Australasian Health Facility Guidelines

Part B - Health Facility Briefing and Planning

0480 - PET Unit

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Australasian Health Facility Guidelines

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01 INTRODUCTION

01.01 Preamble

This Health Planning Unit (HPU) has been developed for use by project staff - architects, planners, engineers, project managers and other consultants, and for end users to facilitate the process of planning and designing a unit that will be fit for purpose in line with local service plans.

It should be read in conjunction with the Australasian Health Facility Guideline (AusHFG) generic requirements and Standard Components described in:

- Part A: Introduction and Instructions for Use
- Part B: Section 80 - General Requirements
- Part C: Design for Access, Mobility, OHS and Security
- Part D: Infection Prevention and Control
- Part E: Building Services and Environmental Design.

It is strongly recommended that this HPU is read in conjunction with HPU 500 - Nuclear Medicine Unit.

01.02 Introduction

DESCRIPTION OF POSITRON EMISSION TOMOGRAPHY (PET)

'Positron Emission Tomography (PET) is a nuclear medicine technology that uses short-lived radioisotopes to enable the non-invasive imaging of metabolic functions within the body. While computed tomography (CT) and magnetic resonance imaging (MRI) primarily provide information about anatomical structure, PET can image and quantify biochemical and/or physiological function. This is important because functional changes caused by disease are often detectable before any structural abnormalities become evident'. (Department of Health and Ageing 2009)

The primary radioactive isotope used for clinical PET is Fluorine-18 fluorodeoxyglucose (FDG), obtained from a cyclotron, with a half life of 110 minutes. This can only be transported relatively short distances before use. Because of this short half-life, the supplied isotope undergoes multiple half- lives of decay during the working day. This necessitates careful planning with respect to patient scheduling and may require one or more deliveries per day.

POSITRON EMISSION TOMOGRAPHY / COMPUTED TOMOGRAPHY (PET/CT)

All modern PET cameras now incorporate a CT scanner as an integral component of the equipment. Whereas PET detects biochemical changes, CT detects anatomical changes and the images can be 'fused'.

CT is mainly performed for anatomical localization and attenuation correction. Staff and licence requirements for additionally performing a diagnostic CT as part of a PET/CT study are governed by applicable State regulations and licence conditions.

The CT may be used for radiation therapy simulation. Laser positioning lights will need to be incorporated into the scanning room design if used for this purpose.

CYCLOTRON AND RADIOPHARMACY

DHS Victoria (2004) defines a cyclotron as follows:

'The Cyclotron is a device that is used to produce beams of charged particles that can be directed at a specific target. Cyclotrons are used for cancer treatment (proton therapy) and radioisotope production. Fluorodeoxyglucose (FDG) is used primarily for cancer diagnosis and Palladium-103 for prostate cancer implants'.

Radiopharmaceuticals for a PET unit are either provided by an on-site cyclotron or by third party suppliers.

This HPU does not address the detailed planning and design requirements for a cyclotron and associated radiopharmaceutical laboratory. However, if one is planned, assess the location and the necessary spatial requirements at a very early planning stage with particular emphasis on structural requirements to support the weight of the equipment, radiation shielding needs, and radiopharmaceutical support laboratories. The area required for the PET tracer production facility, including the cyclotron depends on the tracers to be produced and functional requirements of the facility and needs to be determined on an individual basis.

Hospitals with a cyclotron have Radiopharmacy Laboratories for their PET/CT use and provide services to other hospitals.

01.03 Policy Framework

RADIATION SAFETY AND PROTECTION

All issues relating to radiation protection and safety are subject to each jurisdiction's legislation with regard to Radiation Safety Acts and Regulations.

Codes of Practice and guidelines relating to radiation safety and protection are available from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), www.arpansa.gov.au

In particular, project staff should familiarise themselves with RPS 14.2 - Safety Guide for Radiation Protection in Nuclear Medicine (ARPANSA 2008b). This safety guide is one of three guides that support the application of the Code of Practice for Radiation Protection in the Medical Application of Ionizing Radiation.

CT SHIELDING

For specific radiation shielding requirements for the CT component of the equipment, refer to RPS 14.1 - Radiation Protection in Diagnostic and Interventional Radiology (ARPANSA 2008a).

IONISING RADIATION

For safety requirements for laboratories and precautions needed to prevent the exposure of workers and members of the public to excessive levels of radiation where sources of ionising radiation are used, refer to AS 2243 (Stds Aust 1998).

01.04 Description

DESCRIPTION OF PET HEALTH PLANNING UNIT (HPU)

PET/CT technology is used extensively in cancer assessment staging of disease, restaging and the evaluation of treatment response; in neurological disease in the evaluation of refractory epilepsy and neurodegenerative conditions and much less frequently in the assessment of viable heart muscle in cardiac disease.

A PET/CT Unit provides facilities for delivery of radiopharmaceutical agents and scanning under carefully controlled conditions. It is assumed that all new scanning equipment will be combined PET/CT scanners that fuse functional image information from PET with anatomic information from CT.

This HPU also assumes that all isotopes are obtained from external sources.

SCANNING PROCESS

The PET radiopharmaceutical is drawn up into the syringe and calibrated behind lead or lead glass viewing barriers in the Hot Laboratory (Hot Lab).

The syringe is then transported to the uptake rooms using special mobile dose shields and administered to the patient via a pre-inserted cannula. A portable lead barrier may optionally be used by the operator for shielding during dose administration. Patients are usually scanned within an hour of injection uptake.

Patients are escorted from the uptake room to the toilet just prior to scan to void the bladder before being escorted to the scanning room and positioned for scanning. Once the scan is complete, outpatients remain in a radiation shielded discharge waiting room until the scans have been reviewed by the medical staff and may then return home.

PATIENT CHARACTERISTICS

Patients may be:

- all ages, levels of acuity and frailty;
- ambulant and wheelchair-dependent outpatients, the predominant patient group; and
- inpatients.

Some bariatric patients may be unable to be scanned due to both weight limits on the scanning bed and the girth of the patient who may not be able to fit through the scanner. Girth therefore needs to be assessed before the patient is injected with the tracer.

02 PLANNING

02.01 Operational Models

HOURS OF OPERATION

The PET Unit will usually operate during business hours with arrangements for emergency access afterhours.

MODEL OF CARE

PET services are delivered in a discrete unit often, but not necessarily, collocated with the Nuclear Medicine Unit with which it may share support facilities. As PET is extensively used as an oncology diagnostic tool, it may be located in a comprehensive Cancer Centre.

FUTURE GROWTH

Service planning relies on population projections and advances in technology. In cases where it is expected that population growth will require enhanced service capacity within a five year period, the following issues need to be addressed with regard to future expansion of the Unit:

- expansion of the scanning rooms to allow for upgrades to the equipment which will require additional shielding, increased load bearing capabilities and services requirements;
- access for supply and installation of new equipment;
- increased numbers of bariatric patients; and
- identification of expansion zones for increased staffing requirements to meet service demand and technological changes.

In the future there may be combined PET/MRI systems. Design of a scanning room to accommodate a PET/MRI unit differs substantially from designing for a PET/CT unit - radiofrequency and magnetic shielding are required for MRI and weight is substantially greater. Tertiary facilities may need to consider how a PET/MRI unit could be accommodated in the future.

02.02 Operational Policies

GENERAL

Operational policies have a major impact on the design, and the capital and recurrent costs of health facilities. Policies will vary from unit to unit depending on a wide range of factors but the cost implications of proposed policies should be fully evaluated to ensure the most cost-effective and efficient design solutions are developed.

The development of operational policies is crucial to defining how the Unit will operate within the hospital, the health service, as well as in relation to adjoining health services from which patients may be referred. Users should define their own policies - refer to Part B Section 80 for further information. The following topics are specific to this HPU.

AMBULANT PATIENT WAITING

Waiting areas should allow separation of dosed and undosed patients. Undosed outpatients, pre-scan, may wait in the general public waiting area with their family / supporters. Inpatients may be taken directly into an uptake room.

Once the scan is complete, outpatients leave the Unit via a separate radiation shielded discharge area. For further information refer to ARPANSA (2002), RPS 4 on the discharge of patients undergoing treatment with radioactive substances.

ANAESTHESIA AND SEDATION

General anaesthesia (GA) or deep sedation is rarely needed except in units with a large paediatric component. However, at least one uptake room should be GA capable with direct access into the scanning room.

FILM / RECORDS STORAGE

Imaging using Picture Archive and Computer System (PACS) is assumed for film storage therefore neither a dark room nor hard copy film storage will be necessary. PACS storage will be required either locally or as part of a hospital-wide system.

In the absence of a comprehensive electronic patient record system, storage space for paper copies of patient scan reports / consent forms and referral documentation will be required. All patient records, including paediatric records, should be maintained and retained according to relevant jurisdiction policies and procedures. For adults this may range from seven to 15 years, and 21 years for children.

Consideration should be given to electronic records in the future including electronic ordering of scanning procedures.

MANAGEMENT OF MEDICAL EMERGENCIES

Management of medical emergencies will be in accordance with hospital policy. A resuscitation trolley should be easily accessible.

MANAGEMENT OF RADIOACTIVE SUBSTANCES SPILLS

All surfaces including floors, bench tops, walls and junctions should be impermeable and easy to clean. An emergency shower and eye wash for patients and staff should be readily accessible and located in close proximity to all areas of potential exposure.

A decontamination kit should be stored in the Hot Lab for quick access to contain and clean up radioactive spills.

PATIENT MONITORING AND COMMUNICATIONS

Dosed patients are alone in uptake rooms and during the scanning process and should be under observation at all times in case of emergency via closed circuit TV cameras (CCTV) with monitors in the Control Room and/or Staff Station. Cameras should be located at both the head and foot of the PET scanner.

A staff and emergency call system is required in the uptake rooms, scanning rooms, waiting areas and toilets. An appropriate intercom system is required from the control room to communicate with patients in the scanning room. The system may also be extended to the uptake rooms.

Ancillary procedures during uptake and scanning processes may include electrocardiogram (ECG) and electroencephalogram (EEG) monitoring of the patient’s condition with remote monitors in the Control Room or Staff Station.

PATIENT TRANSPORT

The model of care / service plan for the Unit should define whether the Unit will have its own porter staff, possibly shared with an adjoining unit or use a central transport department.This decision may depend on the number of inpatient studies to be undertaken. If required, facilities should comprise a small porter’s base with handbasin, linen storage, portable oxygen cylinders and parking areas for trolleys and wheelchairs.

RADIOACTIVE ISOTOPES - DELIVERY

PET Units will receive sealed radioactive isotopes, delivered to a licensed person and will be required to handle and store these as described within the Radiation Protection guidelines. Refer to ARPANSA (2008b), RPS 14.2, Section 10.4 on the Storage and Safe Handling of Sealed Radiation Sources.

Isotope deliveries for PET studies with their short half life will usually be once or twice daily direct to the department, depending on workload. Usually a vial of FDG is delivered to the PET Unit for dispensing by technologists. In some cases, unit doses may be supplied from an on-site or central radiopharmacy.

RADIATION PROTECTION AND MONITORING - PERSONNEL

Staff should be monitored with an approved dosimeter badge attached to clothing. Electronic personal dosimeters may be worn to allow dosage received during the day from specific activities to be assessed and minimised. These are particularly useful during the training of new staff.

Mobile lead screens may be provided for use in uptake rooms for administering radiopharmaceuticals and in scanning rooms for positioning the patient.

WASTE MANAGEMENT - GENERAL

There are several categories of waste but within the context of this HPU, and excluding radioactive waste covered separately below, waste will consist of:

- clinical waste - excluding sharps used for injection of radiopharmaceuticals;
- recyclable waste - usually paper and bottles / cans; AND
- general waste - any waste not included above and which is not capable of being recycled, reprocessed or re-used.

Refer to individual health jurisdiction waste management policies.

RADIOACTIVE WASTE MANAGEMENT

Radioactive waste is material contaminated with radioactive substances and may be solid, liquid or gaseous. An emergency shower and eye wash in the Radiopharmacy Laboratory and a separate shower for patients and staff will be required. A decontamination kit should be stored in the Hot Lab or Radiopharmacy for quick access to contain and clean up radioactive spills.

RADIOACTIVE WASTE DISPOSAL

Radioactive waste is no longer deemed to be radioactive once lead shielded and allowed to decay to a safe level as set by the regulatory authority.

Due to the rapid decay of radioisotopes used for PET studies, very little solid waste will need to be stored except for syringes, needles, cannula etc. Specially designed lead-lined sharps bins are commercially available and should be readily accessible for use by all clinicians as required (ARPANSA 2008c).

The requirement for delay holding tanks for effluent from patient toilets in the immediate post-uptake areas will need to be assessed by the Radiation Safety Officer.

STORAGE

Provide a store for general equipment items that may include space for charging of electric equipment (e.g. IV pumps and transport tugs). Where appropriate, items of equipment may be stored in their room of use to minimise manual handling and OHS issues.

Storage will also be required for general equipment items, sterile stock and medical consumables. Specific items for storage associated with PET scanning will include planning and testing equipment.

If not parked in the scanning room, consideration will need to be given to the corridor parking of the patient's bed when patients are transferred to the scanner table.

STAFFING

A staff establishment should be developed early in the planning process in order to assess the offices, workstations and amenities that will be required.

This HPU does not offer advice on staffing levels. However, a unit should be large enough to ensure that the safety, security and emergency responses of staff on duty are accommodated. Sizing of the unit on this basis provides for improved operational cost effectiveness as well as compliance with security and OHS requirements.

The staff establishment may include:

- PET physicians;
- physicists;

- Radiation Safety Officer;
- PET Technologists;
- nursing staff; and
- administration staff supported by cleaners, orderlies, etc.

TEACHING AND RESEARCH

The extent of teaching and research conducted in the Unit will need to be ascertained to ensure that necessary offices, laboratories, staff and student amenities are provided.

02.03 Planning Models

LOCATION

The Unit should not act as a thoroughfare to other units of the healthcare facility. The floor loading weight of both equipment and shielding should be taken into consideration when locating the Unit. A ground floor site may be the most suitable location but if this cannot be achieved, consider units above, below and adjoining the proposed location with regard to radiation shielding requirements, the weight of equipment and associated shielding and access for equipment and radioactive isotopes.

Care should be taken to ensure that the location of the Unit minimises access by persons such as lost visitors, wandering patients from other units or those with criminal intent.

CONFIGURATION

Configuration of the Unit is critical with regard to patient and staff flows. This should ensure that patients, staff and visitors are not exposed to unacceptable levels of radiation as a consequence of poor layout resulting in unnecessary traffic movement in front of, through or adjacent to areas occupied by injected patients and scanning rooms.

Consider carefully the relative location of ‘hot’ areas - uptake rooms, toilet, scanning room, Hot Lab. ‘Hot’ and ‘cold’ areas should be geographically separated whenever possible.

The security of radioisotopes and radioactive waste is of particular importance. Effective layout can also reduce the need for costly radiation shielding. Separate patient and staff corridor systems and provide separate entries for the general public - outpatients and for patients on beds / trolleys. Patient corridors should all accommodate passing and turning of wheelchairs and beds.

EQUIPMENT PROCUREMENT

Due to the complexities of tendering for and purchasing significant items of high technology equipment, there can be a 12 to18 month timeframe before the final equipment selection takes place.

As the equipment is not generally known at the time of the initial design, a generic design should be undertaken whereby all major manufacturers’ equipment can be accommodated. This also allows for easy future replacements without major renovation costs.

02.04 Functional Areas

FUNCTIONAL ZONES

The following rooms / spaces form the main functional zones of the Unit:

- reception / administration / general waiting;
- patient amenities;
- hot laboratory;
- PET/CT Suite (uptake rooms, scanning room, control room, equipment storage, plant room);
- clinical support areas;

- staff offices and amenities; and
- radiopharmacy (optional).

RECEPTION / ADMINISTRATION

Facilities will usually comprise:

- entry lobby (may be shared with adjacent unit such as Nuclear Medicine or Medical Imaging if units are collocated);
- ambulant patient / visitor waiting (may be shared with adjacent unit);
- access to public toilets;
- reception / enquiry desk;
- administrative offices; and
- clerical work area for filing, photocopying and report writing.

PATIENT AMENITIES

The following patient amenities should be available specifically for PET patients:

- radiation-shielded access toilet/s and change cubicle/s;
- beverage facilities; and
- small shielded discharge lounge / post scan waiting area.

PET/CT SUITE

The PET/CT Suite will consist of the following rooms / areas:

- individual pre-scan uptake rooms (refer Non-Standard Components) with one designed for anaesthesia;
- PET/CT Scanning Room;
- Control Room; and
- Hot Lab and radioactive waste store.

An equipment / plant room will be required for the following:

- uninterrupted power supply (UPS battery);
- water cooling units; and
- electronic cabinets and computer towers.

The Unit may need to be registered or accredited by the relevant authority.

HOT LAB / DISPENSARY AND RADIOACTIVE WASTE STORE

Unless single unit doses are supplied to the PET facility, a Hot Lab will be required where radiopharmaceuticals are drawn up or prepared ready for administration to the patient. A lead glass screen will act as a barrier behind which dispensing and calibration occur.

Radioactive waste holding may also be incorporated into or adjacent to this space. Provide radiation shielding as advised by Radiation Safety consultants. The lab will need to be accredited by the relevant jurisdictional authorities.

Refer to Non-Standard Components for details.

RADIOPHARMACY LABORATORY

A Radiopharmacy Laboratory may be provided for the manufacturing of sterile pharmaceuticals to Therapeutic Goods Administration Standards (TGA).

Hospital radiopharmacies are exempt from TGA certification, provided the in- house kits are used within public hospitals and not supplied to private practices and interstate. Hospital radiopharmacists / radiochemists are exempt from licence if they conform to the above regulation.

Manufacturing of sterile pharmaceuticals as cold kits for supply to private practices or interstate to other nuclear medicine units requires full compliance with TGA for the premises and persons working there. The Laboratory will comprise:

- general work area;
- sterile Manufacturing Area incorporating a Clean Room for cell labelling and in-house manufacture (including a BSC Class 2/3);
- kit production area (Hot Lab);
- radioactive supplies store; and
- dose receiving (PET Return) room, if associated with a manufacturing facility.

Equipment will include a dose calibrator, biohazard safety cabinet(s) Class 2 and/or Class 3. Refer to AS/NZS 2982.1 (Stds Aust 1997).

Details of these laboratories are not covered in detail by this HPU but an approximate square metre area is given in the Schedule of Accommodation to facilitate early planning where such a laboratory is proposed.

CLINICAL SUPPORT AREAS

Provision of, or access to, the following clinical support areas may be required:

- optional small Staff Station - in addition to the Control Room;
- beverage bay - light refreshment will be available for all PET and myocardial perfusion studies as these patients have been fasting for significant times;
- resuscitation trolley bay;
- dirty utility room - may be shared with adjoining unit;
- disposal room - may be shared with adjoining unit;
- equipment store; and
- sterile stock store / clean utility room.

VIEWING AND REPORTING

Provide a dedicated room for viewing and reporting on scans. In determining the size of this room, consider future trends in service delivery and the need to accommodate increasing levels of technology.

Each viewing workstation will require PACS capability, image display monitors, patient information access monitors and a PC at each workstation plus shelving for resource material.

The number of reporting stations will be dependent on service level, number of scanning rooms and the staff establishment.

Dimmable lighting is required and either no windows or windows with blinds for light control.

STAFF OFFICES AND AMENITIES

Depending on the size and location of the Unit and collocation with adjoining units, staff will need access to:

- staff room / beverage bay;
- meeting rooms and library;
- offices in accordance with staff establishment and teaching / research roles; and
- toilets, showers and lockers.

Refer to individual jurisdiction policies regarding office provision.

02.05 Functional Relationships

The source of most inpatients will be Oncology, Neurology and Cardiology Inpatient Units. It is highly desirable that the PET suite has ready access from the Emergency Unit and the Cancer Centre.

Collocation with the main Nuclear Medicine Unit for sharing facilities is desirable but not essential. Refer also to the Functional Relationship Diagram shown later in this HPU.

03 DESIGN

03.01 Accessibility

EXTERNAL

There should be one point of access for outpatients and, where possible, a separate entry for beds / trolleys for inpatients, overseen by the Reception or a Staff Station.

Consideration needs to be given to access requirements for isotope deliveries and for vehicles delivering / removing equipment and providing maintenance.

INTERNAL

Patients should have ready access to water, refreshments, toilets and shower.

03.02 Parking

Patients and visitors will use the public parking facilities with access to drop- off areas and disabled parking. An identified parking area for vehicles delivering isotopes is required. This should be in close proximity to the Hot Lab. It is best to consider this issue during the schematic design phase of the project.

For staff parking, refer to Part C Section 790 for further information.

03.03 Disaster Planning

Each unit will have operational plans and policies detailing the response to a range of emergency situations both internal and external. Consider the ability to effect complete lock-down and issues such as the placement of emergency alarms, the need for uninterrupted or emergency power supply (UPS) to essential clinical equipment such as scanners, electronic sensor taps and services such as emergency lighting, telephones, duress alarm systems, servers and computers.

Arrangements for management of spills and radioactive exposure should be in place. An emergency shower with eye wash station should be readily accessible to staff, patients and the public in case of contamination.

Refer to Part B Section 80 for general information regarding other disaster situations.

03.04 Infection Control

The infectious status of many patients admitted to the Unit may be unknown. All body fluids should be treated as potentially infectious and standard precautions should be taken in accordance with hospital policy.

Handbasins should be located in all clinical areas.

Refer to Part D Infection Prevention and Control for further information and to individual jurisdiction policies and guidelines.

03.05 Environmental Considerations

ACOUSTICS

Sound attenuation should be provided in the following areas:

- uptake rooms
- scanning rooms

- viewing / reporting room.

For further information also refer to Acoustic Requirements noted on Room Data Sheets.

NATURAL LIGHT

Natural light is desirable in all patient areas, the staff room, and controllable in reporting rooms. External windows provided in scanning and uptake rooms should be assessed by a Radiation Consultant for shielding requirements. In practice, it may be difficult to shield windows equal to wall shielding levels.

PRIVACY

Visual and acoustic privacy is required in all consultation, examination rooms and treatment spaces / scanning rooms. Patients on beds / trolleys should not have to pass through public circulation space in order to access treatment areas.

If patients change in the uptake rooms, privacy from CCTV cameras will be required while getting changed. Patients will also require privacy to discuss billing and private health-related concerns.

SIGNAGE

Provide visible warning signs at any general access point to a room where unsealed radioactive material is stored or used. Warning signs should comply with AS 1319-1994 (Stds Aust 1994).

INTERIOR DECOR

As far as possible without compromising clinical practice or safety, the environment should be calming, non-threatening and welcoming.

Treatment areas should have soft colours, paintings, etc to counteract, as much as possible, the isolation during treatment. Consideration should be given to providing a decorative or interesting element to the ceiling for patient interest.

03.06 Space Standards and Components

HUMAN ENGINEERING

Human Engineering covers those aspects of design that permit effective, appropriate, safe and dignified use by all people, including those with disabilities. Refer to Part C Section 730.

ERGONOMICS

Design the Unit so that patients, staff, visitors and maintenance personnel are not exposed to avoidable risks of injury and radiation exposure.

Badly designed recurring elements such as height, depth and design of workstations and counters, shelving and the layout of critical rooms have a great impact on the occupational health and safety of staff as well as the welfare of patients.

Consider work practices in relation to manual handling of equipment with significant weight. Manual handling requirements may be reduced by appropriate local storage. Refer to Part C Section 730 for further details.

ACCESS AND MOBILITY

Where applicable, comply with AS 1428 (Stds Aust 2010). Refer to Part C Section 730 for further details.

BUILDING ELEMENTS

Building elements include walls, floors, ceilings, doors, windows and corridors and are addressed in detail in Part C Section 710. Refer also to Room Data and Room Layout Sheets.

Doorways and turning circles should be sufficiently wide and high to permit the manoeuvring of wheelchairs, trolleys and equipment without risk of damage or manual handling risks, and to allow ingress / egress of equipment for installation or removal.

Provide the same level of shielding to vision panels in doors to treatment rooms and Hot Labs as to the adjoining walls. Ensure that floors are able to support the weight of equipment and shielding, and that equipment is not located in vibration-prone areas.

Consider the need for shielding to floors or ceilings directly above, below or adjacent to the Unit.

03.07 Safety and Security

GENERAL

Safety and security involves people and policies as well as physical aspects but should be built in as part of overall design and not superimposed on a completed facility. A safety audit via a risk analysis of potential hazards should be undertaken during the design process. Refer to Part C Section 790 and to Worksafe Victoria (2007).

OCCUPATIONAL HEALTH AND SAFETY

The handling of people and equipment is a significant issue in this Unit. As radiation exposure to staff can increase with time spent in close proximity to patients, it is important that the design facilitates efficient manual handling practices.

Consider work practices in relation to:

- manual handling of equipment for which significant weight is attached - bariatric patient beds etc
- manual handing of patients e.g. transfers from trolleys and exact positioning for scanning in narrow or confined spaces
- repair and maintenance of scanning equipment.

Manual handling requirements may be reduced by appropriate local storage locations and provision of space around equipment to allow transfers and use of manual handling equipment. Refer to Part C Section 730 and to A Guide to Designing Workplaces for Safer Handling of People (Worksafe Victoria 2007).

SAFETY

Consider the impact of finishes, surfaces and fittings on safety. In particular, consider:

- slippery or wet floors
- protrusions or sharp edges
- stability and height of equipment or fittings
- adequate drainage facilities
- main drains which should be protected from potential contaminants
- adequate protection for workers against infection and any other hazards - particularly radiation exposure.

SECURITY

The security of radioisotopes and radioactive waste is of particular importance. Refer to RPS 14.2 Section 10 - (ARPANSA 2008) and RPS11 - Security of Radioactive Sources, (ARPANSA 2007). For general security, refer to individual jurisdiction polices and guidelines.

03.08 Finishes

WALLS

Walls should be washable and easily decontaminated in the event of a radioactive spill. Refer to Part C Section 710 for further information.

FLOOR FINISHES

Floor finishes and junctions should be impermeable and non-absorbent in case of radiation spills. Refer to Part C Section 710 and also to TS7 (NSW Health & CHAA UNSW 2009).

CEILING FINISHES

Refer to Part C Section 710 for further information.

03.09 Fixtures, Fittings & Equipment

DEFINITIONS

Fixtures and Fittings are defined as follows:

Fixtures: Items that require service connection to walls, floor or ceilings (electrical, hydraulic, and mechanical) and include but are not limited to basins, light fittings, medical service panels.

Fittings: Items attached to walls, floors or ceilings that do not require service connections such as curtain and IV tracks, hooks, mirrors, blinds, joinery, pin boards etc.

For additional detailed information refer to Part C Section 710, Part F Project Implementation Section 680, and to the Room Data Sheets (RDS) and Room Layout Sheets (RLS).

03.10 Building Service Requirements

GENERAL

High cost engineering areas which should receive careful consideration include:

- lighting and the impact of deep planning on lighting requirements;
- the number of sanitary fittings and the potential for reducing these by strategic location;
- extent of the required emergency and uninterrupted power supply;
- extent of provision of emergency doors;
- the need for and the cost benefit / implications of a pneumatic transport system; and
- extent of provision of essential back-up systems e.g. dual generators, chillers, boilers and dual electrical circuits.

Refer to Part E Building Services and Environmental Design, TS-11 Engineering Services and Sustainable Development Guidelines (NSW Health 2007) and Health Facility Guidelines for Engineering Services 2006 (WA Health 2006).

CONSTRUCTION

In constructing the Unit address the following issues:

- ensure that new and existing floor structure and finishes are adequate to meet load requirements for equipment, shielding, patients, and personnel;
- ensure that walls contain necessary support systems for medical service panels;
- provision should be made for cable trays, ducts or conduits in floors, walls and ceilings as required for specialised equipment;
- the integrity of the shielding should not be compromised by ducts and penetrations;
- ceiling height in the scanning rooms should be a minimum of 3 metres;
- ceiling mounted equipment should have properly designed rigid support structures located above the finished ceiling; and
- a tiled ceiling should be considered for ease of installation, service and remodelling.

Note 1: A PET/CT scanner weighs approximately 3 tonnes

Note 2: The wall for PET/CT with radiation shielding weighs approximately 9 tonnes.

ELECTRICAL SERVICES

A sufficient number of power outlets, both general and essential supply, including 3 phase outlets are required for current and anticipated future needs. Refer to TS11 Section 3 (NSW Health 2007), relevant Australian Standards and to jurisdiction specific engineering services guidelines.

An emergency back-up system for the power supply should be available for high priority equipment including cameras and server and for illumination.

Provide uninterrupted power supply (UPS) to the PET/CT scanner equipment and server according to the supplier's specifications.

All treatment rooms are to be body protected electrical areas. All scanning rooms require dimmable down lighting with lighting not located directly above scanning beds.

HYDRAULIC SERVICES

Provisions for water cooling plant equipment will be required within easy access to scanning equipment modules.

When routing hydraulic services and air conditioning ducts in ceiling spaces, the space above PET cameras should be avoided as water leakage can cause significant damage.

The requirement for delayed holding tanks to patient toilets in the immediate post-uptake area will be dependent on the local water authority requirements and advice from the Radiation Safety Officer.

INFORMATION TECHNOLOGY AND COMMUNICATION SYSTEMS

The infrastructure for the following should be considered for the present and possible future expansion:

- wireless technology;
- voice / data systems;
- video conferencing capacity;
- duress call - fixed and personal (optional);
- CCTV monitoring systems of entry points (if considered necessary) and in the scanning and uptake rooms;
- infrastructure for PACS, electronic records and imaging information management system;
- server room; and
- patient / nurse and emergency call systems compatible with existing hospital systems.

Refer also to Part E Section 2 for additional information.

MECHANICAL SERVICES

For general requirements refer to TS-11 (NSW Health 2007) and the Western Australia Health Facility Guidelines for Engineering Services (WA Health 2006).

Refer to specific Special Requirements identified in the Standard and Non- Standard Components.

Special attention is required to cooling and ventilation of scanning rooms and associated computer equipment rooms as the equipment is sensitive to excessive ambient heat. Additional cooling and ventilation will be required.

Temperature control will be required for patient and staff comfort. The temperature of the Unit should be maintained within a comfortable range not exceeding 25˚C.

MEDICAL GASES

Oxygen and suction will be required in all general uptake rooms. Provision of medical air is optional depending on patient acuity and operational policy.

Medical air, nitrous oxide and scavenging will also be required in the scanning room and induction / uptake room where general anaesthesia may be administered.

The PET scanner and cyclotron may use several different radioactive gases.

RADIATION SHIELDING

The principles of radiation safety and protection should be developed and integrated into the design and documentation of the Unit from the earliest stages and it is important that the design team are comprehensively briefed. A qualified radiation expert should be involved in the design.

Advice from Radiation Safety Officer should be sought for each project. Radiation shielding will be required to a number of areas within the PET Unit. These areas include but are not limited to the following:

- pre-scan uptake rooms and patient amenities;
- PET/CT scanning room;
- post-scan waiting areas; and
- Hot Lab / radiopharmacy lab.

Refer to RPS 14.2, Section 10.2 (ARPANSA 2008b). Also refer to applicable State legislation, regulations and guidelines. In NSW, refer to the Draft Radiation Guidelines (NSW Department of Environment and Climate Change 2008).

04 COMPONENTS OF THE UNIT

04.01 Standard Components

Rooms / spaces are defined as:

- *standard components* (SC) which refer to rooms / spaces for which room data sheets, room layout sheets (drawings) and textual description have been developed;
- *standard components – derived rooms* are rooms, based on a SC but they vary in size. In these instances, the standard component will form the broad room 'brief' and room size and contents will be scaled to meet the service requirement;
- *non-standard components* which are unique rooms that are usually service-specific and not common.

The standard component types are listed in the attached Schedule of Accommodation.

The current Standard Components can be found at: www.healthfacilityguidelines.com.au/standard-components

04.02 Non-Standard Components

The following Non-Standard Components are unit-specific:

- PET/CT Room;
- Control Room;
- Uptake Room; and
- Hot Laboratory.

PET/CT SCANNING ROOM

Description and Function

The PET/CT Camera Room provides an enclosed area and equipment for non-invasive scanning procedures.

Patients are usually fully awake but may be sedated or occasionally under general anaesthesia.

Location and Relationships

Bed / trolley access will be required to the PET/CT scanning rooms and uptake rooms, especially the uptake room set up for general anaesthesia.

Direct adjacency to the Control Room is not essential provided that patients are fully monitored via closed circuit television.

Appropriate service links to the Equipment (PET) Plant Room and Control Room will be required according to manufacturer's specifications.

Considerations

The PET/CT scanning equipment has specialised requirements and installation will be according to manufacturer's recommendations based on model and size.

However, it should be noted that while the equipment manufacturer will provide a minimum spatial allowance, this space might not be adequate for all the complex operational requirements in a tertiary facility and needs to be further analysed for optimal functionality in the context of each project.

Weight loading of scanner and ancillary equipment may be 3-4 tonnes plus the weight of radiation shielding. Assessment of the adequacy of floor and other support structures will be required.

Room climate control or airconditioning is essential for equipment functioning. Negative air pressure is required relative to the surrounding areas. CCTV cameras are required at the head and foot of the PET/CT scanner, with monitors in the Control Room positioned to enable visual observation of the patient at all times.

Wall mounted and/or other manual handling assistive devices such as hover mats, or bed tugs or pat slides will be required. The use of ceiling hoists can increase the time associated with transfers and thus radiation exposure. Mobile hoists may be of limited value where they cannot pass under the scanning equipment base.

Ancillary equipment includes water / air chillers and transformers located in the Equipment Plant Room.

A medical service panel is required offering:

- oxygen;
- suction;
- medical air;
- nitrous oxide;
- scavenging;
- power outlets (x 6); and
- nurse / emergency call system.

Additional room provisions include:

- radiation shielding as advised by consultants;
- uninterrupted power supply to camera;
- hands-free intercom to Control Room;
- clock (visible to the patient);
- handbasin and associated dispensers;
- work bench (standing height);
- shelving or louvre storage panels for small clinical supplies;
- glare free, dimmable lighting that is not over the patient table; and
- laser lights for positioning if used for radiotherapy planning.

CONTROL ROOM

Description and Function

The PET/CT Control Room provides facilities for operating the scanning process using scanner console and overview of images. It also allows observation of, and communication with, patients in scanning and uptake rooms via CCTV monitors and intercoms or similar speaker system.

Location and Relationships

The Control Room requires ready access to the scanning and uptake rooms. Direct observation is not essential if CCTV monitoring is provided.

Considerations

The following items are required:

- scanner control / console computer;
- work bench;
- chair(s);

- CCTV viewing monitors;
- temote ECG/EEG monitors;
- screening monitors;
- patient information computers;
- printers and telephone;
- bookshelves; and
- dimmable lighting (may be required).

UPTAKE ROOM

Description and Function

This is the room where patients are injected with the radiopharmaceutical and rest until uptake has occurred before transfer to the scanning room.

Patients (particularly patients undergoing neurological scans) need to be relaxed in a quiet dimmed environment to avoid inappropriate uptake. Uptake duration is typically 45 to 60 minutes. Scanning time varies between 10 and 25 minutes and patients may be sent home or back to the inpatient unit once scans are completed and have been checked.

Location and Relationships

The Uptake Room will require ready access to the Scanning Room and to a radiation shielded patient toilet.

Considerations

The following items are required:

- bed / trolley access;
- radiation shielding as advised by consultants;
- medical service panel including oxygen, suction, power, patient / nurse call;
- mergency call;
- dimmable lighting;
- examination light;
- handbasin;
- optional mobile lead operator’s screen;
- ceiling-mounted closed circuit television camera (CCTV);
- intercom to Control Room (optional);
- patient trolley or recliner chair;
- chair; and
- curtain track and screen around door.

UPTAKE / INDUCTION ROOM

In this room, patients may be anaesthetised or sedated. In most respects, this room is similar to the general uptake room. Additional room requirements include:

- minimum room size of 14m2;
- direct access to scanning room;
- patient monitor;
- nitrous oxide, scavenging and medical air;

- anaesthetic trolley; and
- benches and storage shelves / cupboards for supplies.

HOT LABORATORY

Description and Function

The Hot Laboratory (Hot Lab) will be used for receipt, delivery, storage and dispensing / preparation of radiopharmaceuticals.

Space and equipment is provided for dose calibration, computerised record keeping and quality control activities.

The room will include radioactive waste storage particularly for sharps.

Location and Relationships

It should be readily accessible to/from the uptake rooms.

Ready access is required from the Unit entry for delivery of FDG and other PET radiopharmaceuticals.

Considerations

Provide the following as required:

- radiation shielding as advised by staff / consultants.
- appropriate radioactive signage on access doors.
- sinks and basins with hands-free taps for handwash, decontamination and waste disposal.
- lead-shielded sharps bins and a bin for general radioactive waste that may be located under a bench in shielded cupboards.
- preparation benches incorporating stainless steel sink and lead shielded cover behind which actual preparation occurs.
- optional wall or ceiling-mounted hoist for lifting the transport containers from floor to bench.
- dose calibrator.

AX APPENDICES

AX.01 Schedule of Accommodation

A Schedule of Accommodation follows for one PET / CT camera.

The 'Room/ Space' column describes each room or space within the Unit. Some rooms are identified as 'Standard Components' (SC) or as having a corresponding room which can be derived from a SC. These rooms are described as 'Standard Components –Derived' (SC-D). The 'SD/SD-C' column identifies these rooms and relevant room codes and names are provided.

All other rooms are non-standard and will need to be briefed using relevant functional and operational information provided in this HPU.

In some cases, Room/ Spaces are described as 'Optional' or 'o'. Inclusion of this Room/ Space will be dependent on a range of factors such as operational policies or clinical services planning.

PET / CT SUITE

AusHFG Room Code	Room / Space	SC / SC-D	Qty x m2 Level 2	Remarks
WAIT-10	Waiting	Yes *	1 x 12	Entry lobby / public waiting, may be shared
WCAC	Toilet - Accessible, 6m2	Yes	1 x 6	May be shared, public
RECL-10	Reception / Clerical	Yes	1 x 10	1 staff; may be shared
OFF-2P	Office - 2 Person Shared, 6m2	Yes	1 x 12	Administrative functions. Quantity dependant on staffing establishment
STPS-8	Store - Photocopy / Stationery, 8m2	Yes	1 x 8	
PROP-2	Property Bay - Staff	Yes	1 x 2	
CHPT-D	Change Cubicle - Accessible, 4m2	Yes	1 x 4	Pre and post-scan; radiation shielded
WCAC	Toilet - Accessible, 6m2	Yes	1 x 6	Radiation shielded, patient.
SHD	Shower - Accessible, 4m2	Yes	1 x 4	For emergencies; radiation shielded
CONS	Consult Room	Yes	1 x 12	May also have office function
	Uptake Room		1 x 12	Refer Note 1 above
	Uptake / Induction Room		1 x 18	Radiation shielded
PBTR-H-9	Patient Bay - Holding, 9m2	Yes	3 x 9	May be shared with adjoining unit
SSTN-10	Staff Station	Yes *	1 x 8 (o)	May be shared
BBEV-OP	Bay - Beverage, Open Plan, 4m2	Yes	1 x 4	Include ice machine
BWC	Bay - Wheelchair Park	Yes	1 x 4	Increase to 10m2 area if to accommodate transport staff, trolley, handbasin
BLIN	Bay - Linen	Yes	1 x 2	
BRES	Bay - Resuscitation	Yes *	1 x 1.5	
BHWS-B	Bay - Handwashing, Type B	Yes	1 x 1	In corridor
STSS-12	Store - Sterile Stock, 12m2	Yes	1 x 12	
DTUR-S	Dirty Utility - Sub	Yes	1 x 8	May be shared
	Discharge Lounge		1 x 8	Radiation shielded. Collocate with Beverage Bay
	PET / CT Scanner		1 x 50	Sized to suit the equipment selected.
	Control Room		1 x 16	May need to be radiation shielded
	PET / CT Plant / Equipment Room		1 x 18	Includes server etc. Air-conditioned
STEQ-14	Store - Equipment, 14m2	Yes	1 x 14	General items
	Hot Laboratory		1 x 18	
XRRR	X-Ray Viewing & Reporting Room	Yes *	1 x 18	3 workstations
OFF-S12	Office - Single Persom, 12m2	Yes	1 x 12	Staff Specialist / Unit Director
OFF-S9	Office - Single Persom, 9m2	Yes	2 x 9	Chief Technologist & Physicist
WCST	Toilet - Staff, 3m2	Yes	1 x 3	Within envelope of Unit
CLRM	Cleaner's Room, 5m2	Yes	1 x 5	May be shared with adjoining unit
	Discounted Circulation %		32	

Note: Radiation shielded. Number of rooms based on assessment of workload. NB: one room requires GA capability.

STAFF AREAS

AusHFG Room Code	Room / Space	SC / SC-D	Qty x m2 Level 2	Remarks
SRM-15	Staff Room, 15m2	Y	1 x 15	Includes Beverage Bay
MEET-12	Meeting Room, 12m2		1 x 12	
WCST	Toilet - Staff, 3m2	Y	2 x 3	
SHST	Shower - Staff, 3m2	Y	1 x 3	

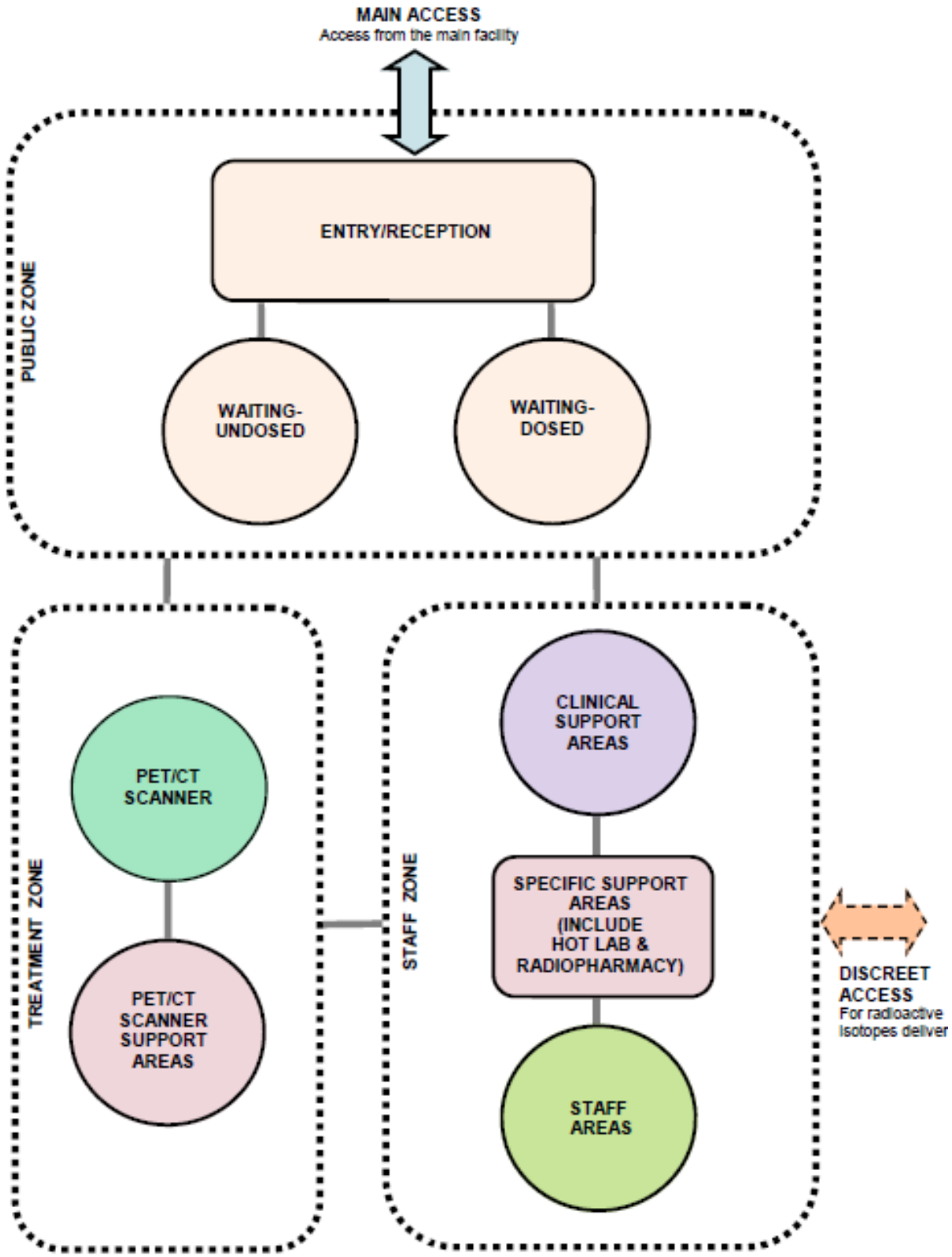
The above may be shared with an adjoining unit.

CYCLOTRON AND RADIOPHARMACY

AusHFG Room Code	Room / Space	SC / SC-D	Qty x m2 Level 2	Remarks
	Cyclotron		80	Nominal size only
	Radiopharmacy		150	Nominal only
	Staff & Technical Support		70	Nominal only

AX.02 Functional Relationships / Diagrams

The following diagram illustrates the functional relationships between zones in a Positron Emission Tomography (PET) Unit.



AX.03 Checklists

Refer to the Planning Checklists at the end of Parts A, B, C and D for general planning checklists.

AX.04 References

LEGISLATION AND STANDARDS

- Radiation Protection: Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), www.arpansa.gov.au

WEBSITES

- Austin Health 2010, Nuclear Medicine and Centre for PET, Austin Health Victoria, viewed 21 June 2010, www.austin.org.au/nmpet/
- Northcoast Nuclear Medicine (NCNM) n.d., Northcoast Nuclear Medicine, viewed 21 June 2010, http://www.ncnm.com.au/index.html
- Radiology Society of NorthAmerica (RSNA) & American College of Radiology 2010, The radiology information resource for patients, Radiology Society of NorthAmerica, viewed 21 june 2010, www.radiologyinfo.org/
- Royal Adelaide Hospital n. d., Department of Nuclear Medicine, PET & Bone Densitometry Website, Royal Adelaide Hospital, viewed 21 June 2010, www.rah.sa.gov.au/nucmed/index.htm

GUIDELINES

- Department of Human Services Victoria 2004, Design Guidelines for Hospitals and Day Procedure Centres, Department of Human Services Victoria.

ARTICLES AND CONFERENCE PAPERS

- Howman-Giles, R Mihm, D Kitsos, T & Trpezanovski, J 2008, Paediatric PET- Initial Experience at The Children's Hospital at Westmead,Technical and Interpretative Issues, Internal Medicine Journal, 38, no. 3.
- Lau, WF, et al. 2005, Clinical experience with the first combined positron emission tomography/ computed tomography scanner in Australia, Medical Journal Australia, vol. 182, no. 4, pp. 172-6.

ORGANISATIONS

- Australian and New Zealand Society of Nuclear Medicine (ANZSNM) www.ANZSNM.org.au
- Australian Nuclear Science and Technology Association (ANSTO) www.ansto.gov.au

NSW POLICY DIRECTIVES

- NSW Health 2005, PD2005_339: Protecting People & Property, NSW Health Policy/Guidelines for Security Risk Management in Health Facilities, NSW Health.
- NSW Health 2005, PD2005_409: Workplace Health and Safety, Policy and Better Practice Guide, NSW Health.
- NSW Health 2005, PD2005_576: Office Accommodation Policy, Public Health Organisations and Ambulance Service, NSW Health.

QUEENSLAND POLICY

- Queensland Health 2008, Work Place and Office Accommodation Policy and Guidelines, Queensland Health.

SERVICE CAPABILITY

- NSW Health 2002, Guide to the role delineation of health services, 3 edn, Statewide Services Development Branch, NSW Health.
- NSW Health 2005, PD2005_602: Area Healthcare Service Plans, NSW Health Guide for Development, NSW Health.

- Queensland Health 2005, Clinical Services Capability Framework, V 2.0, Queensland Health.

REFERENCES

- ARPANSA 2002, Radiation Protection Series 4 - Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances, Australian Radiation Protection and Nuclear Safety Agency.
- ARPANSA 2007, Radiation Protection Series 11: Code of Practice for the Security of Radioactive Sources, Australian Radiation Protection and Nuclear Safety Agency.
- ARPANSA 2008a, Radiation Protection Series 14.1 - Safety Guide for Radiation Protection in Diagnostic and Interventional Radiology. Australian Radiation Protection and Nuclear Safety Agency.
- ARPANSA 2008b, Radiation Protection Series 14.2 - Safety Guide for Radiation Protection in Nuclear Medicine. Australian Radiation Protection and Nuclear Safety Agency.
- ARPANSA 2008c, Radiation Protection Series 16 - Safety Guide for the Predisposal Management of Radioactive Waste. Australian Radiation Protection and Nuclear Safety Agency.
- Department of Health and Ageing 2009, Diagnostic Imaging: Positron Emission Tomography (PET), Australian Government.
- NSW Department of Environment and Climate Change 2008, Draft Guideline 7: Radiation shielding design assessment and verification requirements, NSW Government.
- NSW Health 2005, PD2005_132: Waste Management Guidelines for Health Care Facilities. NSW Health.
- NSW Health 2007, TS-11 - Engineering Services & Sustainable Development Guidelines, V 2.0, NSW Health.
- NSW Health & CHAA UNSW 2009, TS-7 - Floor Coverings in Healthcare Buildings V1.1, NSW Health.
- Stds Aust 1994, AS 1319: Safety Signs for the Occupational Environment, SAI Global.
- Stds Aust 1997, AS/NZS 2982.1: Laboratory Design and Construction - General Requirements, SAI Global.
- Stds Aust 1998, AS/NZS 2243.4: Safety in Laboratories - Ionizing Radiations, SAI Global.
- Stds Aust 2010, AS 1428 (set): Design for Access and Mobility, SAI Global.
- WA Health 2006, Western Australia Health Facility Guidelines for Engineering Services, WA Health.
- WorkSafe Victoria 2007, Designing Workplaces for Safer Handling of People, WorkSafe Victoria.