used within the space. Lacking specific information, the following may be used, based on gross HPU areas.

DEPARTMENT	LIGHTING W/m^2	POWER W/m^2
Medical/Surgical Wards	12	5
Orthopaedic	12	5
Paediatric	12	5
On-call accommodation	12	5
Rehabilitation	12	5
Allied health	12	5
Psychiatric	12	5
Psychogeriatric	12	5
Oncology	12	5
Bio-medical Engineering	12	10
Medical Imaging	12	10
Emergency	15	10
Medical Records	12	5
Pharmacy	12	10
Nuclear Medicine	12	10
Pathology	15	10
Blood Donor Unit	12	5
Medical Library	12	5
Day procedures	12	10
Operating Suite	25	40
Intensive Care Unit	15	10
Coronary Care Unit	15	10
Mortuary	10	5

Linen Handling	10	5
Regional store	8	2
Engineering & Maintenance	8	5
Kitchen	10	-
Staff Cafeteria	12	10
Education	8	5
Main Entrance & Foyer:	8	5
Admission/Discharge	12	15
General Administration	12	15
Staff Amenities	8	-

Additional allowances are required where equipment located in air conditioned space is heated by other means such as hot water or steam.

6.6.40 OUTDOOR AIR AND PEOPLE

Outdoor air shall be provided according to AS 1668 Part 2

The table in Section 15 Appendix 6 contains data from AS 1668 Part 2 with the addition of data on areas of hospitals not covered by the standard. Appendix MD shall be used as a supplement to Table Al of AS 1668 and be read in conjunction with the Standard.

It should be noted that AS 1668 Part 2 permits some concessions on outside air flow rate if filters of sufficiently high efficiency are installed. This use of such filters is permissible provided they are shown to be cost effective by life cycle cost analysis.

In areas where there are high people densities, the actual number of people in the space shall be used. It should be noted that values in AS 1668 for areas such as the Staff Cafeteria yield more people than is normal for such spaces in hospitals.

6.6.45 OTHER LOADS

Margins for other sources of cooling load including infiltration, duct heat gain, fan power and the like shall be calculated according to standard references [2], [7]

6.6.50 SAFETY MARGINS

Safety margins on cooling and heating load calculations shall be zero.

6.6.55 DIVERSITY

Where a central plant serves more than one air handling system, the capacity of the central plant shall be calculated based on the peak simultaneous load, not the sum of the individual loads. In addition, the following diversity factors shall be applied when calculating central cooling plant capacity.

Lighting:	0.90
Equipment:	0.85
People:	0.80

6.6.60 AIR CONDITIONING HEATING LOAD

Heating load calculation shall be based on the following:

Calculation method for heating load as part of air conditioning plant shall be performed using software according to Clause 6.6.05. Where heating only (i.e. non air conditioned) systems are involved, calculations may be according to Clause 6.6.05 or by manual methods in References [2] or [7], and clause 11.3.10.

- Zero solar gain. Outside design conditions for winter in Clause 6.6.10
- Inside design conditions for winter in Clause 6.6.15. Zero heat gain from lights. Zero heat gain from people.
- Outside air quantity calculated in Clause 6.6.40
- Other heating loads such as infiltration according to Clause 6.6.45
- Zero safety margins.

Zero 'Heat up' allowance. Instead provide control system to start heating plant before normal occupancy time to achieve acceptable inside conditions.

6.6.65 EVAPORATIVE COOLING

Evaporative cooling shall be designed to maintain inside dry bulb temperature less than 27º C. Calculation of cooling load and plant sizing shall be according to Sub Section 6.6 or alternatively by the use of computer software supplied by evaporative cooler manufacturers based on the bin temperature method.

6.6.70 DETERMINATION OF SPARE CAPACITY OF PLANT AND EQUIPMENT

GENERAL PROVISIONS

Except as provided below, all plant and equipment shall be sized as set out in the preceding sections to be equal to the load it serves with no additional capacity or duplication for 'safety margins', redundancy or the like. Diversity of load shall be considered when sizing plant that serves multiple systems - refer Clause 6.6.55

No additional capacity shall be provided for future loads unless the required capital for the future plant and/or building has been committed. Where extension of the system is planned, provision shall be made, as blanked valves, for future connection to the existing system but not as additional plant capacity.

6.6.75 SEGREGATION OF SYSTEMS

Air handling systems shall be segregated to permit individual departments to be shut down when not in use. In certain instances, availability can be increased by dividing the area served into separate air handling systems. An example of this is the splitting of the operating theatres so that each pair of theatres is handled by one air handling unit. In this case shutting down the air handling unit for maintenance and the like will still permit other theatres to be used.

6.6.80 NOISE LEVELS

Unless required otherwise by the Project Brief, the design interior noise shall be those in AS/NZS 2107 for 'Recommended Design Sound Level - Maximum'. For specification purposes NR (noise rating) values are preferred.

Convert dB(A) levels in AS/NZS 2107 to NR ratings by subtracting 5 dB(A) in each case. For example AS/NZS 2107 specifies 50 dB(A) for corridors so specification value for corridors would be NR 45.

6.6.85 STANDBY POWER OPERATION

Refer also to Guideline Electrical Services- Standby Power.

Selection of Mechanical Systems

6.7.00 INTRODUCTION

This document deals with selection of mechanical systems for space heating and cooling in hospitals. The procedure for determining whether cooling or heating of a space is to be provided is dealt with in Sub Section 6.3 -General.

Once that decision has been made, this Document sets out the criteria for deciding how it can be best achieved.

6.7.05 AIR HANDLING SYSTEMS

SYSTEM SEPARATION

In a large and complex project such as a hospital it is necessary to provide more air handling

systems than would be the case for a single use building such as an office block. Besides providing systems to meet the needs of separated buildings, fire mode operation and air conditioning zoning to match heat loads, separate air handling systems are required to meet the following requirements.

Varying occupancy times:
Some areas will nominally operate from 9.00 am to 5.00 pm and some will operate 24 hours a day. Some of the '9.00 am to 5.00 pm' areas such as Education may be in use weekends. Additional plants shall only be provided if it can be shown that the life cycle cost is lower than the alternative of operating plant for unoccupied areas out of hours.

Possible tenanting of departments (e.g. Pathology, Medical Imaging):
Separate plant for tenanted spaces shall only be provided if required under the structure of the proposed leases.

Duplication to provide redundancy:
A separate air handling unit is required for each pair of operating theatres.

Prevention of cross contamination:

Separate plant shall be provided for:
- Operating theatres - a separate air handling unit for each pair of operating theatres
- Mortuary
- Main Kitchen
- Where specifically required for isolation purposes. Refer other sections of this document.

Shut Down:

Systems shall be arranged to allow the closing down of whole units (eg ward units) at times of low occupancy.

The air conditioning system shall incorporate only sufficient separation of air handling systems to meet the needs defined above, and zoning for temperature control and smoke control.

6.7.10 ZONING

Zoning of air handling plant shall be provided.

Thermostats or temperature sensors shall be located in a representative area within the zone.

Zoning shall meet the tolerances of the internal design conditions for the particular category of environment selected.

6.7.15 MAINTENANCE

In selecting air handling system types, consideration shall be given to the cost and ease of maintaining the systems. This information and costs shall be incorporated in the Scheme Design Report.

Points to be considered include:

- All plant and components are to be in locations accessible for maintenance and with sufficient space to remove plant components. Access shall comply with Building Code of Australia and WorkCover Authority requirements.

- All plant shall be located so that it can be replaced and with a means of removal i.e. lifting beams, etc.

- Plant and components located over occupied areas shall be such that routine maintenance does not cause disruption to normal hospital activities. In this respect plant should not, for example, be located in ceilings over patient beds.

- System components shall be selected so that spare parts are readily available locally or within 24 hours.

- Selection of systems shall consider the level of maintenance expertise available on site and the level of technical expertise available to the hospital to operate and adjust the system.

- Preference shall be given to simple systems requiring simple maintenance and adjustment with extended periods between routine maintenance.

6.7.20 SELECTION OF SYSTEMS

There is a vast array of air handling systems and combinations of systems that can and have been used in hospital applications. The following provide guidance on their general suitability. It should be noted however that there are many smaller projects involving modification and extension to existing buildings where modification to an existing air handling system, while it may be less than ideal, can produce a far more cost effective solution than replacement with a new system. Should this path be chosen the users shall be advised if of compromises in performance that result.

Constant Volume Systems:

These are suitable for all areas of the hospital and are essential for areas where air flow and temperature control are critical such as operating theatres, mortuary, cytotoxic and aseptic rooms. Except in exceptional circumstances, do not employ re-heat methods to satisfy temperature zoning.

Variable Air Volume (VAV) Systems:

These are suitable for all areas in the hospital other than the special cases requiring constant volume systems. Because of the potential for low air flows at low load, VAV systems must have a means for setting a low limit on air flow (not less than six air changes per hour) either by control limit or by use of fan VAV boxes on centre zone.

Packaged Direct Expansion:

These include air and water cooled unitary style equipment and air cooled split systems. They are normally constant volume but subject to the technical limitations of direct expansion plant may also be used with VAV boxes. Air side performance can be expected to be the same as with other constant volume and VAV systems although attention is required to address the consequences associated with step changes in capacity due to compressor switching.

Of significance is the limited life of packaged direct expansion plant compared with chilled and/or heating water systems and this needs to be addressed in the life cycle cost analysis.

Fan Coil Unit Systems:

Fan coil unit systems served by chilled water with hot water or electric heating are an attractive solution for areas requiring special control or out of hours operation.

Such areas include isolation rooms, computer room and PABX rooms. While potentially suitable for patient rooms the high cost of associated pipe work and need for regular maintenance access make them a solution suitable in special rather than general applications.

Warm Air Furnaces:

Gas fired warm air furnaces provide a capital and energy cost effective means for heating areas where evaporative cooling or no cooling is required. They may be combined with evaporative cooling.

Evaporative Cooling:

Evaporative cooling is suitable for (Mechanical Services) Category 2 areas provided outside design conditions are suitable. They are of NO value east of the Great Dividing Range and require special attention to limit heating costs because of the large volumes of outside air used.

6.7.25 HUMIDIFIERS

Humidifiers are not generally required to be installed in health buildings unless for medical

reasons or for environmental control where 'high tech' equipment is installed and required by the manufacturer. Examples include operating rooms and computer rooms.

Where installed humidifiers shall provide a bacteria-free injection into the air stream.

6.7.30 COOLING SYSTEM

COOLING PLANT

Central cooling plant chiller sets shall be selected to ensure that in the event of failure of a compressor, adequate standby capacity is available for selected critical areas. Select chillers that maintain reliable, energy efficient low-load operation. Chiller plant shall be sized to provide efficient and stable part load operation.

6.7.35 COOLING TOWERS AND EVAPORATIVE CONDENSER SYSTEMS

Cooling tower and evaporative condenser systems shall be designed and installed in accordance with the Health (Legionella) Regulations and AS/NZS 3666.1 to AS/NZS 3666.3 - Air handling and water systems of buildings - Microbial Control. - Regulations under the NSW Public Health Act. Make allowance to keep part of the plant operating during the cleaning process.

Cooling towers and evaporative condensers shall include a side stream filter or cyclonic separator system to provide solids removals from the circulating water systems.

Evaporative cooling may be used for support areas where relief cooling only is required such as kitchens and workshops and some other non-critical areas, where suitable. Observe standards and codes for design as for air-conditioning

6.7.40 HEATING

SELECTION OF SYSTEM

All heating systems shall be thermostatically controlled. Heating systems with long thermal lag (e.g. most types of slab heating) shall only be used when no alternative is available and only when combined with a control system to hold space temperature within 2º C of the winter design value. Systems that rely on opening windows to compensate for over-heating are not acceptable. The surface temperature of heating equipment in occupied areas shall not exceed 50º C. Temperature of the floor shall be not more than l.5º C above the air temperature at 1.5m above the floor.

Open fires, portable heaters and unfluted gas heaters shall not be installed in patient areas.

6.7.45 ENERGY CONSIDERATIONS

Heating systems shall be selected having regard to the life cycle cost of the system. This shall include consideration of;

- Most suitable tariff structure;
- Availability of waste heat from heat recovery processes;
- Possibility of combining space heating reticulation with other; systems (eg domestic hot water)
- Energy sources available on site; and
- Suitability of the system for shut down in summer and when space is not in use (sterilising and domestic hot water should be segregated from space heating).

6.7.50 MAINTENANCE

The conditions set out in 6 .7.15 shall apply to heating systems

6.7.55 CENTRAL BOILER PLANT

Central boiler plant shall be unattended in accordance with WorkCover regulations.

6.7.60 DUPLICATION AND STANDBY BOILING PLANT

Duplicate boiler plant (multiple units equal to the total load) and standby plant (additional plant over and above that needed to meet the load) shall only be provided where needed to meet the availability requirements or to provide efficient and stable part load operation. Refer – Clause 6 .6.60.

6.7.65 BOILER PLANT MAINTENANCE

Similar considerations to those in Mechanical Services - Maintenance section, apply to central plant. While central plant reduces the number of system components, it usually means that they are large and require more complex control systems. Ensure, before proposing central plant, that adequate resource in terms of trained personnel and equipment are available on site to maintain and adjust systems. In order to effectively assess this, hospital policy regarding maintenance will have to be determined at the design stage. For example will the hospital have on site staff or will it rely on contractors?

Ventilation

6.8.00 Mechanical ventilation shall be provided to comply with AS 1668 Part 2 [5].

Outdoor Air

6.9.00 Outside air shall be provided according to AS 1668.2 1991 as adopted by the BCA. Note: AS 1668.2 2002 includes Health Care Facilities and should be used except where in conflict with BCA which refers to the 1991 edition.

In areas where there are high people densities, the actual number of people in the space shall be used. It should be noted that values in AS 1668 for areas such as the Staff Cafeteria yield more people than is normal for such spaces in hospitals.

Ensure that there is sufficient outdoor supply to provide make up for exhaust systems.

All ventilation systems shall be designed to control the high level of odours often generated within Health Care Facilities.

All bathroom and toilet exhaust systems shall be fully ducted and discharge to outside, not to common roof or ceiling space.

Variable volume supply air systems shall incorporate control devices to ensure minimum outdoor air supply to all areas is maintained at all times.

Regardless of whether the area is served via operable windows, forced fresh air shall be provided in accordance with this document to all air conditioned occupied spaces.

Sanitary compartments, Dirty Utility Rooms and similar spaces shall not be ventilated by a system which also serves areas such as Operating Rooms.

Ventilation systems for rooms where ethylene oxide (ETO) sterilizers are used and ETO stored shall be designed in accordance with the Occupational Health and Safety Section of this document. Upon loss of exhaust system airflow, an audible and visual alarm shall activate in the steriliser work area, and at a location that is continually staffed.

Exhaust Air

6.10.00 FAN SYSTEMS

Fan systems are highly recommended to be fitted with differential pressure switches, to

provide remote alarm indication of fan failure. This shall not apply to independent toilet exhaust systems serving single use toilet/shower or bath areas.

6.10.05 SCAVENGING

Each space routinely used for administering inhalation anaesthesia and inhalation analgesia shall be served by a scavenging system to vent waste gases. If a vacuum system is used, the gas collecting system shall be arranged so that it does not disturb patients' respiratory systems. Gases from the scavenging systems shall be exhausted to the outside.

Anaesthesia evacuation systems may be combined with the room exhaust systems provided that the component used for anaesthesia gas scavenging exhausts directly to the outside and does not recirculate.

Scavenging systems are not required for areas where gases are used only occasionally such as emergency rooms and offices for outline dental work.

Acceptable concentrations of anaesthetising agents are unknown at this time. The absence of specific data makes it difficult to set specific standards. However, any scavenging system is highly 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. (Refer also to the Occupational Health and Safety requirements in the Part C of the NSW HFGs (Health Facility Guidelines).

Life Cycle Costing

6.11.00 GENERAL REQUIREMENT

Refer to Section 12, Appendix 3 of this document.

Building Management and Control Systems

6.12.00 INTRODUCTION

The purpose of this Document is to set out the functions of a Building Management Control System (BMCS) and the standards to be applied.

This Document sets out proposals for achieving a system that gives sufficient information to enable the functions of the hospital to be carried out in a cost effective and efficient manner.

The provisions of this Document are to be applied to all new BMCS and to all extensions or enhancements of existing systems.

The BMCS should be an Open Building Control System using either Lon Mark, Lon Works, Modbus or BACnet standards with full interoperability.

Selection of a BMCS system shall be appropriate to the size, nature and location of the project.

Where economically possible, it is preferable to extend on an existing BMCS system on small to medium sized projects rather than to duplicate systems.

Alternatively systems should be selected for high level interface compatibility.
Where this is not possible, low level interface between systems may be considered to achieve a degree of system integration. This should always be considered a last choice.

Also, of significance is the degree of sophistication appropriate to the project and locations. Overly sophisticated systems requiring a high level of computer skills are not appropriate to remote locations. Also see clause 6 .13.05.

6.12.05 ALTERNATIVE TO CENTRAL CONTROL AND MONITORING

The cost of a BMCS is directly related to the number of controls or monitoring points. While the cost per point may be modest, it is inherent in BMCSs that the number of points escalates rapidly because when a decision is made to monitor or control one function that point is duplicated by as many times as the function occurs. For example, if a decision is made to monitor power consumed by each distribution board then the cost is represented not by one point or even the number of boards as each board has three phases per submain and two submains per board.

Typically for a 200 bed hospital there would be up to 20 distribution boards giving a total of 120 points.

Before adding a function to a central control and monitoring system, consider whether lower technology solutions would give an equivalent result. Examples are:

- use of time switches to control plant and lighting instead of central control,
- regular maintenance inspections of filters instead of filter pressure drop alarms,
- local electrical or electronic control of temperature instead of central control and monitoring, and
- manual switching of lighting by security staff rather than by a central system.

Required Functions of the BMCS

6.13.00 CRITERIA FOR SELECTION FUNCTIONS

Subject to the conditions set out below the following functions shall be provided by the BMCS system:

- plant control (temperature, humidity, pressure, etc.).
- optimum and scheduled start and stop of plant.
- electrical load shedding.
- outside air economy cycle control.
- alarm annunciation.
- data gathering and logging.

Given the high cost of providing BMCS, the limited life of the technology (currently about 10 years) and the larger volumes of information generated, the objective in installing a system is to include only those monitor and control points and functions that can be demonstrated to give cost effective control.

Typical functions would include:

Energy Management:
- energy metering from supplier including (as appropriate) KWH and KVA
- chiller and boiler kW output
- power to major submains. (The cut off between ‘major’ and ‘minor’ needs to be viewed by weighing the cost of monitoring against the benefits of allocating costs to departments and some other basis such as floor areas).
- data logging of plant run hours
- electrical load shedding
- emergency power mode operation.

Control:
- start and stop plant.
- Optimise plant operation to reduce energy consumption
- switch off lights and plant for areas not in use. Use of B.M.C.S. for this function is to be justified by economic comparison with alternatives (See 6 .12.05).
- chiller and boiler optimisation.
- temperature control (subject to need to have this centrally controlled).

Alarm Functions:
- fault alarms from critical items. Normally a common alarm for each item of plant will suffice.
- alarms from items of non-mechanical equipment such as blood refrigerators, body holding, kitchen cool rooms, medical gas plant, lifts, diesel generator etc. where fault condition could be life threatening or lead to major financial loss
- fire alarm indication with ability to allocate priorities.

Maintenance Functions:
- hours run log of plant items
- scheduled maintenance
- operating hours logging
- performance logging (eg temperature profiles)
- fault/alarm logging and analysis

6.13.05 OPERATOR TRAINING AND CAPACITY

It goes without saying that if the system is to be installed, it must be capable of being operated, adjusted and maintained. A modern direct digital control BMCS represents a high level of technical complexity and requires an equivalent level from mechanical contractor, operators and maintenance staff. It is essential that any system installed be capable of being understood and operated by hospital staff. They may be backed up by contractors, but if the system is too complex for the hospital staff, experience has shown that it will rapidly fall into disuse for all but the most basic functions.

The system must, as well as being suitable for the staff who will use and maintain it, be provided with technical back-up in the form of comprehensive, useable documentation and a formal training structure for initial and subsequent users.

6.13.10 MAINTENANCE ARRANGEMENT

Consideration should be given on large or complex BMCSs to incorporating a long term maintenance agreement into the installation contract. This arrangement has been common practice with lift contracts for many years and offers a commercial advantage to the purchaser if the maintenance costs are established at tender time. With the present state of BMCS technology it is probable that only the original supplier will be in a position to maintain the system. This makes the possibility of obtaining competitive tenders for maintenance unlikely after the initial installation contract is let.

Such a long-term contract needs to be carefully prepared. In addition to setting out requirements for maintenance of hardware, software upgrades and the like, it must also cover issues such as the training of new operators over the years, modification of software and extension of the system.

Controls – General

6.14.00 Provision shall be made to operate the air-conditioning system within the required temperature and humidity range. The range may need to be adjusted to suit local preference or medical needs when, for instance, elderly patients and babies may require higher temperature.

All adjustable controls such as thermostats are highly recommended to be provided with locking covers to prevent tampering.

All components such as temperature sensors within an occupied space shall be suitable for swab-down cleaning. (Not waterproof).

Building Construction

6.15.00 INTRODUCTION

At present there are no parameters dictating the thermal performance of building construction so that these vary greatly between projects. Issues such as the amount of glass, shading,

thermal mass and insulation have significant impact on both plant cost and operating cost.

The building shall be designed to meet acoustic performance requirement.

6.15.05 THERMAL PERFORMANCE

Thermal performance of buildings is to conform to ASHRAE Standard 90 – 1990.

6.15.10 BOILER, HEATING EQUIPMENT PLANTROOMS

Rooms containing heat producing equipment, such as boiler or heater rooms or laundries, shall be insulated and ventilated to prevent the floor surface above and/or the adjacent walls of occupied areas from exceeding a temperature of 6^{o}C above ambient room temperature.

6.15.15 NOISE AND ACOUSTIC ATTENUATION

Noise levels in any area shall not exceed the exposure standard established in the Occupational Health and Safety (Noise) Regulations. For the purposes of the regulations, the exposure standard means the eight (8) hour equivalent continuous sound pressure level of 85 dB(A) measured in A-weighted decibels referenced to 20 micro Pascals. Due consideration shall be given to the amplification of noise due to multiple sound sources to ensure the exposure standard is not exceeded.

Noise breakout from any plant areas shall not exceed the values for interior noise as determined in AS 2107 -'Acoustics - Recommended design sound levels and reverberation times for building interiors'.

Due consideration shall be given to exterior noise levels to prevent nuisance to the external environment by noise generated by plant.

Air Distribution System - Ductwork

6.16.00 INTRODUCTION

While other materials have been used over the years for ductwork, rectangular galvanised steel has consistently been shown to be more cost effective. This is largely due to the development of automatic sheet metal duct fabrication machines. Rigid circular ductwork is both less efficient in its space requirements and normally more expensive because of the high costs of fittings.

6.16.05 DUCT CONSTRUCTION

Duct Construction is to be in accordance with AS4254. Access for inspection and cleaning shall be provided in accordance with AS3666.

6.16.10 DUCT SIZING

Duct sizing is to be based on the recommended velocity and pressure drop ranges in ASHRAE 2001 Fundamentals.

6.16.15 DUCT DESIGN

Air handling duct systems shall be designed to be accessible for duct cleaning, generally by the provision of access panels.

Access panels shall be fitted at each reheat coil and fire and smoke damper to allow annual Essential Services inspection

6.16.20 Duct acoustic treatment and equipment such as fan coil units, conditioners and VAV boxes incorporating fibrous insulating materials shall not have fibres exposed to the airstream. Perforated facing shall have impervious linings.

Supply air ducting shall be designed and manufactured to prevent possible induction of

contaminated air.

6.16.25 DUCT INSULATION - GENERAL

The issue of whether or not ductwork needs thermal insulation and how thick it should be must be addressed on a job-by-job basis. Although it is a straight forward task to calculate the insulation thickness required, this is rarely done and 'rule of thumb' is applied. With the introduction of alternative materials this can no longer be relied upon and a critical appraisal of the need for insulation is required.

6.16.30 INSULATION THICKNESS

Insulation shall be provided for ductwork to achieve thermal and acoustic performance as follows;

- Air conditioning supply ducts in air conditioned spaces;
- Air conditioning supply ducts in non air conditioned spaces;
- Air conditioning return ducts in air conditioned space;
- Air conditioning return ducts in non air conditioned space; and
- Outside and exhaust ducts, intake plenums, air handling chambers.

6.16.35 GRILLES

Supply air and exhaust air grilles shall be made of non-corrodible material, for example, anodised aluminium section.

Grilles within an occupied space shall be suitable for swab-down cleaning. (Not waterproof).

In mental health patient bedrooms, ceiling-mounted air devices shall be of a secure type.

Air Filtration

6.17.00 FILTERS

The key to selection of filtration equipment is 'appropriate but not excessive'.
Modern dry media filters permit a wide range of media to be fitted to standard frames. Where possible, extended surface filters should be used as they prolong filter life, reduce maintenance costs and reduce energy use. This applies to low efficiency filters as much as to critical applications. This is an area where policy prescription is required as there is a tendency for users to request higher efficiency filters than the application would seem to demand.

Heating, ventilation and air-conditioning systems shall control the concentration of air-borne 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 shall be proportional with the risk.

Filter frames shall be durable and dimensioned to provide an airtight fit with the enclosing ducting. All joints between filter segments and the enclosing ducting shall be fitted with a gasket or sealed to provide a positive seal against air leakage. A manometer is highly recommended to be installed across each filter.

6.17.05 FILTER EFFICIENCY

Additional roughing or pre-filters disposable dry media flat panels type F5 flat are highly recommended to be considered to reduce maintenance required for filters, when efficiency is higher than F7.

Filtration efficiency ratings are based on average efficiency according to AS 1324 - 'Air filters for use in general ventilation and air-conditioning' and AS 4260 – 'High efficiency particulate air (HEPA) filters – Classification, construction and performance'.

6.17.10 AIR FILTRATION SCHEDULE

AREA SERVED	PRE FILTER	MAIN FILTER	FINAL FILTER
Theatres	G4	F8	HEPA**
Category 1 Areas	G4	F8	-
Category 2 Areas	-	F5	-
Category 3 Areas	-	F5*	-

* AS 1668.2 - 2002 specifies filters for ducted supply air systems > 1500 L/s to be F4 filters to AS 1324.1. However, AS 1324.1 lists filters G1 to G4 then F5 to F9 i.e. no F4.

** HEPA filters are subject to Hot DOP testing to AS 4260.

Evaporative Cooling

6.18.00 INTRODUCTION

Evaporative cooling systems have a place in health care buildings. However, there are serious restrictions which must not be ignored.

Geographic Locations: Evaporative cooling is only suitable for hot, dry climates. Broken Hill is a good example. It is quite inappropriate for coastal areas east of the Great Dividing Range. Evaporative Cooling shall only be used west of the Great Dividing Range

Internal Loads: Evaporative cooling is not suitable for areas with high internal latent loads.

Zoning: Evaporative cooling must be applied only when all spaces have similar load profiles.

Relief: Evaporative cooling relies on moving large quantities of air, typically three to five times as much as for air conditioning. Adequately sized relief openings are required if the evaporative cooling system is to be effective.

Heating: Evaporative cooling systems can also be used for heating, but provision must be made for reducing outside air component if reasonable heating costs are to be achieved.

Access: In order to comply with ASNZS 3666, frequent access is required for maintenance inspection and testing. In the case of evaporative coolers mounted above the ground permanent WorkCover Authority approved access is required.

6 .18.05 EVAPORATIVE COOLING

Evaporative Cooling shall only be used west of the Great Dividing Range.

Plant Heat Rejection

6.19.00 VAPOUR COMPRESSION SYSTEM

The vast majority of air conditioning systems employ vapour compressor cycles. They are compact, relatively cheap to buy and have relatively low energy usage. Where possible the ‘waste’ heat rejection from such systems should be used for other functions. This is available either through reverse cycle package systems or by heat recovery from larger chillers. This heat rejection is normally the cheapest form of heating energy available, even on relatively small equipment.

Vapour compression systems should be of the heat recovery or reverse cycle type when economically justified on life cycle cost.

6.19.05 ABSORPTION SYSTEM

Absorption systems typically require five to seven times as much energy as vapour compression equipment. Even with very cheap sources of energy their cost effectiveness is

marginal. They cannot be expected to have a viable life cycle cost unless the heat energy used is 'waste' from some other essential, year round, process. This is never the case in hospitals although it may well be true in certain industrial applications.

Absorption Systems shall not be used unless as a part of total energy plant incorporating power generation.

Full life cycle with analysis is to be provided to substantiate the proposal

Exhaust System

6.20.00 EXHAUST VENTILATION

Exhaust systems shall be provided only when required by code or for life safety.

Systems intended for specific applications such as dissecting should be purpose designed to capture air as close to the source of contamination as possible.

FUNCTIONAL AREA REQUIREMENTS

Operating Suites (Category 1 Area)

6.21.00 SUPPLY AIR

Supply air to Operating Rooms shall be delivered at high level in a way that minimises turbulence and the recirculation of potentially contaminated room air, and provides the cleanest practical air supply over the operating table area. The directions of air flows within Operating Units shall always be from the Operating Room and Set-up Room, through immediately adjacent inner anterooms, Scrub-Up and Anaesthetic Rooms to the Entrance Foyer, Recovery, Changing and post operative Clean-up Rooms - from clean to less clean areas.

Graduated pressurisation relative to pressure in areas adjacent to the Operating Unit ranging from not less than 10 Pascal positive in the Operating Room/s to slightly positive pressure in areas like Entrance Foyer, Recovery and Change Rooms and slightly negative in Clean-up Room/s can be achieved by using carefully balanced supply air and exhaust air systems.

Airflow into the Operating Unit shall be by means of a distribution system that provides a flow of clean supply air over the operating area first then away. Entry of air shall be from the ceiling to deliver a downward air movement with a minimum velocity 0.2 m/s at the level of the operating table.

The barrier effect caused by air movement and not the actual pressure difference is important. As the pressure differentials are relatively small, the preferred method for setting up the air flow is for the total of return and exhaust air to be in the order of 150 l/s to 200 l/s less than supply air with all doors and openings closed. Different designs of Operating Rooms may require some variance in the bleed air quantity. Active control of the pressure difference is not necessary; however, supply air fans are required to be selected so as to maintain constant air quantity as filter resistance increases. This can be achieved by selecting good fan curve characteristics or controls measuring supply air quantity and controlling fan speed to maintain supply air quantity. Air not exhaust or spilled outward from high risk areas may be recycled as return air.

6.21.05 HUMIDITY

Room relative humidity shall be maintained within the range of 30% to 60% relative humidity (RH), except when flammable agents are used, in which case the requirement of AS 1169 (withdrawn) - 'Minimizing of combustion hazards arising from the medical use of flammable anaesthetic agents' – is to maintain relative humidity above 55%. Where humidifiers are used they shall be of the steam type. Limiting humidity range by cooling coil design is acceptable unless there is a specific surgical requirement to warrant precise control of humidity.

6.21.10 TEMPERATURE

The Operating Room temperature shall be adjustable to suit the requirements of the procedure in progress. The temperature adjustment range is highly recommended to be 16 degrees Celsius to 24 degrees Celsius. The proposed function of the room will determine what degree of adjustment is provided. (It is not intended that the system be able to achieve 16ºC on a design day as this will significantly oversize the plant)

To enable individual temperature, infection and odour control, each Operating Room or pair of Operating Rooms shall be served by a dedicated air-conditioning unit which may also serve that Operating Room's adjacent sterile support rooms.

6.21.15 EXHAUST ARRANGEMENTS

Exhaust registers shall be located so that the whole room is effectively scavenged, particularly at floor level. The consultant shall account for the adverse effect (turbulence) of the air flow pattern near the surgical field created by surgical lamps due to their shape, size location and the heat generated by the lamps. Operating Rooms for special procedures such as orthopaedic surgery, organ transplants or total joint replacement may require the provision of an Ultra Clean Air (UCA) system to suit their intended use.

6.21.20 Extraction of relief air and, if incorporated, return air shall be located at low to mid level. Supply air outlets shall be located directly above the operating table. Exhaust / relief air shall be extracted at least in two opposite corners of the operating room to remove anaesthetic gas leakages from the work area whilst ensuring good airflow through the room. Low level exhaust shall be extracted at 200 mm above floor level.
Low level exhaust and other provisions in accordance with AS 1169 (withdrawn), shall generally be provided where flammable anaesthetics are used. Where full provision is not made in accordance with AS 1169 (withdrawn), Operating Rooms shall have a notice, affixed as required, indication that flammable agents must not be used. Further, nitrous oxide shall not be used where low level exhaust is not provided and the range of surgical procedures undertaken in the Operating Room restricted accordingly

Operating rooms where lasers and diathermy equipment are being used shall have adequate suction / evacuation controls for the plume generated. Additionally, overdoor lights shall be included externally to the room indicating ‘Laser in Operation’

6.21.25 DESIGN REQUIREMENTS FOR UCA SYSTEMS

UCA systems shall provide sufficient filtered air moving in the correct direction to efficiently remove the bacteria dispersed by the operating team. The air flowing from the final filter shall contain not more than 0.5 Colony Forming Units per cubic metre of air (CFU/m3).

6.21.30 AIR FLOW

Down flow system: The air flow at one metre from the supply air outlet shall have a minimum average velocity of 0.35m/s and at working height, not less than 0.3m/s.

Cross flow system: The minimum average velocity shall be 0.4m/s measured one metre from the filter or diffuser face.

The siting of the return air grilles shall not cause short circuiting of the supply air. The control instrumentation shall include the indication of:

- Operating status such as 'in use' or 'not in use'
- Terminal filter pressure differential
- System Purging.

6.21.35 Where procedures such as organ transplants justify special designs, installation shall meet performance needs as determined by applicable Australian Standards. These special designs are highly recommended to be reviewed on a case by case basis.

Procedure, Recovery, Delivery and Dental Rooms (Category 1 Area)

6.22.00 Procedure Rooms in which the administration or aspiration of gaseous anaesthetics or analgesics are carried out, shall have adequate ventilation to ensure that the level of gaseous contamination does not rise above a maximum acceptable level. The utilization of a scavenge system is acceptable

Store rooms containing anaesthetic machines shall be ventilated to remove the build-up of nitrous oxide.

Bronchoscopy and Sputum Induction Units (Category 1 Area)

6.23.00 Supply air to Bronchoscopy and Sputum Induction Rooms shall be delivered at a high level in a way that minimises recirculation of potentially contaminated room air and provides the cleanest practical air supply over the procedure area. The directions of air flows within the Procedure Room shall always be from clean to less clean areas.

Total circulated air quantity shall not be less than 12 ACHR when the supply air filters are at their maximum pressure drop of which a minimum of 20% shall be outdoor air. Procedure Rooms and Recovery Rooms shall be maintained at a negative pressure in relation to adjacent areas.

Rooms or booths used for bronchoscopy, sputum Induction, aerosolized pentamidine treatments and other high risk cough-inducing procedures shall be provided with local exhaust ventilation.

Endoscopy Unit Cleaning Facilities (Category 1 Area)

6.24.00 Fully self-contained endoscope cleaning units shall be used to minimize the problems associated with glutaraldehyde fumes. Local exhaust systems shall be provided as necessary to suit the machine.

Fiberoptic endoscopes storage cupboards shall be mechanically vented with an exhaust system to remove glutaraldehyde residuals**.**

Sterile Supply Services (Category 1 Area)

6.25.00 Sterile Supply Services shall be air-conditioned with a minimum of 10 ACHR.

Air movement and ventilation shall achieve a positive airflow from clean to contaminated work areas. Ventilation rates shall be maintained when the zone is not occupied sufficient to ensure dilution rates are maintained.

Isolation Rooms (Category 1 Area)

6.26.00 INTRODUCTION

The two main classes of isolation rooms are:

- Negative pressure rooms for isolating patients capable of transmitting infection by airborne droplet nuclei (Class N) and
- Positive pressure rooms for isolating immuno-compromised patients, who are susceptible to infection (Class P).

6.26.05 GENERAL

Isolation rooms are to comply with the requirements of AS 1668.2.

The ventilation air flow rate shall be not less than 12 air changes per hour or 145 litres per sec, whichever is greater.

Both the supply and exhaust ventilation systems to isolation rooms shall be either separate independent systems for each room or shall incorporate controls to prevent the possibility of cross contamination in the event of a fan failure.
Provide pressure instrumentation, local alarms and monitor fan status.

Ensure that rooms are well sealed to enable the pressure differentials to be maintained.

6.26.10 INFECTIOUS ISOLATION ROOM (Negative Pressure – Class N)

Infectious isolation rooms shall be mechanically exhausted to atmosphere.

Air flow pattern shall be from the health care worker towards the patient with exhaust at low level.

Exhaust duct to be under negative pressure where it runs through the building.

6.26.15 PROTECTIVE ISOLATION ROOMS (Positive Pressure, Class P)

Consult with the health care facility planners for advice on the level of protection and air filtration required.

Pathology, Autopsy and Body Holding. (Category 1 Area)

6.27.00 Systems serving Pathology Areas shall be independent of other systems.

Exhaust from these areas shall be designed not to create any harmful effect to occupants or contamination or to any adjacent areas.

Supply air and exhaust serving autopsy and dissection areas shall be designed to protect personnel undertaking procedures and be discharged in a manner that will not contaminate any adjacent area or system.

Requirements for facilities that conduct autopsies include:

- Single pass air-conditioning utilising 100% exhaust of all air exhaust intakes arranged to provide maximum fume and odour removal with protection of personnel
- Operating the room at negative pressure in relation to adjacent areas
- If necessary, exhaust air to be filtered and odours removed with carbon filters
- Installation of down-draught or back-draught exhaust
- Exhaust system to suit the requirements of the specialist autopsy table.

Note: The above is for facilities which undertake regular autopsies.

Pharmacy – Additive and Cytotoxic Suites (Category 1 Area)

6.28.00 Laboratory and Dispensing Areas in Pharmacy shall be investigated for the necessity to control air flow and exhaust to avoid any possibility of contamination to any adjacent areas.

Cytotoxic Suites shall be designed and constructed in accordance with AS 2639 ‘Laminar flow cytotoxic drug safety cabinets – Installation and use’. The basic design shall be that of a Class 350 Cleanroom varied in accordance with the requirements of AS 2639.

Laboratories and Clean Rooms

6.29.00 Laboratory Areas and Dispensing Areas in Pharmacy shall be designed to comply with AS/NZS 2982.1 – Laboratory design and construction – General requirements, and AS/NZS 2243.8 – Safety in Laboratories – Fume cupboards.

Physical Containment (PC) laboratories shall be designed and constructed according to the requirements of the Genetic Manipulation Advisory Committee publication 'Guidelines for

Small Scale Genetic Manipulation Work' when any work involving genetic manipulation is undertaken.

Dark Rooms and Film Processing Areas

6.30.00 Air spill shall not occur from the Dark Room to adjacent spaces. Dark Room exhaust shall balance or exceed supply and shall be balanced considering equipment-connected exhaust systems. Note some X-ray processors installed through dark room walls have special pressure requirements.

Daylight processing equipment shall be provided with adequate local exhaust ventilation to prevent the uncontrolled escape of chemical emissions. Fumes or potentially contaminated air shall be exhausted to outside air and not recirculated.

Special ventilation requirements shall be dependent upon the type of film processor (automatic or manual) to be installed in Dark Room, Processing and Viewing Areas. Adequate ventilation is required to contain the uncontrolled spread of fumes from potentially harmful chemicals into occupied spaces.

Through-the-wall processors require local exhaust ventilation to each side of the wall. Most processors also require indirect connection of the drier fan discharge to an exhaust system, in addition to general room exhaust for fumes emitted from stored chemicals and the machine cleaning process. Ventilation shall be provided to film processors in accordance with the manufacturers' recommendations.

If remote chemical mixing, reticulated chemical supply and silver reclaiming is utilised, the chemical mixing tank or silver reclaiming unit shall be contained within a ducted enclosure, connected to an exhaust system as described above.

Local exhaust ventilation shall be provided above sink units used in connection with the regular cleaning of X-ray processor equipment components.

Work areas and enclosures used in connection with the manual processing of x-ray film such as dental clinics, shall be provided with dilution ventilation and temperature controls to prevent the build up of fumes.

Vapour emissions from tundishes into which liquid photographic waste discharges shall be controlled.

Ducts that penetrate construction intended to protect against X-ray, magnetic, Radio Frequency Interference, or other radiation shall not impair the effectiveness of the shielding protection.

Podiatry, Prosthetics, Dental & Orthodontic Workshops

6.31.00 Fresh air, ventilation and air-conditioning systems shall be provided with a minimum supply air quantity of 20 litres per second per square metre of facility floor space.

Extraction shall be localised as close as practicable to the sources of contamination identified above.

Exhausts from this area shall be suitably filtered and discharged in a manner that will not contaminate any adjacent area or system.

Capture velocities at the point of localised extraction shall exceed 2 m/s.

Consideration is highly recommended to be given to acoustics to prevent noise nuisance.

Fume cupboards complying with AS/NZS 2243 - Safety in Laboratories - Fume cupboards, shall be installed in chemical mixing areas.

Linen Processing Areas

6.32.00 Air filtration, mechanical ventilation and air-conditioning systems servicing linen processing areas shall be designed to ensure appropriate lint and dust control.

Mechanical ventilation systems shall be designed to remove the heat generated by laundry drying processes utilising systems such as exhaust registers over the dryers or dryers ducted direct to outside air with lint collection provision on all exhaust discharges.

Provision shall be made for regular maintenance to prevent the excessive build up of lint which can be the source of a fire hazard.

Spot cooling with air-conditioned or evaporative cooled supply air is highly recommended to be considered to provide adequate operator comfort in laundries.

Linen Store Areas

6.33.00 Ventilation shall be provided in accordance with AS 1668.2 - Mechanical ventilation for acceptable indoor-air quality

Soiled linen rooms shall be exhausted through a dedicated exhaust system to reduce the risk of cross infection.

The Clean Linen Store shall be supplied with clean, filtered air. Air pressure shall be positive in respect to the rest of the Laundry.

Mental Health Units

6.34.00 Consideration shall be given to the type of heating and cooling units, ventilation outlets, and equipment installed in patient-occupied areas of Mental Health Units. Special purpose equipment designed for psychiatric or prison use shall be used to minimise opportunities for self harm. The following shall apply:

- All air grilles and diffusers shall be of a type that prohibits the insertion of foreign objects
- All exposed fasteners shall be tamper-resistant
- All convector or HVAC enclosures exposed in the room shall be constructed with rounded corners and shall have closures fastened with tamper-resistant screws
- HVAC equipment shall be of a type that minimises the need for maintenance within the room.

MEDICAL GASES

Introduction

6.35.00 The cost of medical gases within hospitals is proportional to the total number of points provided. The main area for cost reduction is in the number of gas points. Commissioning and sign-off is usually in the presence of senior anaesthetist of the hospital.

Medical Gases Outlets

6.36.00 Medical Gas outlets shall be minimised with requirements established at briefing stage.

Allowance shall be in accordance with the latest Health Facility Guidelines. Any departure from AS 2896 to be justified in terms of a demonstrated clinical service need.

Medical gas provisions to Critical Care Areas as defined in Section 2.0 DP13 shall be as follows for each patient bay:

- Two (2) oxygen
- Three (3) suction (one low, two high)

- One (1) medical air
- One (1) nitrous oxide if appropriate on clinical need.
- One (1) scavenging if appropriate

Suction

6.37.00 Two basic methods of producing suction are available. The first is to use a central vacuum pump and vacuum reticulation supply to all outlets. In this all discharges are centralised and filtered before entering the atmosphere.

The alternative system is venturi powered suction outlets in which compressed medical air is used as the energy source for producing the suction. Each outlet must be provided with a separate vent pipe discharging to atmosphere. Venturi suction outlets require frequent maintenance and use an expensive energy source (medical air).

In addition to the cost savings, the central vacuum system is more desirable from an infection control perspective as all discharges are filtered.

Suction shall be from central vacuum system. Comply with AS 2896.

Medical Air

6.38.00 With critical appraisal, many medical air outlets could be eliminated. The change from venturi suction and rationalisation of the number of points would see drastic reductions in the size and cost of central medical air plant.
Reticulation to patient care areas should be reduced to a minimum and only installed where a clinical service need can be demonstrated.

If medical air is to be produced on site the installation must comply with AS 2896.

Medical air supplied for life support systems must be maintained for medical use only.

Tool Gas

6.39.00

Comply with A.S 2896

Although high-pressure medical tool gas can be derived from compressors, the relatively low usage does not justify the high maintenance costs of these compressors. Bottled gas, located close to the theatres, offers the most economic and simple solution.

Refer to M15.5.2 Tool Gas

Tool gas shall be from bottled manifold located near the supply need.

Nitrous Oxide

6.40.00

Comply with A.S 2896

Savings in the provision of this gas largely relate to reduction in the number of outlets and reduction in reticulation costs by locating the manifolds close to the areas of use. It is not unusual to see hospitals where nitrous oxide manifolds are located adjacent to the oxygen store, when the main demand is in Maternity which is located at the opposite extreme of the hospital.

Nitrous Oxide, if required, shall be reticulated from a manifold located adjacent to the point of use.

When nitrous oxide is being used to provide sedation, an appropriate method for scavenging of expired gases shall be provided by connection of appropriate scavenging adaptors to the suction system. It is highly recommended that the risk of chronic exposure to nitrous oxide be

considered.

Reticulation

6.41.00 It is highly recommended that each medical gas outlet emanates from a central storage or generation point and is reticulated to outlets throughout the hospital.

Medical oxygen, compressed air and nitrous oxide multi-bottle storage manifolds shall be arranged in a 'Duty' and 'Reserve' configuration incorporating automatic change-over facility. It is highly recommended that:

- Each manifold include sufficient bottle storage to meet two days demand with additional bottles held in storage to meet three days or holiday period demand and
- All medical gas bottle manifolds are sited adjacent to each other in a location which facilitates ease of access for bottle delivery and pick-up.

The medical gases installation shall incorporate appropriate low and high pressure audible and visual alarms for each medical gas system and vacuum system 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 manned location such as the Emergency Unit with slave panels sited in critical areas such as Operating Unit and Intensive Care Unit. Alternatively, an independent alarm panel can be provided for Operating Unit and Intensive Care Unit. These panels would sense pressures in gas pipelines serving each respective area by means of pressure switches located downstream of isolation valves.

Readily accessible isolation valves shall be provided in each main gas branch pipe to special areas such as Operating Unit and Intensive Care Unit. Valves shall be located in a wall-mounted dedicated valve box incorporating a clear Perspex cover and suitably labelled.

Patient rooms shall have oxygen and suction from a fully reticulated system. The minimum provision shall be an oxygen and suction point provided to each single bedroom and shared oxygen and suction points between two beds within multiple bedrooms.

An active aspirated gas scavenging system shall be provided where anaesthetic gases are administered. This requirement does not apply to areas where analgesic gases are administered and adequate ventilation is provided.

Vacuum (suction) systems utilising central vacuum is highly recommended to be reticulated to each point, except for suction scavenging points which will scavenge flammable anaesthetic gases or a high content of oxygen. These are highly recommended to utilise Venturi-suction with discharges as per requirements for suction pump discharges in AS 2896 - Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems.

Venturi type suction systems shall not be used in rooms where infection control is required.

Ancillary Mechanical Service

6.42.00 Ancillary Mechanical Services could include the following additional services:

- Dental surgeries
- Sterilizers
- Steam generation systems
- Mortuary equipment
- Pneumatic transport systems
- Compressed air systems for industrial use
- Refrigeration plant (e.g. cool rooms)

Dental System

6.43.00 Dental compressed air shall be designed in accordance with AS 2866 (withdrawn). Dental suction shall be designed in accordance with AS 2686 (withdrawn).

7. HYDRAULIC SERVICES

Introduction

7.1.00 This document outlines the place of Hydraulic Services within hospital design and the philosophy behind the development of the document.

Standards, Codes, Regulations and NSW Health Policy Directives & Circulars

7.2.00 The following documents are applicable to the design and installation of hydraulic services in hospitals:

- AS/NZS 3666 Air Handling and Water Systems of Buildings Microbial Control.

  AS/NZ 3500 series - Plumbing and Drainage.

- New South Wales Government Gazette No. 126 dated July 1999 of New South Wales Code of Practice Plumbing and Drainage. The introduction of requirements where water temperatures exceed 50 deg C at taps, backflow prevention, storage water tanks and expanded range of approved non metallic water pipes for use in potable water supply systems.

- WorkCover Authority of NSW Safety Guide No. 4517 in regard to Thermostatic Mixing Valves installed in Healthcare and Accommodation Industries.

- NSW Health Department Circulars outlining requirements for the provision of cold and heated water. The circulars have both management and operational implications which must be addressed before decisions on the type of hot water generation and system can be decided. Additionally, the circulars describe the type and style of taps to be provided.

- NSW Health Department Policy Directive PD2005 /344 – Requirements for the Provision of Cold and Heated Water

- AS 4032 series - Water supply – Valves for the control of hot water supply temperatures

- Standards Australia of the Standard MP52 requiring all components, plant and equipment installed within cold and hot water piping systems to which potable water supply pipelines connect to be certified.

- Requirements of the Building Code of Australia.

- PCA204 Plumbing Code of Australia 2004.

Glossary of Technical Terms

7.3.00 A Glossary of Technical Terms is in Section 10, Appendix 1 of this document.

Objectives

7.4.00 The objective of this document is to present a common set of criteria for hydraulic services in a format which is accessible both to designers and those who brief designers. In general specific planning procedures and known design criteria have not been addressed.

This document does not cover general subjects which are normally dealt with under ‘good engineering practice’. Designers are to refer to Australian Standards for good practice and statutory regulations for minimum standards. Similarly calculation methods which are available in AS/NZS 3500 and similar codes have not been repeated.

The change in philosophy from minimum standards to recommended standards embodied in

AS/NZS 3500 is now adopted in regulations. Although this document does not alter this approach, it is recommended that future studies be carried out as part of the development of other guidelines with the objective of modifying AS/NZS 3500 to be more relevant to the Health Building environment.

Application

7.5.00 Hydraulic services comprise that work installed by a licensed person in accordance with Statutory Regulations generally known as plumbing and drainage code. Hydraulics services comprise the following:

- Sanitary Drainage
- Sanitary Plumbing
- Trade Waste Plumbing and Drainage
- Trade Waste Pre Treatment
- Grey Water Systems
- Stormwater Systems
- Rising Mains and Pumps
- Fixtures and Fittings
- Water Services (Hot and Cold)
- Gas Services
- Fire Hydrant Systems and Fire Hose Reel System
- Hydrotherapy Pools

Gas services within the scope of hydraulics are limited to reticulated gas such as natural gas or on site liquid petroleum gas storage cylinder with local reticulation.

The requirements of statutory regulations complicate the nature of the water services by requiring further sub groups:

- Domestic cold water
- Domestic hot water
- Domestic warm water (38ºC – 43ºC)
- Flush services
- Non potable cold water
- Non potable hot water
- Ultra pure water
- De-mineralised water
- Legionella free water
- Irrigation system water

General Installation Requirements

7.6.00 Materials shall be selected that are suitable for the specific characteristics of the service being installed. This shall include consideration of parameters such as temperature and concentration of wastes, corrosion, leaching and chemical attack.

Fixed services and maintenance points shall be located in a manner that does not create unacceptable risk or disturbance to patients or staff – including maintenance personnel – and health care procedures.

Service elements such as pipes, isolating valves operating switches and alarms shall be clearly identified.

Location and operation of fixtures shall suit the application and shall not cause a health risk.

Fixtures shall be easily cleaned. Water discharge devices such as flushing tanks and shower roses, shall be selected to enhance water conservation.

Water Supply

7.7.00 SITE WATER SUPPLY

If practicable, it is highly recommended that the water service is supplied from an external ring main and connected at two locations with a valve midway to maintain a continuity of supply in each section of the building should maintenance be required.

Where water quality does not comply with Health – Quality of Drinking Water – Regulations, National Health and Medical Research Council /Australian Water Resources Council 1987 Guidelines or local guidelines, consideration shall be given to providing a water treatment / filtration plant to maintain the integrity of hot water equipment, tapware, specialist health equipment and air-conditioning plant pipework.

Water quality shall not cause risk to patients and shall be suitable for intended medical procedures.

Where water supply is critical, it shall be available at all times.

Where the water supply is reliable, local critical demand shall be satisfied with individual local back-up. Duty and standby pumps shall be designed and installed if the supply system includes pumping.

7.7.05 BACKFLOW PREVENTION AND FILTERS

Backflow prevention devices shall be providing in accordance with AS/NZS 3500 requirements and the Local Authority. They should be located at the meter for site protection and at sources that require zone and individual protection.

Water filters should be installed on the potable water supply to protect sensitive components used in TMVs and sensor-operated tapware.

7.7.10 METERING

Water meters shall be provided for each site connection. Meters will be read by the water authority to charge the site. In addition to this authority's meter, a number of sub meters to monitor water consumption shall be installed. These meters shall be installed at cooling towers, kitchens, separated buildings, external irrigation systems, laboratories, hot water systems, tank outlets and any other areas where water consumption greater than 20KL per day will occur. All meters shall be capable of providing a pulse outlet. Backflow protection shall be installed as required by relevant codes such as AS/NZS 3500 as a minimum.

7.7.15 SITE RETICULATION

Where possible, locate reticulation pipes in below-floor voids at ground floor level and in ceiling or roof spaces, clear of mechanical equipment with droppers connected to the sanitary fixtures and equipment. Where slab on ground construction is utilized, install pipework in spaces at upper floor levels and ceiling spaces.

Avoid locating pipework over inpatient areas and other areas that could be adversely affected by noise generated in water pipes. Hot and cold water pipes shall be separated by enough distance to avoid heat transfer. Hydraulic services shall not be located above electrical services and Operating Theatres.

Avoid copper pipes in or below ground concrete slabs.

Avoid flusherette services and in-wall cisterns.

Do not design for 10mm diameter copper tube to single fixtures.

Water velocities up to 1.5 metres per second are acceptable at maximum peak demand.

Consideration of probable demand shall be exercised where two fixtures in the same room

space will be used by one person only; such flow rates shall be taken as a single fixture only.

Where water quality is known to be corrosive to copper tube, plastic pipe materials such as cross linked polyethylene or polypropylene random could be provided.

Water supply systems shall be adequately zoned and isolated to provide local safety shut downs whilst maintaining maximum availability. Isolation valves are highly recommended to be located on the service lines to individual fixtures or group of fixtures.

Single fixture or zone backflow prevention devices shall be designed to comply with AS/NZS 3500.1 – Water supply. Vacuum breakers shall be installed in hose bibs and supply nozzles used for connection of hoses or tubing in laboratories, cleaner's sinks, bedpan-flushing attachments and autopsy tables.

To prevent condensation, closed cell foam insulation shall be installed on pipework where dew point can be reached. Insulation shall have a continuous vapour barrier.

All isolation valves for hydraulic services shall have permanently fixed brass identification discs. Discs shall be clearly permanently engraved to identify the item.

When the service plan includes haemo-dialysis, continuously circulated filtered cold water shall be provided.

7.7.20 WATER STORAGE

Cold water storage shall be provided only in those instances where the public utility main is inadequate to supply the hospital complex.

Where main supplies are doubtful, storage shall be based on 3 hour supply based on a consumption of 1000 litres per bed per day.

Where practicable, administration buildings and non-essential facilities shall be excluded from storage facilities.

Where storage tanks are required, they shall be separated into two 50% sections each capable of separate drain down and cleaning without system shut down.

Precast round storage tanks shall be considered for external or roof mounted use.

All tanks shall be fitted with close fitting lids. Overflow shall be provided with flap valves. Ball float valves shall be of a non hydraulic shock type.

Attention is drawn to solar gain on exposed tanks.

Where hot water is stored in commercially produced mains or reduced pressure vessels, preference shall be given to stainless steel as an alternative to enamelled mild steel.

Domestic Hot and Warm Water Systems

7.8.00 DOMESTIC HOT WATER

System design generally shall comply with AS 3500.4 - Hot water supply systems.

A minimum of two hot water units is required to be installed in each main system. Remote point of use type systems may utilise a single unit.

Care is required in assessing domestic hot water requirement. This particularly applies to storage capacity and regeneration of hot water for outlets supplied in a Health Care Building.

Hot water piping is highly recommended to be arranged in a ring main or a number of ring mains and incorporate a hot water return pipe.

Branch pipework to individual outlets or groups of outlets shall not exceed three metres for 15 mm diameter pipe in order to minimise deadlegs. Each branch shall be equipped with an

isolation valve for maintenance purposes located adjacent to the cold water supply branch isolation valve serving the same outlets.

Hot water supply to areas such as Dirty Utilities is required to be separated from the remainder of the hot water system using approved back-flow preventers.

Central hot-water distribution systems serving patient care areas shall have a flow and return to provide continuous hot water at each hot water outlet.

Circulation pumping shall be designed and installed with both a duty and stand-by pump. Calorifiers shall be of a failsafe design.

7.8.05 WARM WATER SYSTEMS

Warm water systems shall either be centralised circulating systems or thermostatic mixing valve systems connected to the domestic hot water system and cold water supply.

Generally branch services to sanitary fixtures to which patients have access shall be provided with warm water in accordance with the current NSW Health Circular. (2002/10)

7.8.10 THERMOSTATIC MIXING VALVE (TMV)

Thermostatic mixing valve (TMV) designs shall comply to AS 4032 series - Water supply – Valves for the control of hot water supply temperatures, and installation shall comply to AS 3500.4 - Hot water supply systems.

The inlet hot water temperature to TMVs shall not exceed the recommendation of TMV manufacturers.

Where concealed, TMVs shall be identified with clear signage in a visible location to ensure servicing is carried out.

TMVs shall be mounted at a maximum height of 1.6 metres from the floor slab for maintenance purposes.

Tempering valves shall not be used.

7.8.15 CENTRALISED WARM WATER SYSTEMS

Centralised plant warm water systems which are approved for use in the Health Care Facilities may be considered as an alternative to thermostatic mixing valves where a cost advantage can be demonstrated after consideration of both capital cost and maintenance routines required by NSW Health Circulars.

Circulation-type warm water systems are approved by NSW Health.

A decision to design piped warm water rather than TMVs should only be taken after consultation with management of the Health Care Building.

Factors which should be considered in the decision would be:

- Capital costs of each system to create warm water;
- Proposed method of disinfection and associated costs;
- Maintenance costs of the systems for plant, valves and disinfection;
- System monitoring, testing and data recording costs.

Heat Recovery

7.9.00 A number of mechanical systems provide large quantities of ‘waste heat’ - that is - heat which would normally be rejected to atmosphere. This heat can potentially be used for heating domestic hot water or warm water with resulting energy savings.

Principal among these is the central chilled water plant in which waste heat at certain times of the year far exceeds the potential for its use in domestic and space heating. Depending on the

type of chiller used, heat may be available at up to 55ºC. As such it is suitable for preheating of water for domestic use.
Refrigeration plant, principally kitchen cool rooms, may also be adapted to provide waste heat for domestic hot water pre-heat. As with chilled water plant temperature limits apply.

General Reticulation Requirements

7.10.00 DESIGN PRESSURE

The design of water piping systems shall achieve 50kPa minimum water pressure when taps are fully open and a maximum water pressure of 500kPa when taps are fully open.

7.10.05 PIPING RETICULATION

Pipe sizing shall be calculated allowing for domestic hot water or warm water draw off loads to all sanitary fixtures utilising an accepted diversity factor based on recommended probability of simultaneous use.

Thermal insulation shall be provided to all circulating water pipe work.

Sanitary Plumbing and Drainage

7.11.00 GENERAL

Drain pipes shall be designed and installed to comply with AS 3500.2 - Sanitary plumbing and sanitary drainage

Gravity drain systems shall be installed wherever possible. If pumping systems for the disposal of sewerage or effluent are installed they shall be installed in duplicate and shall be connected to the hospital standby generator power supply. Alternatively, the systems shall incorporate a minimum of four (4) hour storage in the event of disruption in normal power supply.

Drain pipes shall be designed and installed to suit the waste carried and the temperature of waste. Where possible, it is highly recommended that ipipework is concealed and vents are interconnected in roof or ceiling spaces to reduce the number of roof penetrations.

It is highly recommended that drainage piping is not installed within the ceiling or exposed in operating and delivery rooms, nurseries, food preparation areas, food serving facilities, food storage areas, computer centres and other sensitive areas. Where exposed overhead drainage piping in these areas is unavoidable, special provisions shall be made to protect the space below from leakage, condensation or dust particles.

Inspection and cleaning openings shall be positioned external to the building fabric. Where this is not possible, inspection and cleaning openings shall be positioned in ducts or within the wet areas it serves. Inspection and cleaning openings shall not be positioned in ceiling spaces.

Access pits suitable for cleaning and pumping out are recommended in service areas rather than cleanout openings within pipes and junctions. Access pits are highly recommended to be located adjacent to vehicular access.

Waste water systems access covers, inspection openings and inspection chamber covers shall not be located within high risk areas, within functional areas.nor pass through walls and ceiling spaces of patient rooms and treatment rooms.

Floor drainage grates shall not be installed in the clean area of a Sterile Supply Unit or treatment area. It is highly recommended that floor drains are rationalised to an absolute minimum due to their ability to harbour bacteria.

Mixing of chemicals wastes that result in fume emissions shall take place within a vented drainage system and not at a common tundish.

Drain liners serving automatic blood-cell counters shall be carefully selected to eliminate the potential for undesirable chemical reactions (and/or explosions) between sodium azide wastes and copper, lead, brass, and solder.

Connect mechanical plant equipment drains to the sewage system, in particular, plant which discharges water containing chemicals. Drains from fan coil and air handling units may discharge to sewer.

Sanitary Fixtures

7.12.00 INTRODUCTION

Sanitary fixtures constitute a major cost component of hydraulic services and should be selected to achieve the following criteria:

- Function
- Aesthetics
- Durability
- Vandal and Breakage Resistance (to the degree possible)
- Clean lines
- Sealed to wall and floor surfaces
- Ongoing availability of parts and services

Selection of sanitary fixtures is usually made by the architect in consultation with the Client and Hydraulics Consultant for special hospital-type fixtures. Poor choice of fixtures can add significantly to the total cost of hydraulic services without enhancing their function. This particularly applies to selections made on appearance criteria rather than function. For example choosing a non-white fixture can double its price compared with standard white.

7.12.05 SELECTION CRITERIA

Sanitary fixtures shall be selected on the following criteria:

Hygiene:
That is ease of cleaning and potential for holding infectious material. Cleaning costs are a major component of hospital operating costs and fixtures which are time consuming to clean add significantly to this.

Durability:
In general, most domestic standard fixtures are of adequate durability for hospital applications. Exceptions to this are non-ceramic materials (e.g. plastic and fibreglass) where the potential for damage by cleaning with abrasives may require additional management control.

Suitability for Function:
Quite clearly the fixture must be suitable for its function. Beyond meeting their basic function, additional enhancements must be demonstrated to be necessary on a clinical need basis.

Colour:
Only white fixtures (not coloured) shall be selected.

Cost:
Where the above criteria are met, selection between alternatives shall be on the basis of lowest capital cost.

7.12.10 WC PANS

WC pans shall be pedestal type with a flush-to-floor concealed trap connection and shall be suitable for disabled persons use in compliance with Australian Standards.

Only when justified by cost analyses are wall hung WC pans or wall flush back pans acceptable.

WC pans shall be provided with white open front seats (mixed sex use) where appropriate, constructed of solid section, high quality, scratch resistant thermosetting plastic with soft close hinges. Seat covers shall only be provided to W.C. pans located in shower rooms or bathrooms.

WC pans shall be provided with cisterns and dual flushing buttons, pads or levers. Concealed in-wall cisterns shall only be provided where architectural constraints demand Flushing valves (either tank or mains-fed) shall be subject to cost justification.

7.12.15 PATIENT & PUBLIC USE BASINS

Basins for use by patients and the public shall be selected on the basis of the total cost to install including the cost of any associated supports, vanity etc; In general on stud walls.

Patient-use basins shall be simple support vanity type with wall-mounted cocks with self-draining spout. On masonry walls, wall-hung basins may be cost effective.

Basin shall be provided with 40mm chrome plate 'P' trap with in-wall waste pipe. Integral trap basins shall be not be used except in disabled persons toilets.

Subject to economic justification, single lever pillar taps may be used.

Supplies to taps shall be colour coded.

-	Yellow:	Warm Water	38ºC – 43.5ºC
-	Blue:	Cold	15ºC
-	Red:	Hot Water	50ºC and above (Not for use in patient care areas)

7.12.20 SCRUB (SURGEONS) BASINS

Scrub basins are expensive and shall only be installed where a demonstrated clinical need for scrub facilities exists. Scrub basins shall be supported from masonry or suitably reinforced stud wall construction. Scrub taps shall be elbow action or knee action with wall mounted self draining spout. Temperature controlled water shall be provided in accordance with warm water practice.

7.12.25 SCRUB TROUGHS

Scrub troughs (refer AS 1756 – Household sinks) shall be fabricated from stainless steel Grade 302 1.2mm thick to Dept of Commerce, New South Wales standard design.

Scrub troughs shall be provided with single lever down cast spray elbow action taps, knee operated or sensor taps. Client request for knee- operated or sensor taps may be approved if justified. These shall be supplied from a temperature adjustable thermostatic mixer valve.

Only where clinical justification can be established shall hands free proximity switch or similarly activated sprays be provided. Where provided, such taps shall incorporate a timer and TMV temperature control and be of modular electronic design suitable for easy component replacement.

7.12.30 SHOWERS

Showers shall be provided with slide rail telephone-type handsets and flexible hose. Slide rails shall be 32 mm stainless steel securely fixed as a grab rail. Hoses shall extend 1800 from wall mounting and terminate not less than 150mm above the flood level of the shower floor. Telephone handsets should be impact resistant. White plastic hoses shall be minimum 15mm. reinforced plastic material.

Particular attention is directed to sealing shower outlets effectively to a continuous water proof membrane which shall prevent the transmission of water via the interface between floor waste risers passing through floors.

The floor of en suite rooms shall be graded from door of room to floor waste outlet. At an early stage of planning, incorporate a set down into concrete floor so that provision is made for graded floor.

7.12.35 SINKS

Sinks shall be constructed of stainless steel with wall-mounted taps and local isolation taps.

Sinks for domestic applications of a non-medical nature shall be standard commercial products.

Non standard fabricated stainless steel sinks may be provided only in kitchens or where a clinical need can be demonstrated.

Sinks shall be complete with stainless steel on plastic 50 mm waste outlets. Provide loose fitting plastic plug.

Where appropriate, provide lever action single mixer tap rather than hot and cold sink set taps.

7.12.40 URINALS

Wall hung ceramic urinals with manual cisterns shall be used in preference to stainless steel urinals or electronic flushing devices. Stand on grate stainless steel urinals shall not be used. Automatic urinal flush cisterns shall not be used.

7.12.45 BATHS

Baths shall be constructed of thermoplastic and shall have wall mounted cocks.

Flow rates to baths shall allow a quick fill time (20mm inlet outlet cocks and services shall be provided).

Cleaning regimes shall utilise non abrasive cleaning materials.

7.12.50 FLOW CONTROL

Water conservation by terminal fitting flow control is considered highly important to water quantities used by Health Facility Buildings at fixtures which provide a continuous flow such as showers and basins. Where a filled fixture (eg bath or pot sink) is provided, it is important that the fill time is not increased by flow control.

Shower Flow Rates
Water flow to showers shall be determined by flow required from selected shower outlet for 10 minute duration.

Diversity of flow shall be applied to the number of showers in the Building.

7.12.55 ISOLATION

Provide individual isolation where the architectural layout is such that group isolation to basins is not economical. Individual mini taps shall be used for hot and cold service flow control where required.

Trade Waste

7.13.00 INTRODUCTION

Trade waste (liquid) is usually that waste (waste water) which is discharged to public sewers from industrial or commercial processes. It is liquid containing substances used in the manufacture or processing of food preparation or industrial process but does not include domestic waste water from showers, water closets, basins and sinks.

The type of liquid waste should be identified and reference made to the Water Authority Standards. Wastes which are not acceptable for direct discharge to sewer mains should be identified and a method incorporated in the design that will treat or break down the strength or temperature of the liquid waste so that compliance with the Water Authority Standards is achieved.

The authority which controls the treatment and disposal of liquid waste products will impose maximum standards of contamination or standards of acceptance. These standards apply to all waste products discharged to the disposal system, usually the sewer. In addition the authorities may charge the user for the quantity and quality of trade waste discharged in order to recover the cost of treatment.
In each case of anticipated trade waste discharge, the regulatory authority (Water Board or Shire Council) must be approached with the anticipated discharge.

The information on discharges is provided by the users and it is essential that they establish as accurately as possible the quantities and concentration of anticipated pollutants. It is important to note that investigation into the work practices and methods used by the hospital must be undertaken to accurately estimate the type, volume and nature of waste products intended to be disposed of by means of the sewer.

7.13.05 WASTE CATEGORISATION

One way of reducing the level of pollutant discharge to sewer is by on site pre treatment plant. The types of pollutant that 'on site' pre treatment plants will remove, dilute, neutralise or arrest are:

Type of Pollutant	Example	Department Producing Pollutant
Floatable	Grease	Kitchen
Suspended	Solids	Plaster Room, Mortuary
Chemical	By-Products	Laboratory, Hydrotherapy Pool
Thermal	Heat	Sterilisers
Biological	Dangerous Pathogens	Laboratories, Mortuary
Toxic Products	Cyanide, Metal Trace Elements	Laboratories, Medical Imaging, Oncology, Endoscopy
Active Products	Radioactive Waste	Nuclear Medicine
Biochemical Oxygen Demand (BOD)	Degradation	Laundry, Animal House, Kitchen

7.13.10 ALTERNATIVE APPROACHES TO PRE-TREATMENT

Assumptions should not be made regarding the type and strength of liquid waste that may be generated from areas of health facilities. At scheme design stage of planning, it is advisable to obtain written statements from users regarding the frequency, quantity and strength of liquid tradewaste which may be generated and ask the Water Authority for an opinion regarding appropriate method of treatment. Liquid tradewaste treatment may be assumed and it may not be necessary.

Hospitals and other users have a number of options for meeting the standards for trade waste discharges set by the regulatory authorities. These are:

1. Eliminate or minimise the waste
2. Pre-treat the waste before discharge to sewer.
3. Reduce the concentration of contaminants to acceptable levels.
4. Separate the waste and have it removed from the site by other means (usually contractor)

Of these, 1 and 4 are management issues and must be considered at planning stage before the alternatives are incorporated in the design. As with many other issues these are amenable to objective analysis using techniques such as life cycle costing. An example of this approach would be to compare the costs and merits of on-site silver recovery from medical imaging processes with collection and removal by a contractor for off site recovery and treatment.

Consideration should be given under item 3 above to the minimisation of processes and the use of products which are trade waste generators. For example cooking arrangements should minimise the use of oil and fats. Where possible recovery of such cooking by-products should be at the point of origin rather than by removal from waste water.

As part of the scheme design phase of the project a 'Waste Audit' should be undertaken for all types of waste (solid or liquid). The audit can then be used to assist in deciding the most appropriate ways of dealing with the waste**.**

7.13.15 REGULATORY STANDARDS

Each water authority may establish its own standards. It is the responsibility of designers to obtain the current standards from the authority having jurisdiction over the site.
The following may not be disposed of to the sewerage system:

- Hypodermic needles
- Syringes
- Instruments
- Utensils Swabs
- Dressings
- Bandages paper or plastic items
- Any portions of human or animal anatomy
- Infectious and solid waste subject to agreement of the regulation authority.

7.13.20 ORGANIC POLLUTANTS

SUBSTANCE	1991 STANDARDS	1994 STANDARDS
BOD	Acceptance standards to be determined by the treatment capacity of the receiving sewer system.	Acceptance standards to be determined by the treatment capacity of the receiving sewer system.
Grease	As above	50 mg/l
Beach Grease	100 mg/l	5 mg/l
Sulphate	Acceptance standards to be determined by the treatment capacity of the receiving sewer system.	200 mg/l
Suspended Solids	Acceptance standards to be determined by the treatment capacity of the receiving sewer system.	1500 mg/l

7.13.25 INORGANIC POLLUTANTS

POLLUTANT	PRIMARY TREATMENT SEWAGE PLANT	SECONDARY / TERTIARY SEWAGE TREATMENT PLANT	1994 STANDARD PROPOSED
Barium	20 mg/l	20 mg/l	2 mg/l
Mercury	0.05 mg/l	0.05 mg/l	0.03 mg/l
Copper	10 mg/l	5 mg/l	5 mg/l
Lead	10 mg/l	10 mg/l	2 mg/l
Iron	100 mg/l	100 mg/l	50 mg/l
Silver	2 mg/l	2 mg/l	2 mg/l
Selenium	5 mg/l	5 mg/l	5 mg/l
Cadmium	5 mg/l	5 mg/l	1 mg/l
Ammonia	200 mg/l	100 mg/l	50 mg/l
Phosphorus	N/A	50 mg/l	50 mg/l
Formaldehyde	50 mg/l	50 mg/l	5 mg/l
Nitrogen	N/A	200 mg/l	50 mg/l

7.13.30 GREASE AND PLASTER TRAPS

Grease will remain in suspension in water at temperatures in the order of 38ºC and above.

The purpose of the grease trap is to cool the kitchen waste to a point where the grease separates from the main body of waste water and remains as a removable floating substance on the water surface.

Where pre-cooked meals are produced off site and re-constituted on site the provision for grease treatment shall be adjusted in accordance with the on site load. Should washing up be undertaken on site and cooking off site, grease trap provisions related to 50% of full load

calculations shall be offered to authorities for negotiation and approval.

Grease traps may be constructed of pre-cast or cast in situ concrete, galvanised mild steel plate, fibreglass or stainless steel. Grease traps generate corrosive fumes which attack copper and must be ventilated.
Grease traps shall be located on site in a position accessible from outside of the building without need to interrupt any services and which is easily accessible for tanker vehicle access.

It is preferable to avoid pumps, but a permanent pump-out pipe link to a disposal point may be provided if no alternative exists. Pumps should be a positive displacement helical screw type. Mobile pump arrangements provided by the cleaning service are preferred to in-house pump systems. Where practicable above ground galvanised mild steel grease traps should be considered because of their superior thermal performance.

Plaster traps shall have easy access for emptying and cleaning. They should be located outside the treatment room or should be accessible from outside the room. Servicing should be able to be carried out with minimum disruption.

Trade waste substances intended to be disposed via sewer systems should be reviewed to determine if there are alternative ways of removal from buildings.

Selection of pipe materials, jointing type and processes should be carefully selected so that material will not deteriorate by conveying the proposed waste. Recommendations of Australian Standards, NSW Code of Practice, Plumbing and Drainage and Manufacturers should be followed to ensure long life of the selected pipe material.

All pre-treatment waste systems such as dilution pits, arresters and strainer baskets shall be located in the service / dirty zones of the department if the system cannot be installed externally.

Photographic Waste

7.14.00 GENERAL

Photographic processing including x-ray processing is a significant source of trade waste.

This waste may include a large quantity of metals including iron and silver. A range of chemicals is used in the processing of film and paper. The chemicals contribute to two types of liquid wastes - spent photographic chemicals and contaminated rinse waters. The following are found in photographic waste:

Silver:
Treatment of photographic waste should be aimed at collecting the easily recoverable silver by collection service or by on-site processing. Silver is found in film and photographic paper; also in ‘spent’ fixer and bleach fix.

Sulphate:
Corrodes concrete sewer pipes and can produce hydrogen sulphide, a dangerous gas.

Sulphite:
Consumes dissolved oxygen in sewage leading to anaerobic conditions and odours.

Ammonia:
High concentration of ammonia may pose an occupational health risk to sewer workers. Ammonia may also corrode copper pipes.

7.14.05 PIPE SYSTEM

Photographic wastes corrode copper pipes which must not be used to convey trade waste products. UPVC is the preferred material.

Fixer and developer shall not be discharged directly to the sewer. They shall be collected and treated by on-site processor or taken off site to be treated by an authorised waste disposal agent.

7.14.10 HOUSE KEEPING

'House keeping' refers to activities and practices which minimise the amount of waste generated. There are a number of housekeeping practices which are applicable to photo processing.

Reducing the amount of water used has a number of benefits. It will save on water as well as reducing the pollutants in waste. Equipment used in the industry is becoming more sophisticated. Some processing machines do not use water at all, whilst older ones use too much water. Machines that use water should be checked to determine if they are using too much.

Limit the amount of chemicals used. Chemicals are relatively inexpensive to buy, but their disposal is expensive.

Look for alternative products which do not include ammonia. There are a number of chemicals available which are made with alternative substances. Consider regeneration of spent chemicals on site instead of disposal. Consider the use of non-bromide-based materials.

X-ray processing plant should include a wash-water limiter or control system on any water wash processor. This will ensure that water is used only when film is being processed, and that only the minimum amount required is used.

7.14.15 SILVER RECOVERY

Install a suitable silver recovery system or make appropriate collection arrangements.

Where a collection system is employed, fixer and developer shall be collected and stored for off-site treatment and disposal.

Where a silver recovery system is employed, in shall be in accordance with the trade waste agreement and all spent solution that contains silver (such as bleach fix) must pass through this system and into a dilution tank.

7.14.20 BALANCING TANK/PIT

After the waste water has passed through the silver recovery unit, it must go into a balancing tank/pit. All other photographic waste must also go into this tank, including all water from washing baths and tanks. The nature of photographic waste allows a cancelling out or neutralisation of wastes to occur in the tank. This makes sure that a concentrated waste does not enter the sewer in one peak load.

The balancing tank should meet the following volume criteria for x-ray developing with a minimum of 1 hour retention:

Hospitals & Specialist X-Ray - Minimum Size	200 litres
Medical Centres with X-Ray Service - Minimum Size	100 litres
Dentists and other small practices - Minimum Size	50 litres

Stormwater Drainage

7.15.00 AUSTRALIAN STANDARD

Storm water system design generally shall comply with AS/NZS 3500.3 – Stormwater Drainage as referred to in the BCA and Local Authority by-laws.

7.15.05 STORMWATER DETENTION

Where required by the Local Authority, a stormwater drainage system that will collect roof water and surface water runoff in accordance with Local Council requirements shall be installed. Stormwater is to flow through a series of pipelines and pits, then treated for impurities before being processed through an on-site stormwater detention basin. The stormwater then discharges into Council's system for the area.

7.15.10 STORMWATER RETENTION

Where required by the Local Authority, a stormwater drainage system that will collect roof water and surface water runoff in accordance with Local Council requirements shall be installed. The stormwater is to flow through a series of pipelines and pits, and then treated for impurities, before infiltration into a number of in-ground absorption pits.

7.15.15 ROOF DRAINAGE

Roof rainwater collection systems shall be designed to handle a 20 year cycle, 6 minute storm duration as available from Bureau of Meteorology statistics. Surface water collection shall be based on a once in 5 year cycle storm of 6 minutes duration where a fail safe flood path exists. Where a fail safe flood path does not exist, a once in 100 year storm of 6 minutes duration shall be used as a calculation basis as available from Bureau of Meteorology statistics.

Roof drainage systems shall be designed to incorporate separate overflow relief discharge to minimise roof gutter overflow and consequent building damage and service interruptions.

Consideration shall also be given to ways of preventing leaf build up in gutters to prevent building damage and service interruption due to gutter overflow.

Surface water drainage lacking a fail safe flood path is to be avoided.

Box gutters are not acceptable. Eaves gutters or fail safe design are preferred.

Storm water drainage grates shall be cross-webbed in car parks and paths and not be located in wheel chair access areas or trolley areas.

Water Storage for Reuse

7.16.00 ROOF WATER

A life cycle costing is to be completed and if required by the Local Authority, a roof water run-off system shall be provided that collects, treats and distributes as potable water for human consumption or for irrigation and toilet flushing.

Roof water is to be collected and discharged into an on-site storage tank where the water is treated and distributed as potable water.

The tank is to be sized to include any future buildings shown on the drawings. A water balance study must be undertaken to ensure the storage tank has water available at all times.

The storage tank is to be constructed from reinforced concrete or other impervious material. A partition within the tank structure shall be provided that allows half the tank to remain in service while the other half is being cleaned out in accordance with AS/NZS 3500.

The water is to be treated with measured doses of chemicals in accordance with the requirements for potable water consumption. A detention period of 30 minutes is necessary before the water is discharges at the fixtures.

In-line pumping equipment is to be provided capable of delivering potable water to the fixtures at the required pressure and on demand.

Overflow from the storage tank is to discharge into Council's stormwater system.

At the completion of the works, the tank should be filled with potable water, tested, commissioned and fully operational.

7.16.05 GREY WATER

Collection of shower, bath and basin waste should be assessed with a life cycle costing analysis to determine if the collection of grey water is acceptable and if the Local Authority will allow it.

7.16.10 HYDROTHERAPY POOLS

Hydrotherapy pools require large amounts of heat both to maintain the temperature of the pool water and to offset evaporation from the water. The moisture evaporated from the water must be removed from the space, usually by ventilation. Potential exists to transfer this waste heat back to the pool water and space heating using commercially available heat pump systems. While requiring higher capital costs than conventional heating, these systems offer very large energy cost savings and should be considered for all proposed hydrotherapy pools. Life cycle cost analysis should be applied.

On Site Cogeneration (Heat Recovery Systems)

7.17.00 INTRODUCTION

Hospitals have the potential to utilise plant and systems that provide a primary function and in so doing reject heat that potentially can be used for a secondary function. Such systems are often referred to as cogeneration systems.

Examples of cogeneration systems are:

- Natural gas engine driven plant to drive large chillers to produce the cooling energy for air conditioning systems
- Natural gas engines to drive electrical generators for the production of electricity for site use and resale to the distribution authority.

In running the natural gas engines, very large amounts of high grade waste heat from engine exhaust gases and engine cooling (radiators) are generated at temperatures up to - and in some cases exceeding 100ºC; heat that is normally wasted to the environment. This heat can be recovered and used for heating water for domestic hot water use, thereby offsetting the cost of natural gas to directly heat the water.

There are other forms of low grade heat that can be recovered for preheating water such as heat rejected in the refrigerant gas cycle in the chiller plant used in the air conditioning system.

Additionally, use of solar energy as a heat source for water heating should be evaluated.

In such cases waste heat should be recovered as a matter of course or solar heating utilized. These systems may also be subject to green house or energy credits that will impact on the savings in adapting these systems. The viability of these systems should be subject to a life cycle costing evaluation and incorporated into the hospital design where the evaluation is favourable.

Such systems can compromise the integrity of water purity and care in design in regard to cross contamination is an important issue.

Pumping Systems and Deep Excavation

7.18.00 Pumping systems may be required for sewer, stormwater and water supply.

Pumping is to be avoided if other means are available. This includes extreme low grades of drainage (say 1%). Consider relocation of fixtures by negotiation with the architect.

Life cycle costing may be applied to situations where a choice between expensive rock excavation and pumping is involved. Non-essential fixtures in such conditions should be evaluated.

Deep Excavations: Prudent design should be exercised to avoid excessively deep drainage.

UPVC Plumbing

7.19.00 UPVC pipes represent an economic alternative to metal pipe (cast iron and copper) for

sanitary plumbing. Some restrictions apply in relation to its temperature properties and metal pipe will still be required for some applications.

Sanitary plumbing above ground shall utilise UPVC pipes and fittings for all waste discharges other than continuous hot waste flows from sanitisers and sterilisers.

Life cycle cost comparison recommended to evaluate UPVC with fire stop collars compared with cast iron pipe stacks.

Landscape Irrigation

7.20.00 Landscape irrigation systems are to be discouraged. Instead planting should comprise native plants suitable for the geographical location.

Landscape contracts should include a significant plant stabilisation period to establish self-sustaining growth.

Landscape watering, where provided, shall comprise local hose cocks with manual local controlled satellite systems.

Consideration shall be given to self-activated tractor sprinklers for large grassed areas. Where automatic irrigation systems are unavoidable, dripper systems are preferred to spray systems.

Gas Service Installations

7.21.00 The gas service installation is to be designed and installed in accordance with AS 5601, AG601 Gas Installations and AS/NZS 1596 the storage and handling of LP Gas.

NATURAL GAS: Where natural gas is available, provide natural gas from the local authority's infrastructure. The pipeline to be a metered service with a regulator and located in an appropriate position on the property.

LP GAS: Where natural gas is not available and liquefied petroleum gas (LPG) is economically viable to other forms of energy, provide for the on-site facilities. Ensure the LPG service is sized for natural gas to enable easy conversion should natural gas become available to the site in the future.

Provide a LPG storage tank and locate the tank in a safe and secure area where it is accessible to service vehicles. The LPG tank to have with lockable hinged steel dome cover to valve and regulator complete with hinge pins, padlock and keys.

Design the size of the tank to ensure that the time between refilling is not less than three weeks at maximum daily load.

Install the LPG tank on a 100mm thick reinforced concrete slab. Extend the slab size beyond the plan view of the tank by 1500mm in all directions.

Provide an 1800mm high chain wire fence security with galvanised steel posts and galvanised steel top and bottom rails. Install the fence around the perimeter of the concrete slab enclosing the LPG tank with lockable gates at diagonally opposite corners.

Appropriate fire protection facilities are to be installed.

Kitchens shall be provided with appropriately labelled gas isolation valve/s at the main entry point for isolation in event of fire.

8. FIRE SERVICES

Introduction

8.1.00 INTRODUCTION

Fire systems are systems installed in buildings to detect or protect the building and occupants from smoke or fire.

Fire detection is the process of detecting fire or smoke in buildings using:
- Smoke and thermal detectors
- Manual call points.

Fire protection of buildings relates to the active process of protecting the building (fire fighting) by use of:
- Fire hose reels
- Fire hydrants
- Sprinkler systems
- Gaseous fire quenching systems
- Fire extinguishers.

In conjunction with the detection or protection systems, other services are utilised to assist occupants in the safe evacuation of buildings, being
- EWIS warning systems
- Smoke management systems
- Emergency lighting systems.

Provision of fire protection services in hospitals is defined by current regulations and codes to give an appropriate level of protection to patients, personnel and buildings

Installations are to always be designed to the minimum required to meet the regulations. Smoke detection systems are to be installed in all patient care buildings.

8.1.05 CODES AND STANDARDS

Fire services are to be designed to the following codes and standards:

BCA	Building Code of Australia
AS 1670	Fire detection, warning and intercom systems,
AS 4428	Fire detection, warning, control and intercom systems – Control and indicating equipment
AS 1603	Automatic fire detection and alarm systems
AS/NZS 1221	Fire hose reels
AS 2419	Fire hydrant installations
AS 2118	Automatic fire sprinkler systems
AS 4214	Gaseous fire extinguishing systems
AS 1851	Maintenance of Fire protection equipment
AS/NZS 1841	Portable Fire extinguishers
AS/NZS 2293	Emergency evacuation lighting for buildings
AS 1668.3	Smoke control systems for large single compartments or smoke reservoirs
AS/NZS 1668.1	The use of mechanical ventilation and air-conditioning in buildings-Fire and smoke control in multi-compartment buildings
AS/NZS 3000	Electrical Installations

Note: Some smoke management relevant sections of the BCA are strongly linked to HVAC services. Consequently relevant issues are discussed in the Mechanical Section.

8.1.10 COST EFFECTIVENESS

There is scope for more cost effective fire protection of health care buildings. In particular:

1. The BCA requirements for EWIS in a hospital should be rationalised and standardised. The part that the EWIS plays in the emergency plan should be explained. The role of floor wardens and head wardens in a conventional building do not apply. In particular the facilities to be provided at a staff station should be clearly stated. Perhaps a WIP and a break glass unit would suffice.

2. The treatment of patient care areas in terms of speakers and audible alarms should be spelt out.

- The design of the sprinkler system should not preclude the use of innovative technologies such as:
- Extended coverage sprinklers,
- Residential sprinklers,

4. Areas ancillary to patient care should be defined in terms of the nearest BCA and AS 2118 categories. Large areas of the hospital, particularly administration, may be suitable for the installation of light hazard sprinklers. Capital and Life cycle costing techniques to be used to determine the feasibility of using sprinkler systems.

Planning

8.2.00 GENERAL

The best means of reducing capital and recurrent costs for fire services is in careful planning of buildings to minimise or avoid the need for fire protection, especially sprinklers.

Fire Safety Engineering (FSE) allows a holistic approach that can provide benefits in terms of cost effectiveness and increased functionality. A building less than 25m in height does not require sprinklers but the provision of sprinklers may enable some other modification to the building that is desirable.

Where specific facility-related fire risks are not covered adequately in the BCA and other relevant regulations, the risk shall be analysed and a suitable engineering solution shall be developed and implemented to maintain an acceptable risk level. The need for additional measures for a specific facility and the suitable solution shall be established during the design process.

Consideration should be given to undertaking FSE analysis of all significant health care buildings.

Health buildings shall be planned to minimise or avoid the need for sprinkler systems.

8.2.05 SPRINKLER DESIGN

Where installed, sprinkler pipe systems shall be determined by the full hydraulic calculation method.

The need for fire sprinklers for a specific facility and the suitable solution shall be established during the design process by a Certified Fire Engineer.

9. LIFTS

Introduction

9.1.00 Lifts in New South Wales are required to be designed and installed to AS 1735 – Lift Code Series and the BCA (Building Code of Australia).

Lift installation and inspection under the Act and Regulation are the responsibility of the building owner, and the lift design and installation the responsibility of the contractor. WorkCover have the power to enter any building at any time.

General

9.2.00 NEEDS ASSESSMENT

The need for lift (vertical transportation) services is determined by a number of factors which include the following:

- The number of floors in the building
- Types of departments (hospital planning units) proposed to be accommodated within the building, and
- Type of inter-departmental traffic within the building likely to be generated for movement of people and goods e.g.
  - the number of staff and shift patterns, visitors and visiting hours
  - the location of theatres and x-ray facilities
  - the distribution of food, beverages, supplies, and waste disposal
  - emergency evacuation of patients, staff and visitors.

The type and extent of lift services to be provided is determined by the type and volume of traffic likely to be generated within the building and the service performance level that is considered acceptable for the level of medical service being provided by the hospital.

9.2.05 CAPITAL COST

The capital cost of lift installations is determined by a number of factors. The key factors include the following:

- The number and type of lifts (i.e. bed/passenger, goods or service)
- The type of lift drives (i.e. electro-hydraulic, geared electric, gearless electrical)
- Lift car interior finishes and lift control system.

Design economy is achieved by careful selection of the suitable type and size and appropriate number of lifts for the building. coupled with the need to limit cross infection by separating patients from visitors and staff.

This document deals with the key elements which influence the lift selection.

Glossary of Technical Terms

9.3.00 A Glossary of Technical Terms is provided in Section 10, Appendix 1.

Objectives

9.4.00 The aim of this document is to provide a consistent basis for the assessment of vertical transport provisions in hospital projects.

Application

9.5.00 This document will apply to all new lift installations and, where possible, to refurbishment, etc. of existing installations.

Services

9.6.00 GENERAL

The types of lifts to be selected are determined by the traffic requirements which can be broadly divided into three groups:

- Passengers; used for staff, ambulant patients, visitors.
- Goods; use for food trolleys, medical supply trolleys, linen trolleys, garbage and waste.
- Patients in beds and empty beds, furniture and equipment.

For a multi-lift installation (particularly for a high rise building), it will be cost efficient to assign different lift type and car size to suit a particular type of traffic grouping.

For a medium to low rise building, multi-purpose lifts would be selected to minimise initial capital and recurrent costs.

This document covers some of the key selection criteria when lift services are considered to be required for the proposed building development.

Factors Determining the Need for Lift Services

9.7.00 To minimise recurrent costs, new hospital buildings should be planned without the need of lift services.

Notwithstanding, lift services are generally considered to be necessary under the circumstances listed below.

1. Where patient care areas are located above a level with direct egress to a road or open space (BCA requirement)

2. Where interdependent HPUs are not on the same level.

Operating Suite	<---------->	Emergency
Operating Suite	<---------->	ICU/CCU
Operating Suite	<---------->	Inpatient Units
Inpatient Units	<---------->	Kitchen
Inpatient Units	<---------->	Supplies
Imaging	<---------->	Emergency (Note)
Imaging	<---------->	Operating Suite (Note)
Imaging	<---------->	Inpatient Units (Note)

3. When the building has three or more levels for reasons of work efficiency

Note: When the Imaging Department is not on the same level as Emergency, Operating Suite and Inpatient Units, satellite facilities will be required if lift services are not provided.

Lift Positions

9.8.00 When lift services are found to be necessary for a hospital building, the planning and schematic design for the lift installation shall be carried out at the very early stage of the project. This is due to the long delivery and installation times of lift systems, and the preferred need to be able to incorporate actual contract liftwell dimensions in the structural design to minimise space loss.

The proposed lifts should be centrally located and should be easily accessible. The required number of lifts as determined by detailed traffic analysis will be grouped in one or more nodes.

Greater flexibility and performance efficiency may be gained with a smaller number of nodes (groups) depending upon the building arrangement.

The number of lift nodes required for the building or abutting buildings is determined by the horizontal distance that building occupants would have to travel from anywhere on the floor to the lifts. The lift nodes shall be positioned such that the maximum travel does not exceed 50m.

Stairwells should be planned and positioned immediately adjacent to a group of lifts to encourage pedestrian traffic.

Number of Lifts

9.9.00 The number of lifts required for a hospital building is determined by the peak traffic requirements in terms of the following:

- Number of people and vehicles (trolleys) requiring the lift service during the peak period, peak traffic or peak period is not defined in the guideline. Examples potentially giving rise to peak traffic periods would be staff shift changeovers, visiting times, meal times, casualty or outpatient overloads.
- Handling capacity of the proposed lifts (i.e. the car size and drive performance),
- The extent of downward traffic during the period of up-peak.
- Whether it is desirable to group all lifts together. Consideration should be given to the separation of general public and specialised patient lifts in larger hospital situations and the effect this has on the budget.

Detailed traffic analysis and performance calculations shall be carried out during the early planning stage of the project to determine the number of lifts required and their optimum grouping and location.

Should the results of the traffic study indicate that only one lift is required for both ambulant and non-ambulant patients, one additional lift of the same type shall be provided in the case of one lift being put out of service for routine maintenance or due to equipment faults. Both lifts shall be grouped together but in separate fire rated shafts for compliance with B.C.A. requirements.

Type and Mix of Lifts

9.10.00 The types and mix of lifts shall be assessed based on the following criteria:

1. Bed/passenger lifts are to be used for both people and vehicular traffic for moving goods and patients on trolleys.
2. Orthopaedic bed/passenger lifts may be used in place of bed/passenger lifts provided that the need for a larger lift car can be justified on the basis of clinical need.
3. Consideration may be given to a separate Food Services Lift for meal delivery if the kitchen is at one end of the building. However, justification for the provision is required.
4. For lift installations with four or more cars, the lift car entrance at the main landing for loading of food trolleys and other supplies trolleys should be separated from the normal lift lobby. Where functionally allowable patient and public lifts should be separated.
5. Dedicated Food Services Lift(s) is/are not required. Express services can be provided by the provision of Special Key Control in the lift control system.

6. Dedicated 'dirty' goods lift(s) is/are not required.

Drive Systems

9.11.00 There are two main drive systems for lifts: electro hydraulic drive and electric drive. The traffic study analysis together with the decision on type and mix of lifts shall determine the lift drive systems.

An electro hydraulic lift is driven by a pump which raises or lowers the lift car by varying the oil pressure in a ram. The pump is driven by an electric motor.

An electric lift is powered by an electric motor (AC or DC) which is coupled to the hoisting mechanism through a reduction (worm) gear. The motion of the car is obtained through traction between suspension ropes and driving sheaves. There are varying types of electric lifts and selection should be based on life cycle cost analysis and fitness for purposes.

Basic options available in the drive selection are:

- Traction with overhead machine room.
- Traction with underslug machine room.
- Hydraulic with machine room adjacent to lift well.

A new type of traction lifts without machine room are not suitable at present (May 2005) because the standard car sizes available are too small for hospital beds.

A hydraulic lift has a lower initial cost and maintenance cost, when compared with a similar duty electric traction lift. The area required for lift well and machine room is smaller (about 12 % smaller), resulting in more efficient use of building space.

Extensive usage of a hydraulic lift raises the oil temperature and lowers its viscosity. Erratic performance of the lifts affects the floor leaving accuracy.

In summary, hydraulic lifts are suitable for the following applications:
- Low rise hospital of up to 3 or 4 landings and not more than 10 metre travel.
- Primarily used by disabled persons.
- Where an overhead machine room is not practical due to aesthetic or other considerations.

Lift Controls

9.12.00 The number of lifts shall be determined by the building characteristics and usage. No more than four lifts should ever be located in line, and where additional lifts are required to serve the same levels, a second facing bank shall be employed in a common zone.

Each lift zone shall be controlled by the associated control system, facing banks being considered as a single control zone.

The control systems shall be microprocessor based.

A special service control facility shall also be provided to permit authorised staff to secure exclusive service of the designated lift(s) for medical emergencies or routine meal delivery.

9.12.05 OPERATION ON EMERGENCY CONTROL

The lift control system shall be capable of operating the lifts on emergency power in the following manner:

- Immobilise lifts at the main landing,
- Bring remaining lifts to the main landing in sequence, and
- Permit one or more designated lift(s) to remain in service as determined by the available capacity of the emergency power supply.

Earthquake Protection

9.13.00 The lift design and installation shall incorporate earthquake provisions in accordance with the Australian Standard AS 1170.4 (with Supplement 1) Earthquake Loads.

Traffic Analysis and Lift Performance

9.14.00 GENERAL

The lift requirement in a hospital shall be determined at an early stage of design development.

A lift consultant shall be engaged to carry out a traffic study to determine the lift requirements.

The following basic information is required for traffic analysis and shall be provided to a lift engineer:

- Number of floors and the intended usage.
- Floor to floor height.
- Building population or floor areas.
- Number of beds for health care building.
- Number of medical and other staff.

In hospitals the activity sequences include professional and non-professional staff involvement with patients, administration and other back-up activities. The back-up activities are: cleaning (sterilisation, laundry), catering, records and goods handling.

9.14.01 PERFORMANCE CRITERIA

The criteria used for lift design are Average Waiting Time (AWT) and 5-minute Capacity (PC5) and Maximum Transit Time (TP). PC5 us defined as percentage of the building population carried in 5 minutes by the lift system.

The accepted design standards for hospitals are:

- Averaging Waiting Time: 30 to 50 sec
- 5-min capacity: 10 to 15 % of population
- Maximum Transit Time: 120 to 150 minutes

Major teaching hospitals require the highest standard of services and this shall be provided.

If the hospital population is not available, use 3 to 5 persons per bed to estimate.

9.14.05 TROLLEY TRAFFIC AND OTHER SERVICES

In hospitals, trolley traffic is estimated to be four up and four down trips for every 100 beds.

Document conveyor can be used for handling of medical and x-ray records.
Service lifts can be used for movement of dirty and clean laundry to and from laundry store.

Pneumatic tube system can be used for movement of blood samples, pathology specimens and pharmaceutical products to and from laboratories.

Lift Car Sizes and Finishes

9.15.00 LIFT CAR SIZES

A bed/passenger lift shall have a minimum clear size of 1600mm wide x 2300mm deep x 2400mm high and be provided with handrail all round and a shirting as specified in Section 22 of the Lift Code AS1735 Part 2.

A bigger car size, 1800mm wide x 2600mm deep x 2400mm high is required to accommodate orthopaedic and intensive care beds.

The smaller (and less costly) car should be selected where orthopaedic procedures are not expected to be used.

Some saving can be achieved with less elaborate lift car finishes as special wall finishes can add considerably to the cost of a lift car. The car interior finishes should always be designed for serviceability and ease of cleaning

9.15.05 GENERAL

NSW Health have determined hospital type car sizes for two types of use: a larger capacity for orthopaedic patients and a smaller for other hospital use. The smaller (and less costly) car should be selected where orthopaedic procedures are not expected to be used.

Some saving can be achieved with less elaborate lift car finishes as special wall finishes can add considerably to the cost of a lift car. The car interior finishes should always be designed for serviceability and ease of cleaning.

It would appear more relevant for the two types of use to be extended to include for bed patients, as defined in Clause 6.1.2, non-bed orthopaedic patients, and other hospital use.

The car size for non-bed orthopaedic patients, and other hospital use could be similar, although the lift for patients in wheelchairs should be sized to allow easy turning of the wheelchairs in the lift. NSW TAFE have standardised on a 1600 wide by 1650 deep car to allow this, and this could be a reasonable standard size, pending further information on the smaller 'Hosplan' lift size.

Goods and Services Lifts

9.16.00 FOOD SERVICE GOODS LIFT

Provide enough lifts to allow the exclusive use of at least one lift for food services. In off peak times these lifts can be used for other domestic type duties.

In any hospital requiring vertical transportation, the food service requires exclusive use of at least one lift at meal times. Planning should provide free access to this lift in a manner that the delivery of raw material, meals and collection of dirty dishes etc. does not interfere with and/or hinder other traffic. The same lift can be used at off peak times for linen delivery and dirty linen collection and other domestic-type duties. This lift should be served by a lobby separate from those provided for normal passenger use.

9.17.10 SERVICE LIFTS / DUMB WAITERS

Consider relative position of sterile areas and pharmaceutical distribution systems.

Service lifts (or dumb waiters) with automated loading and unloading ability may be considered between the Sterile Supply Unit and the Operating Suite. With judicious planning, requirement for vertical transportation may be removed.

9.17.05 LOAD AND COST REDUCTION

If vertical goods transportation is required, service lifts/dumb waiters are cheaper than passenger lifts.

Both the goods lifts and the service lifts mentioned above can relieve traffic loading from the main costly hospital bed/passenger lifts and can reduce main lift requirement and consequent cost.

Transport of Small Items

9.18.00 TELELIFT, DOCUMENT HOIST, PNEUMATIC TUBE SYSTEM

Consider other type of materials transport systems in larger hospitals only if this will reduce lift traffic load (Refer to - Lifts-Trolley Traffic and Other Services).

Various document and materials transport systems are available on the market, the installation of which could assist in demand reduction on the lifts and should be considered. Consideration should include the use of electronic transmission systems for information between diagnostic services, treatment areas and wards.

9.18.05 PNEUMATIC TRANSPORT SYSTEMS

Pneumatic tube transport systems with leak-proof carriers that have a clear see- through section to enable visual inspection of content prior to opening are highly recommended.

Use of a clear, leak-proof inner bag system is highly recommended.

The pneumatic piping system is to be designed and suitable to permit clean out of piping and disinfection via use of a special dispensing tube or other strategy.

Transport tube system carriers shall be capable of being sterilised or disinfected.

If pneumatic transport systems are installed, the number and location of pneumatic transport stations must be assessed.

10. APPENDIX 1 GLOSSARY OF TERMS

General

10.1.00

Brief - A document which describes the intent and purpose of a facility. A detailed or design brief fully describes individual spaces and their function in sufficient detail for final design to be completed. The Brief is the basic document used by the designers to develop their proposals.

Elemental Cost - A method of analysing the overall cost of a project or system by breaking it into individual elements and applying a cost to each of these.

Health Facility Guidelines - Documents issued by the NSW Health for the design of each department or unit (HPU) in a Health Care Facility.

Health Briefing System (HBS) - The Health Briefing System is a briefing tool to assist consultants, engaged on Health capital projects to develop Room Data Sheets and Room Layout Sheets. Consultants wishing to access the HBS are to contact the Asset and Contract Services Branch to register for access to the System.

HPU. - Health planning unit

Life Cycle Costing - A method of comparing the cost of different proposals or systems which includes all the costs of owning and operating the system over a stated period of time. This cost is represented as a single figure called Net Present Value. This allows early comparison of widely different proposals on a common basis.

Communications

10.2.00

Backbone Cabling - Permanent spine cabling emanating from one central position to various parts of the building for interconnection of telecommunications equipment.

Building Backbone Cable - A cable that connects the building distributor (BD) to the floor distributor (FD).

Building Distributor (BD) - A distributor in which the building backbone cable(s) terminate and at which connections to the campus backbone cables may be made.

Campus - A premises containing more than one building.

Campus Backbone Cable - A cable that connects the campus distributor to the building distributor(s).

Campus Distributor (CD) - The distributor from which the campus backbone cabling emanates.

Closet - MDF (main distribution frame) room/cupboard, riser cupboard, distribution frame housing/enclosure.

Cross-Connect - Distribution frame, patch panel, patch field

Horizontal Cabling - Reticulation cabling/facility cabling for connection of voice and data terminals

Distributor - The term used for the functions of a collection of components (such as, patch panels, patch cords) used to connect cables.

Floor Distributor (FD) - The distributor used to connect between the horizontal cable and other cabling subsystems or equipment.

Jack - Socket

Network Interface - The point, provided by the network carrier (e.g. N.S.W. Government Network Provider, Telecom, Optus), where interconnection between the carrier's network and building or campus communication wiring occurs.

Main distribution frame (MDF) - Network boundary

Pathways and Raceways - Riser shaft, cable tray/trough, cable duct/conduit, accommodation

DII - Data terminal equipment

FDDI - Fibre distributed data interface

IC - Intermediate cross-connect

ISDN - Integrated services digital network

LAN - Local area network

MC - Main cross-connect

PABX - Private automatic branch exchange

STP - Shielded twisted pair

TC - Telecommunications closet

UTP - Unshielded twisted pair cables

WAN -

Mechanical Services

10.3.00 **Air Conditioning** - A system for providing temperature and humidity control to spaces by means of cooled and heated air. Air conditioning always includes filtration, cleanliness and cooling achieved by use of refrigeration equipment. Heating only and evaporative cooling systems are not classified as air conditioning.

A.I.R.A.H. - The Australian Institute of Air Conditioning Refrigeration and Heating Incorporated.

Air Handling System - A system of mechanical equipment including fans, duct work filters heating and cooling coils and outlet grilles. Air handling systems cool and/or heat air and distribute it to the space served.

A.S.H.R.A.E. - The American Society of Heating, Refrigeration and Air conditioning Engineers.

Availability - The percentage of operating time that a system or component is available to carry out its required function. This is different from reliability; which relates to how frequently the system fails.

Building Management and Control System (BMCS) - A centralised electronic system for monitoring and controlling mechanical and electrical plant and equipment. Some older systems may only monitor plant and not control it.

C.I.B.S.E. - The Chartered Institute of Building Services Engineers (U.K.)

Direct Digital Control (D.D.C.) - A form of automatic electronic control

Chiller - Air conditioning equipment that produces water at low temperature (typically 7 ºC) which is used in other plant. Some cooling may be a process only (i.e. electron microscope).

Condenser - Air conditioning equipment used to transfer heat taken to cool a space to the air outside a building. Condensers may be either air cooled or water cooled.

Cooling Tower - A piece of equipment which cools water (usually to about 30 ºC) by passing it through a moving air stream. This is normally combined with a water cooled condenser.

Diversity - The percentage of people, lights, equipment, etc. that are on (or present) simultaneously compared with the total used for design.

Evaporative Cooling - A process of cooling air by passing it over wet pads before blowing it into the space. In dry climates it can provide adequate cooling but is unsuitable-for humid coastal areas. Large amounts of air are required and therefore large ducts.

Heating - Equipment providing space heating for comfort or other purposes that is be part of an air-conditioning system.

Maintained Redundant - Plant in excess of the required capacity that is maintained in an operational state to be available in the event of plant failure.

Mechanical Ventilation - Plant and systems providing toilet and general exhaust systems, fume cupboards, biohazard cabinets, exhaust hoods, smoke management and pressure and infection control systems based on pressure and airflow direction control. Mechanical ventilation can be part of an air-conditioning system.

Non Redundant - Additional plant which is not in excess of the 'maintained redundant' requirement. For example, if two units are provided each of 50% capacity, they are 'non redundant'. If three are provided, each of 50% capacity, one will be 'maintained redundant'.

Refrigeration - Equipment used for cooling equipment for coolrooms and other not comfort related cooling purposes.

Shade Co-Efficient - The ratio of solar energy passed through a window compared to clear 6 mm thick glass (Clear glass is 1.0).

Smoke Control - A means prescribed by regulation for controlling and removing smoke in case of fire.
Steady State Availability - Proportion of time that plant is available to run given the combined effects of maintenance and reliability. This is commonly called 'availability.'

Supply Air - The amount of air supplied to a space.

U Value (Thermal transmittance co-efficient) - The rate at which heat is transferred over time through a building component such as a wall or roof. It is expressed as watts per square metre per degree kelvin (W/m^2K).

Zoning - The division of areas served by air conditioning systems into groups having common thermal and load characteristics. Typical examples are zones for north or west facing rooms, centre (i.e. non external) rooms, and spaces of high occupancy such as conference rooms or cafeterias. Zoning may also be provided for smoke and fire control.

Hydraulic Services

10.4.00 **Drainage** -Pipes 65mm to 300mm located below ground.

Flush Back Pan -A W.C. pan designed to sit flush against the floor and rear wall to minimise cleaning.

Flushing Valves -A valve designed to flush W.C. pans, slop sinks and some types of bed pan washers.

Grey Water -Lightly polluted domestic waste water from basins and similar.

Integral Trap -A ceramic trap built into a basin or urinal.

Legionella -Organism, a short name for legionella pneumophilia found in water. It is dormant at low temperatures but becomes active and multiplies above 38ºC. May be lethal to the aged or debilitated, attacks the respiratory system via aerosol droplets.

Low Grade Heat -Heat available at a low temperature (usually below 30ºC) where direct thermal transfer is inefficient.

Macerator -A device which shreds the solid material in waste water.

Non-Potable -Not fit for drinking.

Detention and Retention -A requirement of Councils to retain rainwater on site in a pond or similar to reduce the peak flow impact of storms.

Thermostatic Mixing Valve (T.M.V) - A valve which automatically mixes hot and cold water to a pre-determined temperature.

Trade Waste -Liquid waste other than domestic sanitary fixture waste.

Trade Waste Pre-Treatment -Treatment of trade waste near source prior to mixing with other waste products.

UPVC -Unplasticized polyvinyl chloride. Used for plastic pipes.

Further definitions are available in the Australian Standard AS/NZS 3500.0 of the National Plumbing and Drainage Code Part O: Glossary of Terms contains the terms and description most widely used in the industry to describe aspects of Hydraulic Services.

Lifts

10.5.00 **Bed/Passenger Lift –** Passenger lift designed to accommodate mobile hospital beds, stretchers, trolleys and wheel chairs.

Orthopaedic Bed/Passenger Lift –Passenger lift to accommodate mobile hospital beds in fully extended position with traction frame fitted.

Passenger Lift –Lift primarily for ambulant people and people on wheel chairs.

Goods Lift- A lift used for carrying goods or materials and in which only the attendant and persons required to load and unload are intended (or permitted) to travel.

Service Lift – Small goods lift in which passengers are not permitted to travel, and which is controlled from outside the lift well.

11. APPENDIX 2 REFERENCES AND FURTHER READING

Electrical Services

11.1.00 AUSTRALIAN STANDARDS
The following Australian Standards shall be complied to within this Document:

AS/NZS 3000	Electrical Installations
AS/NZS 3009	Electric Installations - Emergency Power Supplies in Hospitals
AS/NZS 3003	Patient Treatment Areas of Hospitals and Medical, Dental Practices and Dialyzing Locations.
AS/NZS 3013	Electrical installations–Classification of the fire and mechanical performance of wiring systems
AS/NZS 1680.1	Interior Lighting – General Principles and Recommendations
AS/NZS 1680.2.5.	Interior Lighting – Hospital and medical tasks

11.1.05 REFERENCES

Building Energy Manual NSW Public Works 1993

IESNA. HB-9-2000 Lighting Handbook

Electricity Supply Act 1995 No 94 (or current Tariff legislation)

Communications

11.2.00 AS 2220.1 and AS 2220.2 - Emergency warning and intercommunication systems in buildings.

EWIS guidelines

Mechanical Services

11.3.00 LEGISLATIVE ENVIRONMENT

The following legislative requirements refer to Australian Standards and shall be complied with where applicable.

- Building Code of Australia
- Health (Legionella) Regulations
- Building (Legionella Risk Management) Regulations
- Occupational Health and Safety Regulations.

11.3.05 AUSTRALIAN STANDARDS

The following Australian Standards shall be complied to within this Document:

AS 1228	Pressure equipment - Boilers
AS 5601	Gas installations Set
AS 1324.1	Air filters for use in general ventilation and air-conditioning-Application, performance and construction
AS 1386.1	Cleanrooms and clean workstations - Principles of clean space control
AS 1386.4	Cleanrooms and clean workstations - Non-laminar flow Cleanrooms - Class 3500
AS 1668.3	The use of mechanical ventilation and air-conditioning in buildings-Smoke control systems for large single compartments or smoke reservoirs
AS 1668.2	The use of mechanical ventilation and air-conditioning in buildings-Ventilation design for indoor air contaminant control
AS 1668.2 Supplement 1	The use of mechanical ventilation and air-conditioning in buildings - Ventilation design for indoor air contaminant control
AS 1668.1	The use of mechanical ventilation and air-conditioning in buildings-Fire and smoke control
AS/NZS 1677.2	Refrigerating systems - Safety requirements for fixed applications
AS/NZS 2107	Acoustics—Recommended design sound levels and reverberation times for building interiors
AS 1807.1-26	Cleanrooms, workstations, safety cabinets and pharmaceutical isolators - Methods of test
AS 2243.3	Safety in laboratories - Microbiological aspects and containment facilities
AS 2243.6	Safety in laboratories - Mechanical aspects
AS 2243.8	Safety in laboratories - Fume cupboards
AS 2593	Boilers – Safety management and supervision systems
AS 2639	Laminar flow cytotoxic drug safety cabinets - Installation and use
AS/NZS 2982.1	Laboratory design and construction - General requirements
AS/NZS 3000	Electrical Installations
AS 3653 superseded	Boilers - Safety, management, combustion and other ancillary equipment see DR 99268
AS/NZS 3666.1-3	Air-handling and water systems of buildings-Microbial control
AS 3892	Pressure equipment-Installation
AS 4254	Ductwork for air-handling systems in buildings
AS 4343	Pressure equipment - Hazard levels
AS 4260	High efficiency particulate air (HEPA) filters - Classification, construction and performance
AS 4426	Thermal insulation of pipework, ductwork and equipment-Selection, installation and finish

11.3.10 REFERENCES

1. ASHRAE 1991 HVAC Applications Volume, American Society of Heating, Refrigeration and Air Conditioning Engineers Inc.

2. ASHRAE 1993 Fundamentals Volume, American Society of Heating, Refrigeration and Air Conditioning Engineers Inc.

3. Building Energy Manual, N.S.W. Public Works, 1993

4. AIRAH/ACS Design Aid DA 9 A: Air Conditioning Systems – Design and 71 Temperature Data, AIRAH Melbourne, 1990.

5. AIRAH/ACS Design Aid DA 9: Air Conditioning Systems – Load Estimation and Psychometrics, AIRAH Melbourne, 1990.

6. ASHRAE 1993 Fundamentals Volume, American Society of Heating, Refrigeration and Air Conditioning Engineers Inc.

7. Building Energy Manual, N.S.W. Public Works, 1993

Hydraulic Services

11.4.00 AS/NZS 3500 - National Plumbing and Drainage Code

Fire Services

11.5.00 Building Code of Australia

AS 1670	Fire detection, warning and intercom systems
AS 4428	Fire detection, warning control and intercom systems – Control and indicating equipment
AS 1603	Automatic fire detection and alarm systems
AS/NZS 1221	Fire hose reels
AS 2419	Fire hydrant installations
AS 2118	Automatic fire sprinkler systems
AS 4214	Gaseous fire extinguishing systems
AS 1851	Maintenance of Fire protection equipment
AS 1841	Portable Fire extinguishers
AS/NZS 2293	Emergency evacuation lighting for buildings
AS 1668.3	Smoke control systems for large single compartments or smoke reservoirs
AS/NZS 1668.1	The use of mechanical ventilation and air-conditioning in buildings-Fire and smoke control in multi-compartment buildings
AS/NZS 3000	Electrical Installations

Lifts

11.6.00. G.R. Strakesh. Vertical Transportation: Elevators and Escalators

AS 1735 – SAA Lift Code

AS 2121 – SAA Earthquake Code

Building Code of Australia

Elevator World Educational Package and Reference Library Volume 2

Elevator Maintenance and Traffic – 1990 Edition

12. APPENDIX 3 LIFE CYCLE COSTING

General

12.1.00. INTRODUCTION

Life cycle costing is an approach to cost analysis that brings future costs into today's decision-making process. As such it has application to the decision making process when selecting major pieces of equipment or types of installations, and for analysing the financial benefits of various available energy systems. Life cycle costs should be assessed for all significant decisions and, in particular, be applied to high energy use equipment.

Standardised life cycle costing procedures are to be applied to elements of a project having a value over 1% of the project cost or $100,000 whichever is the lesser. This document identifies particular items where decisions must be justified on a life cycle cost basis.

The concept of life cycle costing to justify decisions has been adopted in this document; with the nomination of one procedure and the provision of its data indices.

Life cycle costing should be based on an appraisal of economic consequences of various solutions as they relate to current capital expenditure, future maintenance, energy running and plant operating costs.

Careful consideration must, therefore, be given to the following elements:
- proposed capital expenditure
- maintenance and repair costs
- replacement costs at the end of economic life
- energy usage costs

Relevant data base for:
- escalation rate
- discount rate
- energy escalation rate
- operating hours
- economic life
- costing or investment period

12.1.05 PROCEDURE

The procedures to be implemented are those set out in pages 361 to 375 of the Building Energy Manual available from the NSW Office of Energy. The recommended procedure is based on Net Present Value Analysis which expresses, as a single total, all costs in terms of the equivalent cost incurred now. Definitions of various economic terms applicable to the life cycle costing are contained in 12.20.10 below.

It is important to note that the implementation of life cycle costing can return a decision that requires greater capital cost. It will only do so to the benefit of the whole of life cost.

12.1.10 DEFINITION OF ECONOMIC TERMS

Economic Life: Average of the economic life years as contained in the NSW HFGs (Health Facility Guidelines). If none given, refer to the Energy Manual.

Costing Period: 30 years.

Capital Cost: Total as installed cost.

Salvage Value: Value remaining at the end of the costing period by reporting the capital cost equally over the economic life.

Discount Rate: To be in accordance with NSW Treasury Guidelines.
Escalation Rate: 0% for non energy costs as per page 363 of The Building Energy Manual. Use current consumer price index for energy costs.

Energy Escalation Rate: Current consumer price index.

12.1.15 ROOM DATA SHEETS

Part of the detailed (or Design) Brief provides a full description of individual room to allow designers to finalise their proposal.

Refer to Part B – Standard Components of the NSW HFGs (Health Facility Guidelines).

12.1.20 SCHEME DESIGN

(Sometimes called Sketch Design). The first stage of the Design and Documentation Process (Item 5 in the Process of Planning) where the general arrangement of departments, rooms, floor levels, plant rooms, road works, etc., is defined.

Mechanical Services

12.2.00 GENERAL REQUIREMENT

The selection of air handling, and heating and cooling systems shall be subject to life cycle costing (including maintenance costs), to show that the system(s) proposed give the lowest life cycle cost.

Life cycle costing calculations shall be in accordance with AS/NZS 4536 Life Cycle Costing.

This Mechanical Section provides data specific to mechanical services and is to be used in conjunction with AS/NZS 4536 - Life cycle costing – An application guide.

12.2.05 ECONOMIC LIFE

Economic life of mechanical components shall be those listed in Appendix MC to this Section of the Guidelines. The economic life given is based on data in the Building Energy Manual, supplemented by additional data from ASHRAE.

12.2.10 ENERGY COSTS

Energy costs shall be based on current published tariffs or supplier's proposed contract rates. Scheme Design Report shall include Life Cycle Analysis of;

- Alternate energy sources and associated systems to prove the proposed energy source; and
- Proposed central plant configuration (if central plant is to be incorporated in the project).

The Building Energy Manual, Figure 11.1 presents historical data on the change of energy costs over time.

Where a fuel is likely to change in cost at a rate that is different from the general rate of inflation, the estimated rate of change in energy costs shall be considered in life cycle costing.

It should be noted that in some instances (eg natural gas and electricity), energy cost increases from suppliers are subject to defined escalation formula and where these exist they are to be used for calculation purposes.

12.2.15 ENERGY CONSUMPTION

Energy consumption for mechanical heating, cooling and ventilation systems shall be modelled using approved energy modelling software. Manual methods shall only be used for simple calculations that do not involve climatic data, variable occupancy or use of load profiles.

The software package shall be a commercial package that has been validated by a

recognised benchmark test. The package shall have good technical support.

Section 14 Appendix 5 contains typical profiles for people, light and power loads based on current usage in New South Wales hospitals. These profiles shall be used unless users in the project in question provide profile data for their specific use of the area. Examples of this would involve multiple shift use of departments such as CSSD or a central regional 'cook chill' type kitchen.

Calculation of heating and cooling loads shall be according to Section 6 of this document.

Climatic data used for energy modelling shall be calculated as set out in The Building Energy Manual, Chapter 15, for the software used.

Hydraulic Services

12.3.00. GENERAL REQUIREMENT

Life cycle costing calculations shall be in accordance with Guideline Life Cycle Costing, refer clause 12.1.00. This Document provides data specific to hydraulic services and is to be used in conjunction with the method described in the Design Process Guideline Appendix A.

12.3.05 ECONOMIC LIFE

Economic life of hydraulic components generally shall be taken as (20) years. For commercial water heaters of mild steel vessel construction 5 years; for stainless steel vessel construction (20) years

12.3.10 ENERGY COSTS

Energy costs shall be based on current published tariffs or supplier's proposed contract rates.

Scheme Design Report shall include life cycle cost analysis of alternative energy sources to substantiate the proposed energy source.

Present argument based on historical data on the change of energy costs over time.

Where a fuel is likely to change in cost at a rate that is substantially different from the general rate of inflation to substantiate the estimated rate of change in energy costs shall be taken into account in life cycle costing.

12.3.15 ENERGY CONSUMPTION

Energy consumption for domestic hot water systems shall include the following:
- Thermal loss from system, vessel, etc, in kW
- Thermal input to system in kW
- Thermal output to system in kW
- Heat up period
- Estimated consumption load per day in kW
- Peak consumption in kW

In calculating energy and hot water consumption the most accurate data available shall be used and enumerated for the determination of usage, diversity, and pump and boiler or heaters, powers and efficiencies.

13. APPENDIX 4 MECHANICAL

Minimum Outdoor Airflow Rates

13.1.00. TABLE OFMINIMUM OUTDOOR AIRFLOW RATES

Occupancy Type	Net floor area per person m^2	Minimum outdoor airflow rate		
		Quantity	Unit	Comments
Cafeterias		15	L/s/person	Use briefed number of seats
Central Sterile Supply Department		10	L/s/person	Allow total of 6 people
*Computer Rooms	25	10	L/s/person	
*Conference/Tutorials Rooms	1	15	L/s/person	Use briefed number of seats
*Consultation Rooms	3.5		L/s/person	Allow 3 persons per room
Coronary Care Unit		10	L/s/person	Allow 2 persons per bed
*Corridors		1	L/s/person	
*Delivery Rooms	3.5	10	L/s/person	
Emergency Department		10	L/s/person	Allow 3 persons per bed
*Food prep areas	3.5	10	L/s/person	
*Foyers		1	L/s/person	
*General Office Areas	10	10	L/s/person	
High Dependency Unit	10	10	L/s/person	Allow 1.5 persons per bed
Intensive Care Unit		10	L/s/person	Allow 3 persons per bed
*Laundry	10	10	L/s/person	
Library	20	10	L/s/person	
Medical Imaging Rooms-General		10	L/s/person	Allow 2 persons per room
Medical Imaging Rooms – Special (e.g. MRI, CT, Screening)		10	L/s/person	(e.g. MRI, CT, Screening) Allow 5 persons per room
Neonatal Intensive Care Unit		10	L/s/person	Allow 1 person per baby
Nuclear Medicine Rooms		10	L/s/person	Allow 2 persons per room
Operating Rooms		20	L/s/person	Allow 12 people per theatre for AC load purposes
Pathology	3.5	10	L/s/person	
*Patient bed rooms	10	10	L/s/person	
Patient Lounges	2	15	L/s/person	Use briefed number of seats
*Physiotherapy	5	10	L/s/person	
*Post Mortem Rooms	5	50	L/s/person	100% fresh air required
*Procedures rooms	10	10	L/s/person	Allow 3 persons per room
Recovery Unit		10	L/s/person	Allow 1.6 persons per trolley
Well Baby Nursery		10		Allow 0.5 persons per baby

Tutorial Rooms	1	15		Use briefed number of seats
*Waiting areas	1.5	10		

Notes:
Occupancies marked with an asterisk are taken without change from Table A1 of AS 1668.2

Other notes to Table A1 of AS 1668.2 apply to the above.

14. APPENDIX 5 LOAD PROFILES

14.1.00 INTRODUCTION

The following data represents a consensus of load profiles for various departments in the hospitals in New South Wales. In general the profiles are expressed in terms of percent (%) of peak design load. It should be noted however that there are many instances where the peak load only occurs on a transient basis for a few days a year and hence the peak of the profile is not 100% of the design load (for example the design people load includes an allowance for the presence of students in Operating Rooms). Similarly fluctuations in visiting times result in percentages for people being less than 100% for some patient care areas.

Diversity has been taken into account in some types of load where it would be inappropriate to use full load during energy modelling. The % power column below is the percentage of internal heat gain due to equipment and does not include fan, refrigeration and related power.

The following date is to be used unless users can demonstrate, using similar profiles, that other regimes apply. This would in general relate to the extended hours of operation, multiple shifts per day and the like. The following example illustrates this:

14.1.05 SAMPLE LOAD PROFILE CALCULATION

The following example is for a Recovery room with space for 12 trolleys. It may operate 24 hours a day but has a peak use between 9am and 4pm. Staff consists of one nurse per two trolleys plus a charge nurse and one patient per trolley. After hours the recovery ward is used, on average, about 20% of the time.

People

No. of patients:	12
No of Nurses:	6
No of Charge Nurses:	1
Total	19

(This represents an average of 1.58 persons per trolley and agrees with the expanded table A1 of AS 1668.2 contained in this document)

During peak use (9am to 4pm) assume that all trolleys are occupied. During the period 4pm to 6pm (1600 to 1800) most patients have returned to wards and staff reduced so assume that 50% of people remain, For the balance of the time, use is intermittent but on average the number of people will be about a quarter of normal for 20% of the time, ie, 5%.

The profile is thus:

0000 – 0900	5%
0900 – 1600	100%
1600 – 1800	50%
1800 – 2400	5%

and on weekends

0000 – 2400	5%

14.1.10 LIGHTS

Although the number of people will vary, all lights will be on when Recovery is in use. Normal use of recovery is 9 am to 4pm, (0900 to 1600) with reduced occupancy but full lighting for a further two hours. Since use is intermittent after hours but is said to be 20%, we will use this as the average percentage of energy used for lighting. It does not however represent 20% of the lights on for 100% of the time.

The profile for lighting is thus:

Weekdays
0000 – 0900 20%
0900 – 1800 100%
1800 – 2400 20%

Saturdays and Sundays
0000 – 2400 20%

14.1.15 POWER

'Power' used in the following table is the energy consumed by equipment within the space and does not include mechanical plant energy for fans, pumps and the like.

Equipment in the space would normally comprise such things as monitors, computers, and other equipment plugged into general purpose electrical outlets. Some diversity may apply to the use of this equipment because not all equipment is normally on at the same time. However this would be taken into account when calculating the peak power usage and the load profile is scaled with 100% at peak.

In the case of our Recovery Ward example, it is assumed that the use of equipment generally follows patient occupancy, so that if only half the patents are present, slightly over half equipment will be switched on. This is because some equipment (such as refrigerators and computers), are permanently on and operate regardless of the number of patients.

During peak usage period of 0900 – 1600 100% of equipment will be on. In the run down period from 1600 – 1800 although on average only 50% of these patients are present, the equipment power usage is established to be 60%, being 50% for equipment used proportional to patients plus 10% for 'permanent' equipment at all times. After hours the percentage becomes 5% (same as people), plus 10% for the 'permanent' equipment.

The resulting profile is:

Weekdays
0000 – 0900 15%
0900 – 1600 100%
1600 – 1800 60%
1800 – 2400 15%

Saturdays and Sundays
0000 – 2400 15%

14.1.20 OPERATING ROOM SUITE

Time	%People	%Lights	%Power
OR – General / Endoscopy			
0000-0600	0	0	0
0600-0900	30	25	25
0900-1600	70	100	100
1600-1800	30	25	25
1800-2400	0	0	0
OR – Emergency			
0000-0600	15	15	15
0600-0900	30	25	25
0900-1600	79	100	100
1600-1800	30	25	25
1800-2400	15	15	15
Set-Up / Corridors			
0000-0600	25	25	0
0600-1800	25	100	100
1800-2400	25	25	0

Note: Assumes General Operating Room in use Monday to Friday, Emergency Operating Room in use 7 days per week.

14.1.25 RECOVERY

Time	%People	%Lights	%Power
Monday - Friday			
0000-0800	5	20	15
0800-1600	100	100	100
1600-1800	50	100	60
1800-2400	2	20	15
Saturday & Sunday			
0000-2400	15	20	15

14.1.30 CSSD (Based on a single shift per day Monday –Friday)

Time	%People	%Lights	%Power
Monday – Friday			
0000-0800	5	0	5
0800-1800	100	100	75
1800-2400	5	10	0
Saturday & Sunday			
0000-2400	5	10	0

14.1.35 CRITICAL CARE (Applies to ICU, CCU & HDU

Time	%People	%Lights	%Power
Monday – Sunday			
0000-0800	50	80	70
0800-1800	70	100	70
1800-2400	50	10	70

14.1.40 INPATIENT UNITS

Time	%People	%Lights	%Power
Monday – Sunday			
0000-0600	50	80	70
0600-1800	70	100	70
1800-2000	50	10	70
2000-2400	50	25	50

14.1.45 MEDICAL IMAGING

Note that the power requirements below are based on the average heat emission from x-ray equipment, not the connected electrical load.

Time	%People	%Lights	%Power
Monday – Friday			
0000-0800	5	5	5
0800-1800	100	80	100
1800-2400	5	5	5
Saturday & Sunday			
0000-2400	5	5	5

14.1.50 EMERGENCY

Note that the power requirements below are based on the average heat emission from x-ray equipment, not the connected electrical load.

Time	%People	%Lights	%Power
Monday			
0000-0800	10	100	50
0800-1800	60	100	80
1800-2400	10	100	50
Tuesday – Thursday			
0000-0800	10	100	50
0800-1800	40	100	50
1800-2400	10	100	50
Friday			
0000-0800	10	100	50
0800-1800	60	100	60
1800-2400	100	100	100
Saturday			
0000-0800	10	100	50
0800-1800	60	100	100
1800-2400	100	100	100
Sunday			
0000-0800	10	100	50
0800-1800	40	100	50
1800-2400	10	100	50

14.1.55 OUTPATIENTS, THERAPIES

Time	%People	%Lights	%Power
Monday – Friday			
0000-0800	0	0	0
0800-1600	100	100	100
1600-2400	0	0	0
Saturday – Sunday			
0000-2400	0	0	0

Note that Hydrotherapy Pool and parts of physical therapy pool may be used after hours.

14.1.60 MEDICAL RECORDS & OFFICE AREAS

Time	%People	%Lights	%Power
Monday – Friday			
0000-0800	0	0	0
0800-1600	100	100	100
1600-2400	0	0	0

14.1.65 PHARMACY / PATHOLOGY

Time	%People	%Lights	%Power
Monday - Friday			
0000-0800	0	0	0
0800-1800	100	100	100
1800-2400	0	0	0
Saturday – Sunday			
0000-2400	5	5	5

14.1.70 KITCHEN (Based on conventional Kitchen. If 'cook-chill, figures require adjustment)

Time	%People	%Lights	%Power
Monday - Sunday			
0000-0500	0	0	0
0500-0800	100	100	100
0800-1000	50	100	50
1000-1300	100	100	100
1300-1500	50	50	50
1500-1700	100	100	100
1700-2200	50	50	50
2200-2400	0	0	0

15. APPENDIX 6 ECONOMIC LIFE OF PLANT EQUIPMENT

Mechanical Equipment

15.1.00. TABLE OF ECONOMIC LIFE

Equipment Item	Median Years
Air conditioning	
Window unit	10
Residential single or split package	15
Commercial through- the-wall	15
Water cooled package	15
Heat pumps	
Residential air-to-air	15
Commercial air-to-air	15
Commercial water to air	19
Roof top air conditioners	
Single zone	15
Multizone	15
Boilers, hot water (steam)	
Steel water-tube	24 (30)
Steel fire tube	25 (25)
Cast iron	35 (30)
Electric	15
Burners	21
Furnaces	
Gas or oil fired	18
Unit heaters	
Gas or electric	13
Hot water or steam	20
Radiant heat	
Electric	10
Hot water or steam	25
Other Heaters	
Electrical strip heaters	10*
Oil filled electric radiators	18*
Off-peak electric storage heaters	22*
Radiators (hot water)	22*
Gas convection heater	18*
Air terminals	
Diffusers. grilles. and registers	27
Induction and fan -coil units	20
V A V and double- duct boxes	20
Ductwork	30
Dampers	20
Fans	
Centrifugal	25
Axial	20
Propeller	15
Ventilating roof mounted	20
Coils	
DX. water or steam	20
Electric	15
Heat Exchangers	
Shell and tube	24
Reciprocating compressors	20
Package Chillers	
Reciprocating	20
Centrifugal	23
Absorption	23

Cooling towers	
Galvanised metal	20
Wood	20
Plastic	34
Tanks (depends on material)	15-25*
Air cooled condensers	20
Evaporative condensers	20
Insulation	
Moulded	20
Blanket	24
Pumps	
Base-mounted	20
Pipe-mounted	10
Sump and well	10
Condensate	15
Reciprocating engines	20
Steam turbines	30
Electric motors	18
Motor starters	17
Electric transformers	30
Controls	
Pneumatic	20
Electric	16
Electronic	15
Valve actuators	
Hydraulic	15
Pneumatic	20
Self-contained	10
Pipework and valves	20-25*

Sources:
ASHRAE 1991 HV AC Applications Page 33.3. except * those that are from Building Energy Manual. Chapter 17 Appendix 2.

Electrical - Equipment

15.2.00. TABLE OF ECONOMIC LIFE

COMPONENT	ECONOMIC LIFE
Main cables	25-30
Switchgear & distribution equipment	25-30
Final circuits and outlets	20-25
Lighting installations	20-25
Electric motors	20-25
Generators	25-30
Prime movers, diesel (continuously rated)	15-20
Prime movers, steam (continuously rated)	25-30
Standby prime movers, diesel	
Clock systems	20-25
Call systems	20-25
Fire alarm systems	20-25
Telephone systems	20-25
Batteries (lead acid)	3-5
Batteries (nickel alkaline)	10-15

Lifts

15.3.00. TABLE OF ECONOMIC LIFE

COMPONENT	**ECONOMIC LIFE (YEARS)**
Main cables	25-30
Switchgear & distribution equipment	25-30
Final circuits and outlets	20-25
Lighting installations	20-25
Electric Motors	20-25
Generators	25-30
Prime movers, diesel (continuously rated)	15-20
Prime movers, steam (continuously rated)	25-30
Standby prime movers, diesel	
Clock systems	20-25
Call systems	20-25
Fire alarm systems	20-25
Telephone systems	20-25
Batteries (lead acid)	5-10
Batteries (nickel alkaline)	10-15

16. APPENDIX 7 PROCESS OF PLANNING STAGES

ELECTRICAL EQUIPMENT

Scheme Design Report

16.1.00. INTRODUCTION

The Scheme Design Report is intended to provide an understanding of design decisions taken to date and the basis of those decisions. The report requires designers to justify their decisions and to report on Capital and Recurrent Costs in a consistent format to allow comparison with other projects.

The report aims to ensure that site specific services requirements are identified and appropriate allowances made in the Cost Plan at Scheme Design Stage.

16.1.05 REPORT CONTENT

The report shall contain at least the schedules, reports, drawings, calculations and analyses described below, plus any other deemed necessary by the Project Director, Health Department or relevant Project Committees.

16.1.10 DRAWINGS

1 Submission

Submit drawings at a scale not less than 1:200 showing:

Preferred location of substation, switchboard, emergency generator, mains entry to site, risers, etc.,*

Proposed location of substation, switchboard, emergency generator, mains entry to site, risers, etc.,*

Preferred ceiling and sub-floor reticulation space dimensions.*

Proposed ceiling and sub-floor reticulation space dimensions.*

Drawings at suitable scale to show:

- Preferred location of major plant items.
- Power distribution single line diagram.
- H.V (high Voltage) power supply arrangement.
- Standby generator power distribution single line diagram.
- Security alarm systems schematic diagram.
- Lightning protection system schematic diagram.
- External electrical services layout diagram

Any other drawings necessary to demonstrate the proposed extent and configuration of the proposed electrical systems.

16.1.15 2 Discrepancies

Explain the reasons for differences between preferred and proposed dimensions and layouts in items marked * above.

Describe the consequences and costs of these differences.

16.1.20 ELECTRICITY SUPPLY & DEMAND

Peak maximum demand	KVA
Lowest maximum demand	kVA
Average maximum demand	YES/NO

New substation required	kVA
New substation capacity	kVA
Spare capacity included	kVA
Spare space for additional transformer(s)	YES/NO
Ultimate fully fitted substation capacity	kVA
Power factor correction equipment included	kvar

16.1.25 STANDBY POWER REQUIREMENTS

Total assessed requirement	kVA
Spare capacity included	kVA
No. of generating sets	kVA
Heat banks for testing included	YES/NO
No. of heat banks	kVA
Diesel storage capacity	FULL LOADED HOURS

16.1.30 ENERGY CONSUMPTION ESTIMATES AND TARIFF SELECTION

Peak period	kWh PER ANNUM
Shoulder period	kWh PER ANNUM
Off period	kWh PER ANNUM
Recommended Tariff	kWh PER ANNUM

16.1.35 POWER DISTRIBUTION SYSTEM

Brief description of power distribution system

(Also refer to single line diagram)

Brief description of standby power distribution system

(Also refer to single line diagram)

Provide the following detail of every submain proposed to be installed

Submain Description	
Group A, B or C	(refer to clause 3.6.05)
Normal/ Generator Supply	
Full Load Capacity	
Spare Capacity included	kVA
Wiring system rating	
Voltage drop at full load	%

16.1.40 WIRING SYSTEM FOR PATIENT TREATMENT

List area proposed to be body protected

Department Room/Location

List areas proposed to be cardiac protected.

Department Room/Location

16.1.45 LIGHTNING PROTECTION SYSTEM

Risk assessment factors

A

B

C

D

E

16.1.50 LIGHTING SYSTEM

Describe briefly the lighting proposals

16.1.55 DESCRIPTIONS OF OTHER SYSTEMS

For any system not already analysed provide:

- A brief description of the chosen systems
- Reasons for the choice made, and
- Positive and negative aspects of this choice

16.1.60 REPORT ON EXCEPTIONS FROM GUIDELINES

Guideline Reference	Departure	Reason

[List those aspects of the proposed scheme which do not conform to these Guidelines together with the nature of the departure and reason for departing from the Guidelines]

16.1.65 CAPITAL COST ESTIMATE

An estimate of the forecast capital cost shall be submitted in accordance with the following schedule as applicable.

These estimates are to be prepared for each relevant component on a current rate basis expressed as a lump sum.

16.1.70 ELECTRICAL SERVICES

E1 Power distribution equipment

i) Main switchboards
ii) Distribution boards

E2 Mains and sub mains

i) Consumer mains installation
ii) Sub-mains

E3 Interior lighting
E4 General purpose power outlets and wiring
E5 Cable trays, conduits, floor ducts and skirting ducts
E6 Emergency lighting and exit signs
E7 Stand by generator
E8 UPS system
E9 Cardiac and body protection power provision
E10 Clocks
E11 Signage
E12 Power factor correction installation complete
E13 Testing, commissioning, as installed drawings and manuals, maintenance and defects liability
E14 High voltage Installation complete
E15 Lightning protection system
E16 Security alarm, access control and CCTV surveillance system
E17 Exterior and car park lighting
E18 External sub-mains and mains installation including associated works

SUBTOTAL (Elements E1 – E18) $_____

16.1.75 SPECIAL EQUIPMENT

1 Operating theatre lights
2 Examination lights (mobile and fixed)
3 Hand dryers
4 X-Ray view boxes and multi-plans viewing machines
5 Clocks (battery operated type)
6 Ultra violet room lights
7 U.V. insect destructors
8 Metal detectors
9 Centralised dictation system
10 Illuminated directory/display signs
11 Other items not included above

SUB TOTAL (Elements 1 to 11) $_____

Electrical Services Capital Cost Estimate $_____

16.1.80 RECURRENT COST ESTIMATE

A schedule of annual energy usage and costs shall be submitted in the following form. It is to include the total annual energy cost of the entire electrical installation.

A schedule of annual energy usage and costs shall be submitted in the following form. It is to include the total annual energy cost of the entire electrical installation.

ENERGY SOURCE	**ANNUAL CONSUMPTION**		**NET COST OF ENERGY**	**ANNUAL ENERGY COST**	**ENERGY CONSUMPTION INDEX**	**ENERGY COST INDEX**
	Gj	**kWh**	**CENTS/MJ**	**$**	**MJ/SQM**	**$/SQM**
Electricity Diesel						
TOTAL						

16.1.85 VALUE ADDING STRATEGIES

[Provide a description of design decisions taken that show an innovative approach to reducing both Capital and Operating Costs of the proposed systems.

List here Value-Adding strategies adopted eg. shared reticulation, plant space, waste heat scavenging, etc.]

Description Benefit

17. APPENDIX 8 PROCESS OF PLANNING

MECHANICAL EQUIPMENT

Project Definition Plan

17.1.00. INTRODUCTION

The Project Definition Plan is intended to provide an understanding of the fundamental planning decisions taken to date and the basis of those decisions. The report requires designers to justify their decisions and to report on Capital and Recurrent Costs in a consistent format to allow comparison with other projects. The report aims to ensure that site specific services requirements are identified and appropriate allowances made in the Cost Plan at Project Definition.

17.1.05. EXPLANITORY NOTES

In the following, explanatory notes are provided in [boxes]

[These notes set out a format to be used for the consistent presentation of mechanical systems in the Project Definition Plan. They are intended to assist engineers in completing the relevant parts of the plan. In interpreting its contents]

17.1.10. PLAN CONTENT

The plan shall contain at least the information described below, plus any other deemed necessary by the Project Director, NSW Health Department or relevant Project Committees.

17.1.15. DESIGN CONDITIONS

1 Outside Design Conditions

Summer: [ ] Centigrade dry bulb [ ] Centigrade wet bulb

Winter: [ ] Centigrade dry bulb

Source of Design Conditions:-

It is expected that the source will be AIRAH-ACS Design Aid DA9A – Refer Guideline.

17.1.20. 2 Inside Conditions

Areas	Summer		Winter Source of Design Conditions
Covered	Centigrade dry bulb	%RH	Centigrade dry bulb

[Insert design conditions used in air conditioning and hearing load calculations. Where different conditions have been used for different parts of the project nominate these against respective areas of departments. Where they are user nominated or to meet an equipments supplier's specification this is to be noted.]

17.1.25. Schedule of Areas

CATEGORY 1
Area Type of System

CATEGORY 2
Area Type of System

CATEGORY 3
Area Type of System

[In the above a general description of the 'type of system' is required eg 'Air Conditioned', 'Natural Ventilation', 'Heated Ventilation', 'Radiator Heating', etc.]

17.1.30. REPORT ON EXCEPTIONS FROM GUIDELINES

1 General.

Guideline Departure Reason

Reference

[List those aspects of the proposed scheme which do not conform to these Guidelines together with the nature of the departure and reason for departing from the Guidelines.]

17.1.35. 2 Air Conditioning

[Where air conditioning is proposed for Category 2 and/or 3 areas above, describe what measures have been taken to minimise air conditioned areas, what passive cooling measures have been considered and why it is not considered feasible to provide satisfactory conditions without air conditioning]

17.1.40. CAPITAL COST ESTIMATE

[Provide a cost against each item on the list included in the design proposal.
An estimate of the forecast capital cost shall be submitted in accordance with the following schedule as applicable]

[These estimates are to be prepared for each relevant component on a current rate basis expressed as a lump sum.]

17.1.45. MECHANICAL SERVICES $_____

M1.0 Equipment
M2.0 Ductwork
M3.0 Pipework and valves
M4.0 Insulation
M5.0 Electrical and controls
M6.0 Building management systems
M7.0 Testing, commissioning, as installed drawings, manuals, maintenance and defects liability
M8.0 Special equipment
M9.0 Medical gases

TOTAL (elements M1.0 to M9.0) $_____

17.1.50. VALUE-ADDING STRATEGIES

[Provide a schedule of design decisions taken that show an innovative approach to reducing both Capital and Operating Costs of the proposed systems].

[List here Value-Adding strategies adopted eg, shared reticulation, plant space, waste heat scavenging, etc.]

Description Benefit

Scheme Design Report

17.2.00. INTRODUCTION

The Scheme Design Report is intended to provide an understanding of design decisions taken to date and the basis of those decisions. The report requires designers to justify their decisions and to report on Capital and Recurrent Costs in a consistent format to allow comparison with other projects. The report aims to endure that site specific services requirement are identified and appropriate allowances made in the Cost Plan at Scheme

17.2.05. DESIGN STAGE.

EXPLANATORY NOTES

[These notes set out a format to be used for the consistent presentation of mechanical systems in the Scheme Design Report. They are intended to assist engineers in completing the relevant parts of the scheme design report and also to serve as a reference for readers of the report in interpreting its contents.]

17.2.10. REPORT CONTENT

The report shall contain at least the schedules, reports, drawings and calculations described below, plus any other deemed necessary by the Project Director, NSW Health Department or relevant Project Committees.
DRAWINGS

Submission

Schedule the drawings including name, number, scale, date, etc.

Submit drawings at an appropriate scale to show:

1. Preferred location of plant rooms, major duct areas, major risers, roof mounted plant, cooling towers etc,

2. Proposed location of plant rooms, major duct areas, major risers, roof mounted plant, cooling towers etc,

3. Preferred clear services reticulation dimensions for floor and ceiling spaces, and

4. Proposed clear services reticulation dimensions for floor and ceiling spaces.

5. Plant schematic designs for air and water systems.

6. Single line duct drawings for air handling plants showing proposed zoning

7. Plant rooms layouts showing principal items of plant in block form

8. Other drawings of appropriate scale and detail to adequately describe the extent and configuration of the proposed mechanical systems.

17.2.15. Discrepancies

[Describe any instances where the optimum design has not been achieved due to constraints imposed by the planning, building form, site, etc.

1. Explain the differences between preferred and proposed dimensions and layouts in items (1) – (4) above.

2. Describe the consequences and capital and operating costs of these differences.]

17.2.20. INSIDE DESIGN CONDITIONS

Areas Covered	Summer Centigrade dry bulb %RH	Winter Centigrade dry bulb	Source of Design Conditions

[Insert design conditions used in air conditioning and hearing load calculations. Where different conditions have been used for different parts of the project nominate these against respective areas of departments. Where they are user nominated or to meet an equipment supplier's specification this is to be noted.]

17.2.25. LOAD CALCULATIONS

[Software employed: Provide name of load estimation software used. Refer Guideline for approved software.]

Glazing System Description:

Briefly describe the glazing system used for load calculations. This should include type of glass, coating (if any) and any internal shading assumed. Where more than one type is used nominate the respective areas.

Shade Coefficient U value: ( ) W/m^2K

Provide shade coefficient and U values for the combined glazing and shading systems. Wall System description:

Briefly describe the wall construction used for load calculations. Where more than one wall type is used nominate the respective areas. Provide overall heat transfer coefficient (U value) for each type.

U Value: ( ) W/m^2K

Roof System Description
As for wall system U Value: ( ) W/m^2K

Floor System Description
As for wall system U Value: ( ) W/m^2K

17.2.30. PROPOSED AIR HANDLING SYSTEMS

Use this to outline the proposed air handling systems including hearing only systems and evaporative cooling.

This is a sample page only. Provide additional pages to cover all systems. Use multiple columns per page if desired.

Plant No.	Provide a unique identifying number for each.
Location of Plant	Location of air handling plant eg. 'Plantroom No 1'
Air Handling System Type	Describe the type of air handling system eg. 'Multizone', 'Heating only constant volume'
Cooling Source	eg Chilled Water, Evaporative Cooler, None, etc.
Heating Source	Type of heat source eg LTHW, Reserve Cycle
Names of Areas served	Names of areas or departments served by this plant
Guideline Category	Category of area served in accordance with guideline
Hours of Operation	Normal hours of operation eg. '8.00 am to 6.00 pm. Monday to Friday'

Cooling Capacity kW (R)	Total cooling capacity of the individual plant (if applicable)
Heating Capacity kW	Total heating capacity of the individual plant
Supply Air L/s	Total supply air quantity of the individual plan
Floor Area m^2	Net conditioned and /or heated
Cooling W/m^2	Based on cooling capacity and net area above (if applicable)
Heating W/m^2	Based on heating capacity of the individual plant and net area above
Supply Air $L/d/m^2$	Based on supply air and net area above for the individual plant
Type of Smoke Control	Type of smoke control system (if any) to BCA or System AS1668 part one

17.2.35. CENTRAL PLANT

1. Cooling Plant

Description of Plant:

Describe the overall plant configuration eg. 'Two 500 kW reciprocating chillers with two fibreglass towers, two chilled water pumps, two condenser water pumps'.

Locations:	Location of central plant eg. 'Roof Plantroom'
Total Load:	kW Combined cooling capacity of the plant including diversity allowance.
Average Load kW/m^2	Total load above divided area served.
Total installed capacity	kW Combined capacity of all central chilling plants

Detail any standby plant

Duplication provisions:	Provide here details if any duplicate plant and why provided.

Example:
'Duplicate chilled and condenser water pumps, duplicate condenser water circuits provided to meet availability criteria.'

2. Heating Plant

Refer to 'Cooling Plant' above

Description of Plant:

Location:

Energy Source:

Total Load Kw

Average Load Kw

Detail any standby plant or duplication provisions:

17.2.40. EXHAUST SYSTEMS

Provide details of proposed exhaust systems. Those provided meeting AS1668 Part 2 requirements can be covered by a general note eg.

Toilet exhaust, kitchen exhaust, dirty utility, car park ventilation comply with AS1668 Part 2

Other exhaust systems should be listed individually and described eg

Area Served	System Name	Description
Mortuary	Mortuary	Exhaust from down draft mortuary table to roof mounted fan
Pharmacy	Cyotoxic Cabinet	Exhaust from cyotoxic cabinet including HEPA filter and variable speed fan

17.2.45. MEDICAL GAS SYSTEMS

1 Extent of Medical Gas Systems

Insert the number of each type of medical gas outlet and the source of the gas

Gas	Number of Outlets	Source

2 Description of Central Medical Gas Plant and Storage

Describe the source in detail. Include the location for each

Central Plant:	Number and capacity of central compressors and vacuum pumps together with calculated maximum demand
Manifold storage:	Number and size of cylinders, manifold arrangements.
Bulk Storage:	Size of bulk storage and stand by facilities. State whether leased or not.

17.2.50. DESCRIPTIONS OF OTHER SYSTEMS

For each item of plant, equipment, etc., (not already reported upon) provide:

- A brief description of the chosen system, component or item
- Reasons for the choice made
- Positive and negative aspects of the preferred system

17.2.55. REPORT ON EXCEPTIONS FROM GUIDELINES

Guideline Reference	Departure	Reason

[List those aspects of the proposed scheme which do not conform to these Guidelines together with the nature of the departure and reason for departing from the Guidelines

17.2.60. CAPITAL COST ESTIMATE

Provide a cost of against each item on the following list as included in the design proposal.

An estimate of the forecast capital cost shall be submitted in accordance with the following schedule as applicable.

These estimates are to be prepared for each relevant component on a current rate basis expressed as a lump sum.

17.2.65. MECHANICAL SERVICES

M1.0 Equipment
M1.1 Chillers
M1.2 Boilers
M1.3 Cooling Towers
M1.4 Heat Exchanges
M1.5 Pumps
M1.6 Factory made air handling units
M1.7 Evaporative coolers
M1.8 Process (computer) Air Conditioning Unit
M1.9 Packaged DX Air Conditioning Units
M1.10 Room Fan Coil Units
M1.11 Radiators & Fan Convectors
M1.12 Centrifugal Fans
M1.13 Axial Flow Fans
M1.14 Roof Mounted Fans
M1.15 Electric Duct Mounted Heaters
M1.16 Sounds Attenuators
M1.17 Humidifiers
M1.18 VAV Boxes
M1.19 Air Filters
M1.20 Kitchen Hoods
M1.21 Other Items Not Included in the Above

M2.0 Ductwork
M2.1 Ductwork
M2.2 Air Diffusers & Grilles
M2.3 Fire Dampers
M2.4 Sheet Medal Enclosures for Built-up Air Handling Units Excluding Equipment

M3.0 Pipework and Valves
M3.1 Pipework and Valves
M3.2 Cooling and Water Coils
M3.3 Water Treatment

SUB TOTAL (ELEMENTS M1.0 TO M3.3) $____

M4.0 Insulation
M4.1 Insulation

M5.0 Electrical and Controls
M5.1 Electrical Work
M5.2 Automatic Controls

M6.0 Building Management Systems
M6.1 Building Management Systems

M7.0 Testing, commissioning, as installed drawings, manuals, maintenance and defects liability
M7.1 Testing, commissioning, as installed drawings, manuals, maintenance and defects liability

M8.0 Special Equipment
M8.1 Medical Gas Pendants
M8.2 Fume Cupboards
M8.3 Laminar Flow Benches
M8.4 Cyotoxic Cabinets
M8.5 Steam Generators
M8.6 Cool Rooms
M8.7 Mortuary Table
M8.8 Mortuary Cabinets (refrigerated)
M8.9 Ice Making Machines
M8.10 Audiometric Booth
M8.11 Laundry Equipment

Washers
Dryers
Irons
Presses

M8.12 Dental Equipment
M8.13 Dental Wet Vacuum system
M8.14 Refrigerated Drinking Fountains
M8.15 Paint Spray Booth
M8.16 Fume Cupboards
M8.17 Biological Safety Cabinets
M8.18 Cyotoxic Cabinets
M8.19 Laminar Flow Benches
M8.20 CSSD Equipment
Sterilisers
Anaesthetic washer / decontaminator
M8.21 Other items not included above.

M9.0 Medical Gases
M9.1 Medical Vacuum
M9.2 Medical Oxygen
M9.3 Medical Air
M9.4 Other Medical Gasses (Itemise)

SUB TOTAL (elements M4.0 to M9.0) $_____

Mechanical Services Capital Cost Estimate $_____

17.2.70 RECURRENT ENERGY COST ESTIMATE

[Complete the Recurrent Costs table so as to provide information for the client to assess this component of the Hospital's operating budget.

A schedule of energy usage and costs shall be submitted in the following form. It is to include the total annual energy cost of the entire installation. Energy costs from various sources shall be expressed in terms of the respective published tariffs or contract rates ('units' in the table below) and converted to a common base of MJ for expression of Annual Energy Consumption index. 'Net Cost of Energy' in the table below is to include all associated costs (such as delivery, lease of storage facilities etc) and be expressed in terms of the units in which the energy form is metered or charged.]

ENERGY SOURCE	**ANNUAL CONSUMPTION**			**NET COST OF ENERGY**	**ANNUAL ENERGY COST**	**ENERGY CONSUMPTION INDEX**	**ENERGY COST INDEX**
	Units	**Quantity**	**Equivalent GJ**	**$/MJ**	**$**	**MJ/m^2**	**$/^{2}**
Electricity							
Coal							
Natural Gas							
LPG							
Oil							
TOTAL							
Where the above is based on a 'special rate' attach written confirmation from supplier to the report. Express annual consumption of each energy source in units used by supplier (eg electricity in KWH) then convert in succeeding columns to a common base of megajoules (MJ).							

17.2.75 VALUE-ADDING STRATEGIES

[Provide a schedule of design decisions taken that show an innovative approach to both Capital and Operating Costs of the proposed systems.

List here Value-Adding strategies adopted eg. shared reticulation, plant space, waste heat scavenging, etc.]

Description Benefit

17.2.80 LIFE CYCLE COSTING

1. CALCULATION METHOD

Software used:
[Nominate software used.] Source of Climatic Data [eg. 'Supplied with Software' or 'Calculated in accordance with Building Energy Manual'.]

Source of Load Profiles [Normally these will be the profiles included in the guidelines but where users have nominated particular requirements these are to be noted for the respective department or area]

17.2.85 2. DESCRIPTION OF SYSTEMS ANALYSED USING LIFE CYCLES COSTING TECHNIQUES

[Provide detailed descriptions of each of the alternative air handling systems analysed eg, 'Variable air volume with packaged air handling unit, variable speed fans, chilled and heating water coils, hot water VAV reheat boxes for perimeter zones and fan bypass VAV boxes for centre zones.']

Central Plant Systems

[Provide detailed descriptions of each central plant option eg]
(Chilled Water: Two 1200 kW screw chillers, one heat recovery type (55ºC water) plus one 500kW reciprocating low load chiller. Separate condenser water circuits for each primary and secondary chilled water circuits with duplicate pumps on secondary circuit and one primary pump per chiller. Heat recovery via plate heat exchanger to LTHW circuit. One cooling tower per chiller] ['Heating Water' Packaged hot water boilers at 85 ºC with primary / secondary circuits and heat recovery from plate heat exchanger. One primary pump per boiler, duplicate secondary pumps.]

17.2.90 3. AIR HANDLING SYSTEM

[Provide results of life cycle costing carried out in accordance with the Guidelines. It is intended that all categories will be completed even if 'N.A' (Not applicable) is nominated]

Economic Life:	[In accordance with Guidelines]
Costing Period	[30 years]
Capital Cost	[Cost of the system described in the preceding section This is to include all associated costs including provision of plantroom, electrical supply and the like they vary between options.]
Salvage Cost	[Refer to Guideline]
Interest Rate	[Refer to Guideline]
Gas and Electricity Rates:	[Provide rates based on suppliers published tariffs. If other energy sources are proposed (eg., cost, oil) insert respective data.]
Gas and Electricity Usage:	[Calculated data from the output of approved energy modelling software.

Maintenance: [Estimated average annual cost of maintenance including all labour and replacement parts and replacement materials.]

Operator Costs: [Cost of plant operator if required on a regular basis. Normally nil for air handling systems.]

PRESENT WORTH: [Results of calculations in accordance with Appendix DPA]

LIFE CYCLE COSTING

OPTION	Option 1	Option 2	Option 3

DATA

Economic Life (years)
Costing period (years)

Capital Cost ($)
Salvage Value ($)

Interest Rate (%pa)
Inflation Rate (%pa)
Gas Escalation Rate (%pa)
Electric Escalation Rate (%pa)

Gas Cost (c/MJ)
Electricity Demand Cost ($/kVA)*
Electricity Peak (c/kWh)
Electricity Shoulder (c/kWh)
Electricity Cost Off Peak (c/kWh)

Gas Use (MJ/year)
Electricity Demand (kVA/year)*
Electricity Use Peak (kWh/year)
Electricity Use Shoulder (kWh/year)
Electricity Use Off Peak (kWh/year)

Maintenance ($/year)
Operator Costs ($/year)

*Use kW where the basis of demand measurement.

PRESENT WORTH CALCULATION

Fire Cost

No Times Renewed
Renewal Costs (if applicable)
Salvage Value

Gas Energy Cost
Electric Demand Cost
Electric Energy Cost Peak
Electric Energy Cost Shoulder
Energy Cost Off Peak
Maintenance Cost

PRESENT WORTH

17.2.95 4 CENTRAL PLANT

[Information to follow that for air handling units. Include under ‘Operator Costs’ total annual

cost of providing a Boiler Attendant or the like if required for plant operation or to meet WorkCover Authority requirements.]

OPTION	Option 1	Option 2	Option 3
DATA			
Economic Life (years)			
Costing period (years)			
Capital Cost ($)			
Salvage Value ($)			
Interest Rate (%pa)			
Inflation Rate (%pa)			
Gas Escalation Rate (%pa)			
Electric Escalation Rate (%pa)			
Gas Cost (c/MJ)			
Electricity Demand Cost ($/kVA)*			
Electricity Peak (c/kWh)			
Electricity Shoulder (c/kWh)			
Electricity Cost Off Peak (c/kWh)			
Gas Use (MJ/year)			
Electricity Demand (kVA/year)*			
Electricity Use Peak (kWh/year)			
Electricity Use Shoulder (kWh/year)			
Electricity Use Off Peak (kWh/year)			
Maintenance ($/year)			
Operator Costs ($/year)			

*Use kW where the basis of demand measurement.

PRESENT WORTH CALCULATION

Fire Cost	
No Times Renewed	
Renewal Costs (if applicable)	
Salvage Value	
Gas Energy Cost	
Electric Demand Cost	
Electric Energy Cost Peak	
Electric Energy Cost Shoulder	
Energy Cost Off Peak	
Maintenance Cost	
PRESENT WORTH	

18 APPENDIX 9 PROCESS OF PLANNING

HYDRAULIC EQUIPMENT

Project Definition Plan

18.1.00 INTRODUCTION

The Project Development Plan is intended to provide details of significant design decisions. The Plan requires designers to justify their decisions and to report on Capital and Recurrent Costs in a format that will allow comparison with other projects. The Plan aims to ensure that site specific services requirements are identified and appropriate allowances made in the Cost Plan at Scheme Design Stage.

18.1.05 PLAN CONTENT

The Plan shall contain at least the reports, drawings and board calculations proofs considered necessary to establish the validity of concept design to the Project Director, NSW Health Department or relevant Project Committees.

18.1.20 COLD WATER SUPPLY

Fully describe proposed cold water supply arrangement proposed. Mains supplied systems are preferred.

Confirm the reliability of the public utility's cold water main to supply the project at all times based on historical data and alternative supply paths within the external network. Cold Water Pressure

Confirm the minimum fire pressures and flows. Confirm the system will sustain pressures of not less than 50 KPA at the most disadvantaged fixture.

18.1.25 COLD WATER TANKAGE

Where water storage is proposed provide explanatory notes and design calculations relevant to the use of water storage including the following:

- the purpose of the water storage
- the storage volume provided for each purpose static pressure provided to fixtures supplied from storage
- capacity of storage in hours to maintain essential health care functions served
- proposals related to legionella control.

18.1.30 SEWER

Advise the following:

- Capacity of sewer to serve calculated imposed load.
- Calculated reserve capacity for future building expansion.
- Confirm elevation of sewer connection is sufficient to serve site by gravity drainage.
- Advise costs imposed by public utility as a capital works contribution.

18.1.35 STORMWATER DRAINAGE CONNECTION

Confirm the following as a Civil Engineering item:

- Confirm adequacy of stormwater connection point to accept site catchment based on nominated storm intensities without retention pondage on site.
- Advise Reserve capacity of system for expansion in terms of run off
- Advise retention requirements where this is a mandatory requirements of local authority.

18.1.40 GAS CONNECTION

Confirm the following:

Type of gas (LPG or Natural)

Potential of supply to meet project load in MJ or size of LPG storage vessel.

Scheme Design Report

18.2.00 INTRODUCTION

The Scheme design Report Plan is intended to provide an understanding of significant design decisions. The report requires designers to justify their decisions and to report on Capital and Recurrent Costs in a format that will allow comparison with other projects.

The report aims to ensure that site specific services requirements are identified and appropriate allowances made in the Cost Plan at Scheme Design Stage.

18.2.05 REPORT CONTENT

The report shall contain at least the schedules, reports, drawings and calculations described below, plus any other deemed necessary by the Project Director, NSW Health Department or relevant Project Committees.

18.2.10 DRAWINGS

1 Submission

Schedule the drawings including name, number, scale, date, etc.

Submit drawings at an appropriate scale to show:

Preferred location of plant rooms, major duct areas, major risers, major roof mounted plant, tanks, pre-treatment plant etc,

- Proposed location of plant rooms, major duct areas, major risers, major roof mounted plant, tanks, pre-treatment plant etc,
- Preferred clear services reticulation dimensions for floor and ceiling spaces, and
- Proposed clear services reticulation dimensions for floor and ceiling spaces
- Plant schematic drawings for water systems, plumbing, drainage and rainwater collection
- Single line plan drawings for major pipe routes
- Site plans showing water supply connection, sewer outfall, storm water outfall, LPG storage, water and gas meter location, fire brigade inlet booster connection, external fire hydrants, external hose cocks for irrigation.
- Plant rooms plans showing principal items of plant in block form
- Other drawings of appropriate scale and detail to adequately describe the extent and configuration of the proposed hydraulic systems,

2 Discrepancies

Describe any instances where the optimum design has not been achieved due to constraints imposed by the planning, building form, site, etc.

- Explain the differences between preferred and proposed dimensions and layouts in ‘Proposed clear services reticulation dimensions……..’ above

- Describe the consequences and capital and operating costs of these differences.

18.2.15 COLD WATER SUPPLY

Fully describe proposed cold water supply. Mains supplied systems are preferred. Confirm the reliability of the public utility's cold water main to supply the project at all times based on historical data and alternative supply paths within the external network. Confirm that the water meter provided is the smallest practical size permitted based on the pressure drop at maximum continuous flow which shall be not more than 3% of the maximum working pressure for an approved magnetic drive water meter.

Cold Water Pressure

Confirm the minimum fire pressures and flows. Confirm the system will sustain pressures of not less than 50 KPA at the most disadvantaged fixture.

18.2.20 COLD WATER TANKAGE

Where water storage is proposed provide explanatory notes and design calculations relevant to the use of water storage including the following:

- the purpose of the water storage
- the storage volume provided for each purpose material construction of storage tanks and maintenance provisions
- static pressure provided to fixtures supplied from storage provided as dedicated fire reserve
- capacity of storage in hours to maintain essential health care functions served (e.g. Surgeons Scrub)

18.2.25 SEWER

Confirm the following:

- Capacity of sewer to serve calculated imposed load.
- Calculated reserve capacity for future building expansion.
- Confirm elevation of sewer connection is sufficient to serve site by gravity drainage.
- Advise costs imposed by public utility as a capital works contribution.
- Confirm investigations into the cost in accordance with the life cycle costing procedure herein, of recycled waste water recovery, pre treatment comprising chlorination, filtration and reuse as irrigation supply where considered appropriate.

18.2.30 STORMWATER DRAINAGE CONNECTION

Confirm the following as a Civil Engineering item:

- Confirm an overland fail safe flood path is provided.
- Confirm adequacy of stormwater connection point to accept site catchment based on nominated storm intensities without retention pondage on site.
- Advise Reserve capacity of system for expansion in terms of run off. Advise retention requirements where this is a mandatory requirements of local authority.

18.2.35 GAS CONNECTION

Confirm the following:
- Potential of supply to meet project load in kW
- Calculation basis for established gas load.
- Provide an annual cost of consumption estimate and the fuel tariff applicable
- Advise reserve capacity of system as a percentage of calculated use.

18.2.40 WASTE COLLECTION SYSTEMS

Describe the method of laying drainage system below ground floor slab:

Drainage pipe material:

Describe vertical stack arrangement:

Describe any plumbing systems above ground comprising horizontal aerial drainage collection systems.

18.2.45 TRADE WASTE SYSTEM

Outline design solution and cost impact of designs proposed for the following:

Process
Kitchen
Medical Imaging
Mortuary
Oncology
Endoscopy
Plaster Rooms
Laboratory
Nuclear Medicine
Sterilisation
Animal House
Decontamination
Hydrotherapy Pool
Laundry

Describe measures for reducing capital cost and recurrent cost of Trade Waste.

Examples of this are 'off site' treatment of photographic developing waste and waste minimisation.

18.2.50 RISING MAINS & PUMPS

Where rising mains and pumps are unavoidable provide a full description of the reasons for use, alternatives considered and proposed system.

Describe pipe materials and design velocities, number, type and capacity of pumps.

Confirmation, of acceptance by other land owners is required where rising mains are proposed.

18.2.55 LPG GAS SERVICE

Size of LPG storage vessel:

Tanker location for filling:

Period the stored gas will serve the installation between fillings:

Provide the cycle cost analysis comparisons between Natural gas and LPG where both are available on site.

18.2.60 WATER SERVICE

Maximum pressure:

Minimum pressure:

Is the system pump assisted?

Pump duty:

Basis of design for

Maximum flow:

Minimum flow:

Is the domestic system tank supplied?

[State reasons]

Storage per bed in litres:

Is dedicated fire storage provided?

[State reasons]

18.2.65 DOMESTIC HOT WATER

Are domestic hot water services mains pressure supplied?

Type of hot water storage

Construction material:

Thermal efficiency:

Volume stored domestic hot water (as litres per bed)

Reheat recovery period 15ºC to 70ºC (in minutes)

Domestic hot water heating energy source

Manner of compliance with Public Health Act 1991 in relation to microbial control

18.2.70 WARM WATER SYSTEMS

Are approved thermostatic mixer valves provided?

Design criteria of alternative warm water systems not utilising TMV units:

Maximum load in litres per minute per fixture
Diversity applied:

Has waste heat recovery been incorporated from any source of waste hear?

Estimated annual heat recovery in MJ

Manner of compliance of Public Health Act 1991 in relation to microbial control

18.2.75 ULTRA PURE WATER SERVICE

Describe system, if provided

18.2.80 FIRE HYDRANT & FIRE HOSE REEL SYSTEMS

Is the system tank fed?

Provide design basis of storage for tank fed systems:

Is the system pump boosted?

State pump duty:

Is pump dual powered?

18.2.85 HYDROTHERAPY POOL

Pool volume

Water filtration system

Heating system

Water treatment

Pool turnover period (minutes)

Surge Capacity (litres)

Maximum sustainable water temperature

Heater input in KW

Volume of filter m^3

Filter flow m^3 per m^2/hr

Heat up period in minutes 15ºC to 27ºC

Backwash manual or automatic

Backwash storage tank volume in litres

18.2.90 DESCRIPTION OF OTHER SYSTEMS

[For each system, item of plant, equipment, etc., (not already reported upon) provide:

A brief description of the chosen system, component or item

Reasons for the choice made

Positive and negative aspects of the preferred systems.

18.2.95 REPORT ON EXCEPTIONS FROM GUIDELINES

Guideline Reference	Departure	Reason

[List those aspects of the proposed scheme which do not conform to these Guidelines together with the nature of the departure and reason for departing from the Guidelines.]

18.2.100 CAPITAL COST ESTIMATE

[Provide a cost against each item on the list included in the design proposal].

[An estimate of the forecast capital cost shall be submitted in accordance with the following schedule as applicable[.

[These estimates are to be prepared for each relevant component on a current rate basis expressed as a lump sum.]

18.2.105 HYDRAULIC SERVICES

H1 Sanitary Fixtures
H2 Sanitary Plumbing
H3 Water Services (Hot and Cold)
H4 Gas Services
H5 Fire Hose Reels and Hydrants
H6 External Sewer Drainage
H7 External Water Services

Sub Total (elements H1 to H8) $_____

H8 Special Equipment

Boiling water units
Water drinking fountains
Other items not included

HYDRAULIC SERVICES CAPITAL COST ESTIMATE $_____

18.2.110 RECURRENT COST REPORT

Complete the Recurrent Costs table so as to provide information for the client to assess this component of the Hospital's operating budget.

A schedule of annual energy usage and costs shall be submitted in the following form. It is to include the total annual energy cost of the entire installation. Energy costs from various sources shall be expressed in terms of the respective published tariffs or contract rates ('Units' in the table below) and converted to a common base of MI for expression of Annual Energy Consumption index. 'Net Cost of Energy' in the table below is to include all associated costs (such as delivery, lease of storage facilities etc) and be expressed in terms of the units in which the energy is metered or charged.

ENERGY SOURCE	**ANNUAL CONSUMPTION**			**NET COST OF ENERGY**	**ANNUAL ENERGY COST**	**ENERGY CONSUMPTION INDEX**	**ENERGY COST INDEX**
	Units	**Quantity**	**Equivalent GJ**	**$/MJ**	**$**	**MJ/m^2**	**$/l^2**
Electricity							
Coal							
Natural Gas							
LPG							
Oil							
TOTAL							
Where the above is based on a 'special rate' attach written confirmation from supplier to the report. Express annual consumption of each energy source in units used by supplier (eg electricity in KWH) then convert in succeeding columns to a common base of megajoules (MJ).							

18.2.115 VALUE-ADDING STRATEGIES

[Provide a schedule of design decisions taken that show an innovative approach to reducing both Capital and Operating Costs of the proposed systems.

List here Value-Adding strategies adopted eg. shared reticulation, plant space, waste heat scavenging, etc.]

Description Benefit

End of Document