

Australasian Health Facility Guidelines

Part B - Health Facility Briefing and Planning 0500 - Nuclear Medicine / PET Unit

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01 INTRODUCTION

01.01 Preamble

This Health Planning Unit (HPU) has been developed for use by the design team, project managers and end users to facilitate the process of planning and design.

This revision combines HPUs: 480 Positron Emission Tomography (PET) Unit and 500 Nuclear Medicine Unit which were previously provided as two separate documents. HPU 480 PET Unit will be discontinued.

This revised version has been informed by an extensive consultation process completed during 2015.

01.02 Introduction

This revised HPU describes the specific requirements to plan and design a Nuclear Medicine Unit, including PET which will be required in selected healthcare facilities.

Nuclear medicine may also be referred to a 'molecular imaging' however for the purposes of this HPU, the term nuclear medicine will be used.

This HPU 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 and Part B: Section 90: Standard Components, Room Data Sheets and Room Layout Sheets;
- Part C Design for Access, Mobility, OHS and Security;
- Part D Infection Prevention and Control; and
- Part E Building Services and Environmental Design.

It is recommended that where nuclear medicine modalities incorporate magnetic resonance imaging (MRI) and computed tomography (CT), information contained in HPU 440 Medical Imaging Unit should be reviewed.

01.03 Policy Framework

RADIATION PROTECTION

Codes of practice and guidelines relating to radiation and protection are available from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) website www.arpansa.gov.au. In particular, project staff should familiarise themselves with:

- Radiation Protection Series (RPS) No. 14 Radiation Protection in the Medical Applications of Ionizing Radiation (ARPANSA, 2008). This document outlines ALARA (as low as reasonably achievable) which is used as a guiding principle in radiation hygiene issues, in terms of design and operation of a Nuclear Medicine/PET Unit; and
- RPS No. 14.2 Safety Guide for Radiation Protection in Nuclear Medicine (ARPANSA 2008). 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.

In addition, the American Association of Physicists in Medicine Task Group 108 published PET and PET/CT Shielding Requirements in Medical Physics, Volume 33, No. 1, January 2006.

The Australian and New Zealand Society of Nuclear Medicine publish a range of technical standards such as the Requirements for PET Accreditation (2nd Edition, 2012).

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/NZS 2243 Set: 2006 Safety in Laboratories.

Project staff should also refer to jurisdictional legislation, regulations and licensing requirement for radiation sources.

01.04 Description

DESCRIPTION OF NUCLEAR MEDICINE

Nuclear medicine, including PET, is the specialty of medicine which employs unsealed sources of radionuclide (radiopharmaceuticals or tracers) for diagnosis and therapy.

Nuclear medicine studies primarily show the physiological function of the system or organ being investigated using radioactive substances as opposed to the anatomy as is the case with radiology.

Increasingly, nuclear medicine images are being superimposed on appropriately registered images from modalities such as CT or MRI. This is known as image co-registration or hybrid imaging and is performed to further highlight the part of the body the radiopharmaceutical is concentrated.

Nuclear medicine imaging works by administering a radioactive substance or 'tracer' or 'biomarker' to the patient that releases energy as gamma rays or beta particles. In a normal organ, the radiopharmaceutical will have characteristic uptake, clearance or distribution. Organs not functioning normally will have variations on these characteristics and therefore indicate potential disease. The gamma camera detects the rays and using computer processing, images and functional assessments of organs and tissues are produced.

Nuclear medicine services are usually provided in a dedicated unit or suite of rooms within a healthcare facility that may or may not include a radiopharmaceutical laboratory and a PET suite. The size of a Unit in terms of numbers and type of gamma cameras will be determined by clinical needs, as described in a clinical service plan.

Scanning equipment may comprise:

- gamma cameras, single and multi-head types, noting almost all gamma cameras are now single photon emission computed tomography (SPECT) capable;
- hybrid SPECT / CT cameras;
- PET / CT and/ or PET / MRI; and
- bone densitometry and occasionally, ultrasound.

PET services may be collocated with another service such as an integrated cancer service to improve access to patients accessing a range of diagnostic and treatment services. In these instances, the design would need to incorporate design requirements as outlined in this document and relevant radiation safety publications.

Selected services may also require whole body gamma counters for non-imaging assessments, although it is not common.

Therapeutic procedures may include treatment for an overactive thyroid (hyperthyroidism) or thyroid tumours using radioactive Iodine -131. Some nuclear medicine therapies require inpatient admission (refer to Appendix: Iodine -131 Bedroom for detailed information relating to design).

Other radionuclide therapies can be administered to patients as a day procedure. This distinction relates to the characteristics of the therapy radionuclide utilised, and the radiation hazard they pose to the public when discharged. Increasingly, extended days stays are required as nuclear medicine procedures may include intermittent medical imaging procedures (e.g. Y-90 SIR Sphere administration).

In therapeutic nuclear medicine, the radionuclides used often differ from those in diagnostic nuclear medicine in that they are usually beta or alpha emitters with longer physical and biological half-lives.

Therapy radionuclides may require different facilities to radionuclides used for diagnostic procedures to ensure the safe preparation and administration of the radiopharmaceutical.

A day procedure that will increasingly need to be accommodated is Lutetium therapy. This treatment is currently used to treat neuroendocrine cancers.

SCANNING PROCESS

Radioactive doses/ tracers may be administered by injection, orally or by inhalation (e.g. Technegas). Patients may be scanned during, immediately after, a few hours later, or even several days after administration of the tracer depending on the organs to be studied and the time required for full uptake.

Scanning times vary and may range from as little as 10 minutes for oesophageal transit studies to two hours for whole body scan studies. The general range is 20 to 45 minutes.

Patients may be scanned on the gamma camera table or on their own hospital bed/ trolley although the latter is rarely possible with SPECT and SPECT/ CT cameras. Scanning rooms should be able to accommodate transfer of patient from bed to table and space to 'park' the bed.

Once the scan is complete, patients remain in the waiting room, or holding area in the case of inpatients, until the scans have been reviewed by medical staff to avoid unnecessary return for rescan.

Refer to Radiation Protection Series 4 Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances (ARPANSA 2002) for additional information.

SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SPECT is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera but is able to provide true 3D information.

To acquire SPECT images, the gamma camera is rotated around the patient. In most cases, a full 360 degree rotation is used to obtain an optimal reconstruction. The time taken to obtain each projection is also variable with a total scan time of 15 to 20 minutes.

A SPECT camera may be combined with a CT unit to form a hybrid system and co-registration imaging of the physiology and anatomy of the area/s being scanned. SPECT/ CT requires a separate control room and radiation screening in accordance with CT requirements.

DESCRIPTION OF POSITRON EMISSION TOMOGRAPHY (PET)

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

All modern PET cameras now incorporate a CT scanner as an integral component of the equipment. Whereas PET detects molecular information and changes, CT detects anatomical changes and the images can be co-registered.

CT is mainly performed for anatomical localisation and attenuation correction. Staff and licence requirements for additionally performing a diagnostic CT as part of a PET/ CT study are governed by jurisdictional 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.

The next generation of PET scanners combine PET and MRI.

The primary radionuclide used for clinical PET for the foreseeable future is Fluorine-18 fluorodeoxyglucose (FDG) and Ga-68, obtained from a cyclotron and supplied in a generator. Because of the half-life, the supplied radionuclide undergoes ongoing decay during the working day. This necessitates careful planning with respect to patient scheduling and deliveries.

The efficiency of the scanners has improved in recent years and it is now possible to undertake up to 20 scans per day. To support this level of throughput however would require additional staff and uptake rooms

(i.e. up to 10 rooms). Many services currently provide around 15 scans per PET scanner per day. This number will vary according to local protocols, the number of uptake rooms available and staffing.

CYCLOTRON AND RADIOPHARMACEUTICAL LABORATORY

A cyclotron is a device used to produce beams of charged particles that can be directed at a specific target. Cyclotrons are used for cancer treatment (proton therapy) and radionuclide production. For example, the cyclotron produces F-18 which is used to synthesise the radiopharmaceutical, fluorodeoxyglucose (FDG) which is used primarily for cancer diagnosis.

Radiopharmaceuticals for a PET Unit are either provided by an on-site cyclotron or by third- party suppliers. Increasingly, in-house production of PET tracers is being undertaken, even in sites without a cyclotron as PET radionuclide generators are now commercially available (e.g. Ga-68 generators). This synthesis occurs in a 'hot cell' located within a radiopharmaceutical laboratory. A hot cell is a heavily shielded enclosed workbench, with local QC of the synthesised products.

This HPU does not address the detailed planning and design requirements for a cyclotron and associated radiopharmacy however some design and space information is contained in the Non-Standard Components and Schedule of Accommodation sections of this document.

Some hospital-based laboratories will manufacture radiopharmaceuticals for sale to other healthcare providers which may require good manufacturing practice (GMP) standard facilities.

02 PLANNING

02.01 Operational Models

MODEL OF CARE

The model of care will depend on level of services provided as defined in the clinical service plan.

In large centres, the Nuclear Medicine Unit will be a discrete unit. Where PET services are provided, they will be routinely collocated with other nuclear medicine services where possible. In very small departments, the service may be a discrete area within a Medical Imaging Unit.

Most patients (approximately 95%) having PET studies are managed as outpatients while the proportion of those having nuclear medicine studies is evenly split between inpatients and outpatients.

Nuclear medicine services will include both diagnostic and therapeutic procedures. Increasingly, services will combine both nuclear medicine and medical imaging modalities. An example is Y-90 SIR Sphere administration used to treat non-resectable liver tumours. Patients are transferred between the angiography suite and Nuclear Medicine Unit during the procedure. This type of procedure also requires the transfer of radioactive materials and the resultant waste between the hot lab and angiography suite.

In selected centres, the complexity of procedures may result in patients being held for longer day stays within the Unit. Refer to Operational Policies, Lutetium Therapy for more information.

Radiopharmaceuticals may be made available by direct purchase of a unit dose from a commercial provider. Unit doses and other radiopharmaceuticals will be or prepared and dispensed on-site in a hot lab. Radiopharmaceutical laboratories will also be required in services where radiopharmaceuticals are prepared manufactured and/ or synthesised on-site.

02.02 Operational Policies

GENERAL

The following issues should be considered in the development of the operational model for the Unit, as they will all impact the configuration of the Unit and overall space requirements.

Operational policies should be developed as part of the project planning process. Refer to Part B Section 80 General Requirements for further information.

HOURS OF OPERATION

The Nuclear Medicine Unit will usually operate during business hours with a possible requirement for emergency access after-hours, particularly in tertiary centres. Delivery of radioactive supplies may occur out-of-hours and arrangements will need to be considered when planning a Unit.

SOURCE OF RADIONUCLIDES AND RADIOPHARMACEUTICALS

Radiopharmaceuticals are obtained from a range of external sources both within Australia and overseas. Some will be delivered as unit doses, some are reconstituted and /or dispensed in a hot lab. Those Units that manufacture radiopharmaceuticals for administration will undertake this work in a radiopharmaceutical laboratory.

Technetium-99m is the radionuclide most widely used for nuclear medicine scans.

It is common to have two generators for radionuclide production at any one time as the expiry date for each is two weeks. The generators are placed in customised lead caves on a reinforced bench. Generators may be returned to the supplier on expiry, or may be stored on-site for longer periods.

A weekly delivery will usually provide adequate technetium supply for most units.

HALF LIFE

Half-life is the time required for the radioactivity of the radionuclide to diminish by 50% of its original activity due to radioactive decay. This is different to biological half-life which is the time required to eliminate 50% of the original activity of the radiopharmaceutical from the body. This is important with regard to timing of scans once the radionuclide has been administered to the patient, separation of patients who have been injected but are awaiting scans and also for frequency of delivery of radionuclide from external suppliers.

The most commonly used radionuclide in SPECT is Technetium-99m (99mTc) which is delivered from a 99Mo/99mTc generator and eluted as required and added to a 'cold' kit to create the appropriate radiopharmaceutical with a half-life of six hours. The characteristics of other radionuclides used will need to be considered as it may potentially impact on the design and shielding requirements.

HOT LABORATORIES

A hot lab is a dispensing laboratory accommodating activities including:

receipt and documentation of any radionuclides or radiopharmaceuticals;

- secure storage of sealed sources;
- reconstitution of cold kits with radionuclides, and the subsequent quality control testing;
- dispensing of radiopharmaceuticals for imaging or therapy; and
- receipt and storage of radioactive waste until it is safe for disposal.

All nuclear medicine services will require a hot lab. Where PET services are collocated, a separate hot lab may be required, or a dedicated section of the main hot lab assigned as different shielding will be required. In addition, the PET hot lab should be adjacent to the PET imaging and uptake rooms.

LABORATORIES – HOT LABS AND RADIOPHARMACEUTICAL SCIENCE LABORATORIES

Radiopharmaceuticals for use in diagnosis or therapy are prepared, manufactured and synthesised in a Hot Lab and / or Radiopharmaceutical Laboratory.

There are potentially three functionally different areas within a Unit for these activities.

1. The **nuclear medicine hot lab**, which deals largely with the preparation, quality control and dispensing of radiopharmaceuticals for human use. Preparations are largely confined to the reconstitution of 'cold' or non-radioactive kits with a radioactive solution to create the radiopharmaceutical. The generator which supplies 99mTc pertechnetate for SPECT imaging is housed within this region. Quality control evaluation of preparations may be performed here, patient doses are calculated, dispensed and measured here. Storage of cold kits is usually within this area. The dispensing of therapeutic doses may be within this area, but would require a separate zone. The preparation of radiolabelled blood products may also be within this area, but would also require a separate zone, and some specialised equipment such as a biological safety cabinet, or a Class A environment (depends on types of preparations). This area should be adjacent to the SPECT imaging area.
2. The **PET hot lab**. This area deals with PET radiopharmaceuticals, receipt, dispensing, transfer to automated dose delivery equipment when available, and the general management of patient doses for PET imaging. This area will be adjacent to the PET imaging area, and uptake rooms.
3. The **Radiopharmaceutical laboratory(ies)**. These can vary in size and complexity depending on the operations that are currently performed, or expect to be performed. This will be a separate laboratory used primarily by radiopharmaceutical scientists in contrast to Areas 1 and 2, which are usually used by nuclear medicine technologists. This area will be used variously for the preparation of special formulations. These can vary from labelled blood products to complex synthesis of radiopharmaceuticals such as fluorine-18, or gallium-68 radiopharmaceuticals used in PET imaging. It may be used for cold kit batch formulation. A radiopharmaceutical science laboratory may be adjacent to a cyclotron and be used in the preparation of multiple radiopharmaceuticals from the output of the cyclotron. Specific requirements for these laboratories are detailed in Non Standard Components.

Most Nuclear Medicine Units will have a hot lab, whether for the preparation and dispensing of patient doses from multi-dose vials, or just the receipt of unit doses from a commercial supplier. However, only designated units will have a radiopharmaceutical laboratory.

SEDATION

General anaesthesia (GA) or deep sedation is rarely needed except in units with a large paediatric component. However, at least one SPECT CT (and PET where services for children are delivered) scanning room should be GA capable. Sedation will be administered in the scanning room. Refer to the section on Paediatric Studies below.

Sedated patients will usually proceed to a general recovery area after the examination is completed or may recover in the Unit.

At least one nuclear medicine scanning room should be configured to accept a ventilated ICU patient for scanning purposes.

PAEDIATRIC STUDIES

Sedation, administered by a visiting anaesthetic team, may be needed for small children to undertake specific studies that take 30 to 45 minutes to complete or for which body motion may severely degrade the images. The sedation is usually oral or intravenous, depending on the child's weight. Sometimes a full general anaesthetic is needed, particularly for PET. Unless pregnant, a parent may stay with the child during the procedure. Refer to the radiology information resource for patient's website www.radiologyinfo.org.

BOOKINGS

Appointments are made via a central booking system in order to coordinate supply of radiation substances. Due to the nature of some of the advice and instructions given to patients when booking the scanning procedure, access to an interview room or privacy booth will be required at reception for this purpose.

FILM / RECORDS STORAGE

Picture Archiving and Communication Systems (PACS) is assumed. A colour printer is required when an image is printed. Volumes of printing are low.

In the absence of a comprehensive electronic patient record system, storage space for paper copies of patient scan reports / consent forms and referral documentation may be required if record scanning is not in place. All patient records should be maintained and retained according to relevant jurisdiction policies and procedures.

MANAGEMENT OF MEDICAL EMERGENCIES

A resuscitation trolley should be located in or very near the stress testing room as this is the most likely place for cardiac arrest. PET/ CT services undertaking contrast CT exams may also present a higher risk as anaphylactic reactions may occur. Specific equipment will be required in Units treating children.

MANAGEMENT OF RADIOACTIVE CONTAMINATION

Spills should be managed in accordance with Radiation Protection Series Publication No. 14.2 Radiation Protection in Nuclear Medicine, Section 10.3 Management of Radioactive Contamination, 2008 and radiation management plans.

All surfaces including floors, bench tops, walls and junctions should be impermeable and easy to clean. Floor vinyl will be coved.

An emergency eye wash will be located at a basin in the radiopharmaceutical laboratory. An additional eye wash/ basin station will be required for staff and patients, located in close proximity to all areas of potential exposure.

A decontamination kit should be stored in the hot lab or radiopharmaceutical laboratory for quick access to contain and clean up radioactive spills.

LUTETIUM THERAPY

Selected nuclear medicine services will provide Lutetium-177 peptide therapy for neuroendocrine tumours. This same day treatment requires the patient to receive an intravenous infusion over a four hour period. During treatment, the patient will need to be cared for in a shielded space, either a single room or shared

bedroom. Many services choose to deliver this service to multiple patients at a time to improve staffing efficiencies.

PATIENT REFRESHMENTS

Patients visiting the Unit should have access to drinking water.

Many patients undergoing scanning procedures may be fasting pre-scan, may require a cup of coffee or tea to relieve headaches and nausea, or be provided with a fatty meal to precipitate gall bladder contraction. Provision of refreshments should be supervised by staff.

PATIENT WAITING

For patients undergoing nuclear medicine studies, waiting areas should allow separation of dosed ('hot') and undosed ('cold') patients.

PET patients require isolation in a shielded room after injection, typically for 60 minutes (uptake phase).

It is preferable to separate dosed patients from people who accompanied them to the Unit which may include young adults, pregnant women and children. This is mandatory for all nuclear medicine and PET patients.

Patients having a post-therapy I-131 scan should preferably be separated from patients having diagnostic scans. An area where patients can wait post-scan is also recommended.

Dosed patients should have access to drinking water and toilet facilities without having to travel through general waiting areas. Those awaiting a PET scan should have access to a toilet located between the uptake rooms and scanning room. The number of toilets provided will ensure queuing is avoided.

Inpatients will usually be held in a holding area.

Outpatients and their relatives need to be provided with explicit advice about the radiation safety requirements for themselves and others if they are required to wait several hours for uptake pre-scan. These patients should be encouraged to stay within the dosed patient waiting area, but if allowed to leave should be discouraged from spending time in enclosed public areas such as cafeterias. Inpatients may return to their respective inpatient units.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) will be used in areas of the Unit where there is a likelihood of contamination. The equipment should be monitored and removed before leaving designated areas. PPE may include:

- laboratory coats or protective gowns;
- waterproof gloves; and
- face masks.

In certain circumstances staff may need to wear a protective lead apron. One to two hooks to store lead gowns in each scanning room is usually sufficient. Alternatively, a designated rail with heavy duty hangers may be provided.

Refer to Radiation Protection Series Publication No. 14.2 Radiation Protection in Nuclear Medicine, Section 9.6 Equipment and Clothing, 2008.

RADIONUCLIDE - DELIVERY

Nuclear Medicine Units will receive unsealed radionuclides (delivered to a licensed person).

Technetium generators may only be delivered weekly, depending on requirements. There may be no guarantee delivery will occur during business hours so arrangements will have to be made for couriers to have access to a secure area in the Nuclear Medicine Unit. This can be directly into a small storage area opening off the main corridor or into a nominated area such as the hot lab.

All deliveries will be made directly to hot labs within Unit usually via the loading dock.

Refer to Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.4 Storage and Safe Handling of Sealed Radiation Sources (ARPANSA 2008b).

RADIOACTIVE WASTE MANAGEMENT

Radioactive waste is waste contaminated with radioactive substances and may be liquid, solid or airborne (e.g. gases and vapours).

For further information Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.4 Environmental Issues, 2008.

RADIOACTIVE WASTE DISPOSAL - LIQUID

A delay holding tank within the Unit for effluent from patient toilets, pan sanitisers and laboratory sinks is not required.

For further information regarding toilets associated with treatment of inpatients undergoing radioactive iodine treatments, refer to the Appendix.

RADIOACTIVE WASTE DISPOSAL - SOLID

Solid radioactive waste includes all items / materials used in treatment and manufacture (e.g. laboratory glassware, pipette tips, plastic vials and trays, paper tissues, used syringes, tools etc). Such items are to be bagged, labelled and segregated, and retained in a dedicated secure waste holding area until designated safe for routine disposal, usually after 10 half-lives.

It is essential that items contaminated with iodine are stored in a shielded area for three months to allow for full decay and may then be disposed of in the usual manner (e.g. linen, sharps, and clinical waste).

The radioactive waste store is ideally located in the Nuclear Medicine Unit. A room at the perimeter of the Unit with dual and carefully controlled access is preferred. The room should be shielded.

RADIOACTIVE WASTE DISPOSAL - SHARPS

To reduce the risk of needle stick injury and radiation exposure of staff, needles and cannulae used for dispensing and dose administration should be disposed of into shielded sharps containers at the point of use. When the containers are full they should be held in the radiation waste storage area until designated safe for routine disposal.

STORAGE

Requirements may include:

- storage in the scanning rooms to reduce issues associated with movement of heavy or bulky articles such as collimators and scanning phantoms. This storage can be facilitated by choosing equipment with self-storage options;
- equipment bays for mobile items such as wheelchairs, beds/ trolleys and lifters;
- equipment bay for Technegas unit and argon cylinder/s. The Technegas unit is bulky and sits on a trolley about 600x800mm which can be wheeled to bedside or camera for patient to inhale Tc99m. When not in use, it needs parking space alongside a large cylinder of argon gas. Alternatively, the argon gas may be embedded;
- imaging table or machine;
- general storage for smaller equipment items;
- storage for office supplies; and
- storage for clinical consumables and some medications.

STAFFING

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

The staff establishment may include:

- medical specialists qualified in nuclear medicine including radiologists, endocrinologists, cardiologists and paediatricians;

- junior medical staff;
- nuclear medicine physicists;
- nuclear medicine technologists / scientists;
- radiopharmaceutical scientists;
- nursing staff;
- administration staff; and
- orderlies.

TEACHING AND RESEARCH

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

All major teaching hospitals will undertake staff and student teaching, research and possibly prepare novel radiopharmaceuticals for clinical use.

Units undertaking clinical trials will need to carefully assess needs in excess of routine requirements both in terms of treatment rooms and staff facilities.

02.03 Planning Models

LOCATION

The Unit should not be a thoroughfare to other units of the healthcare facility. Both the Nuclear Medicine service and the PET service are prescribed as controlled radiation areas.

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 radionuclides.

Where a cyclotron is planned, a location below the PET suite is ideal, with direct shielded tube system access to the PET hot lab. A system for rapid transport of very short lived radiopharmaceuticals should be installed.

Future expansion and replacement of major medical equipment needs to be considered when locating the Unit. Considerations may include:

- expansion of the scanning rooms to allow for upgrades to the equipment which will require additional shielding, increased load bearing capabilities and services requirements (power supply and heat dispersion in particular);
- access for supply and installation of new equipment; and
- identification of expansion zones for increased staffing requirements to meet service demand and technological changes.

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 dosed patients and scanning rooms.

The PET area will be in a discrete zone within the Nuclear Medicine Unit.

An effective layout can also reduce the need for costly radiation shielding. Provide separate entries for the general public / outpatients and for patients on beds / trolleys. All patient corridors should accommodate passing and turning of wheelchairs and beds.

If provided, the bone density room should be located near the entry to the Nuclear Medicine Unit to ensure patients do not unnecessarily come in contact with dosed patients. Consider separating the room by distance or shielding to avoid interference from high ambient radiation levels.

02.04 Functional Areas

FUNCTIONAL ZONES

Functional zones will include:

- entry/ reception;
- waiting, both dosed (hot) and undosed (cold);
- nuclear medicine scanning rooms;
- PET scanning and uptake rooms;
 - patient holding/ recovery area;
- clinical support areas; and
- staff areas including office space and related support, teaching and research and amenities.

ENTRY / RECEPTION

Facilities, depending on the size of the service, will usually comprise:

- entry lobby and general waiting area;
- reception / enquiry desk; and
- office space for bookings and other administration activities.

Public toilets should be readily available but need not be inside the Unit.

If the Nuclear Medicine Unit is part of a Medical Imaging Unit, these facilities may be shared.

This area should be arranged so patients cannot readily gain access to other areas of the Unit.

WAITING AREAS - DOSED AND UNDOSED

Waiting areas for nuclear medicine outpatients usually comprise:

- separate areas for dosed and undosed patients who may be ambulant or in wheelchairs;
- access to toilets so that dosed patients are not travelling across the undosed patient waiting area; and
- child play area, if required in the undosed waiting area.

Inpatients, both dosed and undosed, will be managed in the patient holding/ recovery area.

Patients being dosed for PET studies are managed in uptake rooms. Patients are managed in a discharge lounge post procedure.

IMAGING AREAS

The imaging areas will be broadly arranged into two areas: nuclear medicine scanning rooms and PET (CT or MRI).

NUCLEAR MEDICINE SCANNING ROOMS

All the following rooms are accessed by patients and require radiation shielding as advised by consultants:

- dosing / consult exam rooms - ideally adjacent to the dispensing hot lab;

- cardiac stress testing room;
- scanning room/s; and
- a bone density room, if provided would be located with other rooms but should not interrupt other flows.

PET/CT SUITE

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

- individual pre-scan uptake rooms with one designed for anaesthesia and recovery (especially where children are seen);
- PET/CT Scanning Room;
- control room;
- specialised PET patient toilet; and
- hot lab and radioactive waste store.

An equipment / plant room will be required to accommodate UPS batteries, water cooling units, servers and communications racks.

The number of uptake rooms, scanning rooms and hot toilets is determined by the anticipated patient throughput of the facility. Expansion space should be considered during planning.

PATIENT HOLDING / RECOVERY AREA

This area will comprise:

- patient bays for holding/ recovery. The size of each bay and configuration of the overall space should permit both dosed and undosed patients to be held safely;
- a staff station so that staff can observe all bed spaces and preferably have overview of the non-inpatient waiting area as well;
- access to hand hygiene, including hand basins; and
- ready access to dirty utility, linen bay, storage for clinical supplies and a patient toilet.

A dedicated entry for inpatient beds will ensure beds do not travel through public waiting areas.

In selected settings, patients held for extended day stays may be managed (i.e. lutetium therapy). These beds, best arranged in a shielded four-space pod, would be located in an adjacent location so they can be managed by the same nursing team. Access to a 'hot' toilet will be needed.

CLINICAL SUPPORT AREAS

Clinical support areas usually include the following areas:

- viewing / reporting area;
- radiopharmaceutical laboratories;
- hot labs / dispensary /QC zone and radioactive waste store;
- dirty utility room;
- disposal room;
- equipment bays;
- equipment, and general stores; and
- sterile stock store or clean utility room.

Storage space must be available for one or more patient beds (in case of transfer of an inpatient from another facility via ambulance etc. or in case of deterioration of a non-inpatient such that they need to be urgently transferred to an acute care area such as emergency department (ED). Storage is also required for

anaesthetic machines, Morgan trolley, emergency trolley, additional scanning palates, phantoms (both hot and cold).

However, if collocated with a medical imaging unit, some areas listed may be shared.

STAFF AREAS INCLUDING OFFICES AND AMENITIES

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

- meeting rooms to support staff activities, education and research;
- office space in accordance with staff establishment and teaching / research roles; and
- staff amenities including staff room, toilets, showers and lockers. Lockers should be in a secure staff area.

02.05 Functional Relationships

The Unit should be located so ready access is provided from inpatient units (predominately cardiology, oncology and respiratory), the emergency unit and medical imaging unit. Where a PET is included, the location in relation to the radiation oncology unit should be considered.

Easy access including drop-off is needed for patients arriving as outpatients.

03 DESIGN

03.01 Access

EXTERNAL

Provide:

- direct access for delivery of radionuclides / cold kits both during and after business hours;
- easy access to/from all clinical units; and
- easy access for vehicles providing maintenance or delivery of large, heavy equipment items.

INTERNAL

There will be a single public entry point to the Unit. Separate access will be provided for staff, patient transfers and the movement of supplies and waste.

Circulation routes through the Unit will allow access and ease of movement of beds/ trolleys.

Corridor width should be sufficient to allow beds/ trolleys with associated pumps to pass in a corridor.

The Unit should be designed to restrict access to treatment areas and staff only areas. Waiting areas should be arranged to achieve separation between dosed and undosed patient groups.

Consideration regarding equipment replacement needs to be considered during the design phase, including external access and movement through the Unit. Selected equipment items can weigh more than 10 tonnes.

03.02 Parking

The nature of nuclear medicine treatments means that time lost can impact on service provision. For example, PET tracers decay quickly. Access to adequate parking nearby can reduce these delays. Longer treatments may also influence the need for extended hours parking.

For information regarding staff parking, refer to AHIA, 2010, AusHFG Part C: Section 790, Safety and Security Precautions.

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 issues such as the placement of emergency alarms, the need for uninterrupted power supply (UPS) to essential clinical equipment, services such as emergency lighting, telephones, duress alarm systems and computers and the emergency evacuation of patients, many of whom will require assistance.

For further information refer to:

- local jurisdiction disaster management plans; and
- AusHFG Part B: Section 80 General Requirements.

03.04 Infection Prevention and Control

Refer to:

- AusHFG Part D Infection Prevention and Control; and
- jurisdiction policies and guidelines related to infection prevention and control.

03.05 Environmental Considerations

ACOUSTICS

Sound attenuation should be provided, but not limited to, the following areas:

- scanning rooms especially where MRI or air-cooled CT is used;
- viewing / reporting room;
- consult rooms;
- plant and communication rooms; and
- toilets particularly if adjacent to offices.

Also refer to acoustic requirements noted on Room Data Sheets where provided.

NATURAL LIGHT

As much natural light as possible should be provided, especially into public spaces, waiting areas and those treatment areas that patients and staff occupy for long periods of time. 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. Alternatives may be lighting systems that aim to replicate light or provide alternate means of distraction.

Control of external light is essential in uptake rooms and reporting rooms (e.g. for 18-FDG brain scans).

PRIVACY

Visual and acoustic privacy is required in all consultation, examination rooms, and treatment spaces / scanning rooms.

If patients change in the uptake rooms, privacy from CCTV cameras (where used) will be required.

INTERIOR DECOR

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

Ideally, the decor should be relaxing and provide positive distractions for patient undergoing scans that may take some time.

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 AusHFG Part C Section 730.

ERGONOMICS

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

For example, a hoist or crane may be needed to position the generator in the hot lab.

Consider work practices in relation to manual handling of equipment with significant weight. Manual handling requirements may be reduced by appropriate local storage such as equipment bays. These bays may also accommodate mobile patient lifting hoists. Alternatively, a gamma camera scanning room may be equipped with a ceiling mounted hoist to manage patients up to 250kgs.

Refer to AusHFG Part C Section 730 for further details.

ACCESS AND MOBILITY

Where relevant, the design needs to comply with AS 1428 Design for Access and Mobility.

For further information refer to AusHFG Part C: Design for Access, Mobility, OHS and Security, Space Standards and Dimensions.

BUILDING ELEMENTS

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

Ensure that floors are designed to support the weight of equipment, and shielding, and that equipment is not located in vibration prone areas.

Provide the same level of shielding to vision panels in doors to treatment rooms and hot labs as to the adjoining walls.

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

Ensure that the allowances in some equipment specification manuals provide adequate space for complex transfers requirements such as patient from ICU bed to scanner. Refer to non-standard components and the schedule of accommodation for guidance on appropriate room sizes for the scanning rooms.

DOORS AND DOORWAYS

All entry points, doors or openings, should be sized to permit the manoeuvring of beds and other equipment. Larger openings may be required for special equipment (e.g. bariatric beds) as determined by local requirements. Scanning rooms will have a clear minimum opening of 1500mm to accommodate the movement of beds and trolleys.

The size of a basic bed or trolley is often enlarged by the addition of monitors, other equipment and several staff, making movements more difficult than in other areas of the hospital.

It is important that adequate circulation space is provided for the safe and efficient movement of these beds. Corridors throughout the Unit will be consistent with AusHFG Part C Section 710 Space Standards and Dimensions. High volume services may benefit from a racetrack design to reduce turning of beds/ trolleys.

Doorways to scanning rooms should be flush to the floor for ease of camera installation and movement of equipment such as collimator carts. Consideration should also be given to transfer of major equipment through entry doorways when designing. Increased door opening heights required in treatment rooms and transfer path for equipment transfer (gantries etc).

Refer to:

- AHIA, 2010, AusHFG Part C: Design for Access, Mobility, OHS and Security, Space Standards and Dimensions; and
- HPU 440 Medical Imaging Unit for special door and signage requirements related to rooms using CT and MRI.

03.07 Safety and Security

GENERAL

A safety audit via a risk analysis of potential hazards should be undertaken during the design process.

For details refer to:

- Part C Section 790 Safety and Security Precautions; and
- individual jurisdiction policies and guidelines where applicable

SAFETY

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

- adequate protection for workers against infection and any other hazards - particularly radiation exposure. This can be improved by placing areas housing radiation in areas that avoid staff and visitors walking by;
- location of hot labs/ radiopharmaceutical science laboratories as these rooms and associated facilities should be located so they are not accessible by the public;
- locating spill kits in each scanning and injecting room so they are easily accessible; and
- manual handling of technetium generators. The generators weigh up to 20kg and a hoist may be required to transfer from transport package to bench top and vice versa. The hoist should be capable of slow, accurate manipulation to avoid damage to the Mo99 column within the generator shield.

RADIATION SHIELDING AND SIGNS

Advice must be sought for each project from either the Radiation Safety Officer of the facility, a qualified medical physicist or a Certified Radiation Expert (CRE). Radiation shielding will be required to a number of areas within the Unit including but not limited to:

- gamma camera rooms;
- SPECT scanning room;
- SPECT/CT scanning room;
- PET/CT or PET/MR room;
- dosed patient waiting area;
- uptake rooms;
- hot toilets;
- hot labs and radiopharmaceutical science laboratories; and
- reception and other rooms adjacent to dosed patient areas.

Requirements for shielding to floors or ceilings directly above or below treatment rooms or hybrid SPECT/CT rooms should be considered.

As the aim is to reduce the exposure of staff to dosed patients, signage in selected areas will need to be instructional so that patients can self-manage where possible (e.g. movement between uptake rooms and hot toilets). The amount of shielding required is influenced by available space. It may be possible to reduce shielding where additional space is provided.

Visible warning signs are to be provided at every entry to a room where unsealed radioactive material is stored or used.

Visible warning signs are also required to rooms with irradiating apparatus - bone densitometry and SPECT/CT systems.

For further information Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.2 Radiation Shielding and Signs.

SECURITY

General security considerations will include use of duress in selected areas (e.g. staff station, reception). Swipe card access to staff only and other restricted areas.

The security of radioisotopes and radioactive waste is of particular importance. Refer to:

- Radiation Protection Series Publication No. 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10 (ARPANSA 2008b); and
- Radiation Protection Series Publication No. 11 - Security of Radioactive Sources, (ARPANSA 2007).

03.08 Finishes

WALLS

Walls should be washable and easily decontaminated in the event of a radioactive spill. Adequate wall protection should be provided to areas that will regularly be subjected to damage. Particular attention should be given to areas where beds or trolley movement occurs such as corridors, bed space walls, treatment areas, equipment storage bay/ rooms and linen trolley bays.

Refer to AusHFG Part C: Section 710, Design for Access, Mobility, OHS and Security for further information.

FLOOR FINISHES

Floor finishes and junctions should be impermeable, non-absorbent and coved in case of radiation spills.

Where joints exist in vinyl flooring in hot labs/ radiopharmacies, they should be welded. Expansion joints should be avoided within these spaces.

Refer to:

- AusHFG Part C: Section 710, Design for Access, Mobility, OHS and Security; and
- Department of Health, NSW, 2009, Technical Series TS7 - Floor Coverings in Healthcare Buildings.

CEILING FINISHES

Also refer to AusHFG Part C: Design for Access, Mobility, OHS and Security, Space Standards and Dimensions.

03.09 Fixtures, Fittings & Equipment

DEFINITIONS - FIXTURES AND FITTINGS

Room Data and Room Layout Sheets in the AusHFG define fixtures, fittings and equipment (FFE).

Refer to the Room Data Sheets (RDS) and Room Layout Sheets (RLS):

- AusHFG Part C: Section 710, Space Standards and Dimensions; and
- AusHFG Part F: Section 680 Furniture Fittings and Equipment.

03.10 Building Service Requirements

GENERAL

High cost engineering areas which should receive careful consideration by design teams 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 essential back-up systems (e.g. dual generators, chillers, boilers and dual electrical circuits);
- dimmable lights in reporting areas, scanning rooms and uptake rooms; and
- low light capable CCTV monitoring may be required.

Refer to:

- AusHFG Part E Building Services and Environmental Design; and
- jurisdiction guidelines relating to engineering services.

CONSTRUCTION

In constructing the Unit, it will be necessary to ensure:

- new and existing floor structures and finishes are adequate to meet load requirements for equipment, shielding, patients, and staff. Some examples include:
 - a PET/ CT can weight approximately three tonne and a PET/MRI can weigh approximately 10 tonnes;
 - shielding of up to three cm thickness, or the lead equivalent thickness, is required for PET shielding;
 - 'hot cells', used within radiopharmaceutical science laboratories can weigh between three and 10 tonnes;
 - RF shielding is required for MRI with current PET-MRI operating at up to 3 tesla;
- shielding is required for MRI with current PET-MRI operating at up to 3 tesla;
- provision is 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;
- extraction systems in hot labs and radiopharmaceutical laboratories;
- penetrations for sewer/water/electrical may need to be angled and shielded, as well as located strategically in terms of radiation hygiene considerations;
- ceiling heights in the scanning rooms should be a minimum of three metres;
- ceiling mounted equipment should be designed with rigid support structures located above the finished ceiling; and
- laser marker systems may be required in the PET camera room to assist with radiation therapy planning and co-registration systems.

ELECTRICAL SERVICES

A sufficient number of power outlets, both general and essential supply, including three phase outlets, will be required to support current and anticipated future needs.

An emergency back-up system for the power supply should be available for high priority equipment illumination of patient's areas including scanning rooms.

Provide uninterrupted power supply (UPS) to cameras, acquisition workstations and servers to prevent data loss and/or damage during power surges or brown outs and to reduce the risk of reimaging that patient. Intent is to provide limited supply to support patient care until the back-up power supply is available.

All patient areas should be body protected.

All scanning rooms require dimmable down lighting with lighting not located directly above scanning beds.

Refer to:

- relevant Australian Standards; and
- jurisdiction specific engineering services guidelines.

HYDRAULIC SERVICES

When routing hydraulic services and air conditioning ducts in ceiling spaces, avoid the space above major medical equipment as water leaks can cause significant damage.

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

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

Unit design should address information technology and communications issues including:

- 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;
- robotics systems housed within hot cells and operated remotely via computer;
- point to point data;
- server room; and
- patient / nurse and emergency call systems compatible with existing hospital systems.

MECHANICAL SERVICES

Additional cooling and ventilation will be required to scanning rooms and associated computer equipment rooms as the equipment is sensitive to excessive ambient heat. Additional cooling capacity should be built in to allow for future growth and technological development of scanners. Some scanners may require chilled water for cooling.

Avoid large temperature changes in scanning rooms (>4°C/hour) because of the possibility of crystal fracture in gamma cameras.

General air conditioning needs to cool equipment but not blow over partially undressed patients. Patients waiting in uptake rooms should be provided with a warm environment as this helps with the uptake of radiopharmaceuticals.

The temperature of the Unit should be maintained within a comfortable range not exceeding 24°C.

Smoke detectors in treatment rooms should be sensitive to radiation (i.e. Photoelectric). The location of these units needs careful consideration.

Additional air extraction may be required in the camera room/s where ventilation agents such as Technegas are administered in accordance with state regulatory requirements.

Hot lab and Technegas room air should not be recirculated but exhausted. Both rooms should be at a negative pressure to the rest of the Unit.

The Hot Lab may require a fume cabinet with ducting to a stack.

A system of moving product from a cyclotron to point of use may be considered where there is a significant distance. Options might include a 'dumb waiter' or pneumatic tube system.

However a pneumatic tube system will not be needed.

MEDICAL GASES

Oxygen, suction and medical air will be required in all scanning rooms, stress testing rooms and to patient bed bays.

Nitrous oxide and scavenging will be required in rooms where general anaesthesia may be administered, particularly in units where children are treated.

Argon gas is required for Technegas machines where this agent is used for lung scanning. Argon may be provided by a mobile cylinder or piped.

Medical gases installation and testing in accordance with AS2896 (Stds Aust 1998b).

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 the design team is comprehensively briefed. A qualified radiation expert should be involved in the design.

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

- pre-scan uptake rooms and patient amenities;
- SPECT / CT scanning rooms;
- PET-CT uptake and scanning rooms;
- PET-MRI room;
- post-scan waiting areas; and
- hot lab / radiopharmaceutical laboratory.

Refer to Radiation Protection Series Publication No 14.2 Safety Guide for Radiation Protection in Nuclear Medicine, Section 10.2 Radiation Shielding and Signs.

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; and
- 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/standardcomponents

04.02 Non-Standard Components

Non-standard components are unit-specific and provided in accordance with specific operational policies and service demand. These non-standard components for Nuclear Medicine Units are detailed below.

SCANNING ROOM - SPECT AND SPECT/CT

Description and Function

A scanning room is used for obtaining nuclear medicine images. The room for SPECT/CT should be larger to accommodate the hybrid technology.

Equipment may be a SPECT camera or combined SPECT/CT hybrid system.

Radiation shielding is required for SPECT/CT.

Bed / trolley access is required plus space to park bed or trolley.

Installation of equipment should be in accordance with manufacturer's recommendations.

Location and Relationships

Rooms are ideally provided in pairs with direct access from a control room, which can be shared.

Ready access is required from dosing rooms and dosed patient waiting areas.

Considerations

Considerations include:

- UPS power is required to the cameras and associated acquisition / processing workstation/s to prevent data loss and/or damage during power surges or brown outs;
- individual room temperature and humidity control is required;
- dimmable down lighting should be placed so that lights do not shine directly into the patient's eyes; and
- bed / trolley access is required plus space to park a bed or trolley during the patient scan.

In addition to the camera / CT, fixtures, fittings and equipment will include:

- collimator rack/s used as a directional guide. The size and length of the collimator holes determine which gamma rays reach the detector in the camera. A range of collimators will be required. Collimator racks vary according to the model / level of gamma camera;
- ECG trigger and monitor for cardiac scans;
- CCTV camera (optional in SPECT/CT room);
- protective lead clothing;
- medical gases - oxygen, suction, medical air on service panel. If one room is to be used for sedation, nitrous oxide and a scavenge will be added;
- nurse and emergency call system;
- power outlets on the medical services panel;
- hand basin - Type B;
- PAT slide wall-mounted;
- storage / prep bench and shelving; preferably with roller-shutters for ease of managing cleaning requirements re scanned patients colonised by multi-resistant organisms (MROs);
- TV - fixed or portable (optional) for patient entertainment or patient / staff information;
- overhead power to avoid floor leads; and
- computer data points near gamma camera unit as well as processing workstations.

Scanning rooms also need to consider the space requirements for servicing equipment and machines which is frequently done in-situ given the size of these machines. Machines may be pulled apart to provide access to internal workings thus occupying a larger space than when operational.

CONTROL ROOM

Description and Function

The control room may be integral to the SPECT scanning room but a dedicated control room is preferred. A dedicated control room is required for SPECT/CT (as per CT imaging requirements).

This room requires:

- a lead observation screen for clear view of patient and equipment;
- a work bench and chairs;
- viewing monitors; space for SPECT consoles and anaesthetic slave monitors if required;
- shelves for manuals and stationery;
- space for computer equipment racks;
- brown out blinds for observation window for patient privacy; and
- CCTV monitor if CCTV camera installed in SPECT/CT room.

Considerations

If RT scans are to be done then space for the RT information system computer required.

CONSULT ROOM

Description and Function

This room is used for patient consulting, examination and administration of isotopes.

In most respects, this room is similar to the Standard Component - Consult Room except that radiation screening will be required.

Location and Relationships

Ready access to scanning rooms and general patient waiting is required.

Ideally, it should be located adjacent to the Hot / Dispensing Lab.

BONE DENSITOMETRY ROOM

Description and Function

A room for bone densitometry imaging studies primarily for osteoporosis assessment and management.

Patients are not usually required to change unless clothing has metal fasteners – zips etc. If necessary they may change within the room itself unless throughput can be improved by providing separate change rooms.

The room should allow the operator to maintain a safe distance from the active equipment and to be able to see the patient during the scan and not positioned with back to the patient.

In facilities with spinal cord injury units or where the Unit may be expected to see a larger number of highly dependent patients, the room should be sufficiently sized to allow safe transfer from a trolley.

Location and Relationships

The room should be located at or near the Unit entry to prevent patients coming into contact with dosed patients waiting scanning or having to pass in front of the scanning rooms. The scanner should be separated by distance or shielding from adjoining areas used by dosed patients. Check whether high radiation levels from nearby patients e.g. I-131 or PET could interfere with data/image quality of BMD scans.

Provide ready access to undosed patient waiting areas or alternatively these patients may use the general public waiting area.

Considerations

Other considerations include:

- bone densitometer machine - dual-energy x-ray absorptiometry - DXA or DEXA & console desk;
- computer workstation and height adjustable chair;
- shelving for gowns, positioning pillows, braces etc;
- hand basin Type B; and
- shielding as required noting modern machines have a very low radiation dose for the scans.

ENTRY LOBBY - RADIONUCLIDE DELIVERY

Description and Function

A space where external couriers deliver radionuclides.

Location and Relationships

Ensure the room is readily accessible to/from the hot lab. An external entrance may be provided so that deliveries do not have to penetrate the main Unit.

Considerations

Other considerations include:

- radiation shielding as advised by Consultants;
- appropriate radioactive signage on access doors; and
- crane system to assist with movement of heavy goods (e.g. shielded generator, weight above safe lifting limits).

Services may instead receive deliveries directly into the hot lab.

HOT LABORATORY

Description and Function

A hot lab is a dispensing laboratory in which the activities can vary quite widely between institutions. Where PET services are collocated, a separate hot lab may be required, or a special section of the main hot lab assigned to these activities due to either the different shielding requirements, or required proximity to the scanning rooms.

The hot lab will accommodate the following activities:

- receipt and documentation of any radionuclides or radiopharmaceuticals;
- dispensing of radiopharmaceuticals for imaging, possible into an automatic dose dispensing unit; and
- a special section of the hot lab will receive and store radioactive waste until it is safe for disposal.

Location and Relationships

Ensure the room is readily accessible to/from dosing rooms and scanning rooms.

Considerations

Other considerations include:

- radiation shielding as advised by Consultants;
- appropriate radioactive signage on access doors;
- possible use of a computerised dispensing system;
- crane system to assist with movement of heavy goods (e.g. shielded generator, weight above safe lifting limits).
- a sharps bins and a bin for general radioactive waste which may be located under a bench in lead-shielded cupboards;
- the design of a preparation bench incorporating a stainless steel sink and a lead shielded cover behind where preparation occurs. The cover may be fixed or hinged;
- sinks and basins with hands-free taps for hand wash and decontamination;
- fridges, freezers and storage cupboards for cold kits;
- a computer and label printer; and
- dose calibrator.

A dedicated PET hot lab will need to be located alongside uptake rooms. Some services may choose to deliver doses using an automated dose delivery system. This will need to be stored within the hot lab. Doses may also be delivered from the hot lab directly into the patient via a lead lined tube system. Staff only access required.

An L-Block with lead glass shielding will be provided on the bench. Radioactive waste holding may also be incorporated into this space

RADIOPHARMACEUTICAL LABORATORY

Description and Function

A radiopharmaceutical laboratory may be provided for the aseptic manufacturing of pharmaceuticals.

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. This scope is not detailed in this HPU.

Location and Relationships

If there is future expectation of a cyclotron, such a facility should be expandable via provision of a ground level or sub-ground space, suitable for extensive shielding, sited with direct access to the PET hot lab.

Where nuclear medicine and PET services are collocated, a single location for manufacture may be considered. Shielding requirements may vary.

Considerations

Apart from routine laboratory requirements, there will be specific requirements in terms of environment and equipment, depending on the functions it will serve. These could include:

- BSC Class II cabinets for biological protection;
- fume hoods (for extraction);
- laminar flow units in a Class A environment; and
- hot cells (one to two units), for radioprotection.

Each of these units of equipment have their own specific building requirements such as specialist extraction capabilities, positive air pressure, and extra floor loading capacity. There may also be a requirement for additional shielding of the area, access to specific equipment via a 'hole in the wall', or a specific work flow design.

A hot cell can weigh up to 10 tonne, and requires external ventilation as well as a power source.

RADIOACTIVE WASTE HOLDING

Description and Function

A room for the temporary storage of radioactive material until it is fully decayed when it can be disposed of as normal waste. Radiation shielding to be provided in accordance with advice from the Radiation Consultants.

Location and Relationships

Dual access to/from the Unit is desirable but with external access, well controlled.

PET / CT AND / OR PET MRI SCANNING ROOM

Description and Function

The PET/CT scanning 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 CCTV.

Appropriate service links to the equipment 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 three to four tonnes plus the weight of radiation shielding. Assessment of the adequacy of floor and other support structures will be required.

Room climate control or air-conditioning 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 hoists, 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 control electronics and computer of the camera;
- hands-free intercom or similar microphones / speaker system to control room;
- clock (visible to the patient);
- hand basin 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;
- laser lights for positioning if used for radiotherapy planning;
- computer; and
- storage for lead shields moulds etc.

Appropriate provisioning of non-ferromagnetic infrastructure fixture, fittings and furniture is required for PET-MRI as well as lockers for valuables (staff and patients) and network points and GPOs for radiation oncology system computer.

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. This can make shielding design easier.

Considerations

The following items are required:

- scanner control / console computer;
- work bench;
- chair(s) height adjustable;
- CCTV viewing monitors;
- remote ECG/EEG monitors;
- screening monitors;
- patient information computers;
- printers and telephone;
- bookshelves for manuals and stationary;
- storage;
- dimmable lighting (may be required); and
- space for respiratory gating system.

UPTAKE ROOM

Description and Function

A 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 warm, quiet and dimmed environment to promote 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:

- radiation shielding as advised by consultants;
- medical service panel including oxygen, suction, power, patient / nurse call;
- emergency call;
- dimmable lighting (controllable from outside room);
- examination light;
- hand basin Type B, unless located adjacent to the room;
- optional mobile lead operator's screen;
- ceiling-mounted closed circuit television camera (CCTV) if alternate system is not in place;
- intercom to control room or staff station / base;
- patient trolley or recliner chair;
- chair;
- curtain track and screen around door; and
- TV or patient entertainment system.

Where automated dose delivery systems are used, the unit will need to be accommodated outside each uptake room and a suitable lead-lined injection port in the wall that will allow the coil to be connected to both the machine and the patient.

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 15m² to accommodate a patient bed;
- direct access to scanning room;
- patient monitor;
- nitrous oxide, scavenging and medical air;
- anaesthetic trolley; and
- benches and storage shelves / cupboards for supplies.

AX APPENDICES

AX.01 Schedule of Accommodation

A schedule of accommodation follows providing two scenarios: a two camera unit and a four camera unit. For the purposes of this schedule of accommodation, it is assumed the four camera unit will also include a pet service. These schedules of accommodation are indicative only and camera and PET scanner numbers should be based on a clinical services plan which examines future service trends and projected activity.

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.

ENTRY / RECEPTION

Note 1: It is assumed that this entry/reception provides a single public access to nuclear medicine and PET services.

ROOM CODE	ROOM/ SPACE	SC/ SC-D	Qty x m ²	Qty x m ²	REMARKS
			2 Cameras	4 Cameras	
WAIT-20	Waiting	Yes	1 x 20	1 x 30	Refer Note 1
PLAP-10	Play Area – Paediatric, 10m ²	Yes	1 x 10 (o)	1 x 10(o)	
RECL-10	Reception / Clerical	Yes	1 x 10	1 x 15	2 and 3 staff
MEET-9	Meeting Room, 9m ²	Yes	-	1 x 9	Private consultations, bookings etc.
OFF-2P	Office - 2 Person, Shared, 12m ²	Yes	1 x 12 (o)	1 x 15	2 & 3 staff
STPS-8	Store - Photocopy / Stationery	Yes	1 x 8	1 x 10	Assumes usual room requirements plus some file storage, a CD burner and film printer.

WCPU-3	Toilet – Public, 3m2	Yes	-	1 x 3	Unless provided nearby the Unit.
WCAC	Toilet – Accessible, 6m2	Yes	1 x 6	1 x 6	
	Discounted Circulation		15%	15%	

WAITING – DOSED

Note 2: A separate play space may be considered in larger services where a significant paediatric service is provided.

ROOM CODE	ROOM / SPACE	SC/ SC-D	Qty x m ²	Qty x m ²	REMARKS
			2 Cameras	4 Cameras	
WAIT-10	Waiting	Yes	1 x 8	1 x 10	Seating for up to 6 and 8 dosed patients. Refer Note 2
WCPT-4	Toilet – Patient , 4m2	Yes	1 x 4	2 x 4	
BBEV-OP	Bay - Beverage, Open Plan, 4m2	Yes	1 x 4	1 x 4	
	Discounted Circulation		15%	15%	

IMAGING AREAS – NUCLEAR MEDICINE

Note 3: A single sized room is proposed to provide the capacity for services to upgrade SPECT cameras to SPECT/ CT in the future. This future-proofing will impact on planning for a control rooms although control rooms are ideally provided to support SPECT rooms. For services that only seek to provide SPECT cameras, a room size of 42m2 can be used.

Note 4: Both 2 and 4 camera units will require a collocated hot lab. A combined hot lab, serving both scanning rooms and PET scanning, may be possible. In practice, this facility needs to be located close to PET uptake rooms so this can be a limiting step. Hot lab for PET service shown at 500.022.xx.

ROOM CODE	ROOM/ SPACE	SC/ SC-D	Qty x m ²	Qty x m ²	REMARKS
			2 Cameras	4 Cameras	
	SPECT or SPECT/CT		48	48	Rooms should be rectangular (i.e. 6x8m). A

	Scanning Room				SPECT scanning room does not require a control room. Assumes phantoms are stored in camera rooms. 'Hot' phantoms will be stored in a shielded cupboards or hot lab. Assumes most injections are done in this space. Refer Note 3.
	SPECT/ CT Control Room		14	2 x 14	Assumes control rooms shared between two rooms.
STRT	Stress Testing Room	Yes	1 x 18	1 x 18	Trolley / bed access assumed.
CONS	Consult Room	Yes	1 x 12	2 x 12	For dose administration and examination.
TRMT	Treatment Room	Yes	-	1 x 14	Ideally collocated adjacent to the hot lab.
	Bone Density Measurement Room		1 x 12 (o)	1 x 12 (o)	Increase to 16m2 if trolley / bed access required
	Entry Lobby - Isotope Delivery		1 x 4 (o)	1 x 4 (o)	Dual access from main corridor and inside Unit unless delivered directly into hot lab. May be combined with waste holding store.
	Hot Lab		1 x 12	1 x 14	Refer Note 4
	Radioactive Waste Holding Store		1 x 2	1 x 3	Also need store for hot and cold phantoms 6m2.
BES	Bay – Emergency Shower	Yes	1 x 2	1 x 2	Decontamination; sited near hot lab.
	Discounted Circulation		35%	35%	

IMAGING AREAS – PET SCANNING

Note 5: This information details the requirements for one PET scanner. Much of the support space including uptake rooms would need to be increased if additional scanning rooms were provided. This scenario assumes the PET service is a discrete area of the Nuclear Medicine Unit.

Note 6: Ideally an alternate exit point is needed so patients do not have to pass through the Unit post scan.

Note 7: Tertiary services may manufacture radiopharmaceuticals. A separate radiopharmaceutical science laboratory may be provided where dedicated scientists are employed. The scale of this laboratory will be dependent on the scale and scope of manufacturing and associated activities across nuclear medicine and PET services. Selected service that dispense and manufacture may instead plan a combined hot lab/

radiopharmaceutical laboratory. If collocated with the hot lab, designated zones will need to be identified to accommodate major equipment and processes (e.g. hot cells).

ROOM CODE	ROOM/ SPACE	SC/ SC-D	Qty x m ²	REMARKS
			1 PET Scanner	
	PET/ CT Scanner		1 x 50	Sized to suit the equipment selected. Refer Note 5
	Control Room		1 x 14	May need to be radiation shielded
	PET/ CT Plant		1 x 18	Radiation shielded. Includes server, UPS etc. Air-conditioned. Notional space allocation only and will need to be tested by service engineers.
	Hot Laboratory		1 x 16	Will be adjacent to uptake rooms. Refer Note 4.
	Uptake Room		4 x 9	Refer Note 1 above. Assumes ambulant patients who will be injected in a recliner.
	Uptake / Induction Room		1 x 15	Radiation shielded. This room will also be used as an uptake room for those on beds.
	Radiopharmaceutical Laboratory		1 x 40 (o)	Refer Note 7. Notional allocation only. Will only be included where manufacturing is undertaken. Will accommodate various functions and processes, including hot cells
BHWS	Bay - Handwashing – Type B	Yes	1 x 1	In corridor
BMEQ-4	Bay – Mobile Equipment, 4m ²	Yes	1 x 4	

STGN-8	Store – General, 8M2	Yes	1 x 8	
DTUR-8	Dirty Utility – Sub, 8m2	Yes	1 x 8	
CONS	Consult Room	Yes	1 x 12	
	Discharge Lounge		1 x 8	Radiation shielded. Collocate with Beverage Bay
CHPT-D	Change Cubicle – Accessible, 4m2	Yes	1 x 4	Pre and post-scan; radiation shielded
BBEV-OP	Bay – Beverage, Open Plan, 4m2	Yes	1 x 4	Include ice machine
WCPT-4	Toilet – Patient, 4m2	Yes	1 x 4	Radiation shielded. A second toilet may be required in services with high throughput.
BES	Bay – Emergency Shower	Yes	1 x 2	For emergencies; radiation shielded
STEQ-14	Store - Equipment	Yes	1 x 12	General items.
	Viewing / Reporting Room		1 x 18	3 workstations
	Discounted Circulation		35%	

PATIENT HOLDING/ RECOVERY

Note 9: Clinical support space such as utilities, linen bays and mobile equipment bays should be within ready access of the patient holding/ recovery areas.

Note 10: Selected nuclear medicine services will provide Lutetium 177 therapy. There may be a range of ways to accommodate this service. As a starting point, a shielded four bed room may be a way of providing space to accommodate this service.

ROOM CODE	ROOM / SPACE	SC/ SC-D	Qty x m ²	Qty x m ²	REMARKS
			2 Cameras	4 Cameras	
PBTR-H-9	Patient Bay – Holding, 9m2	Yes	3 x 9	6 x 9	Curtained bays

BHWS-B	Bay - Handwashing - Type B	Yes	1 x 1	2 x 1	Part of Inpatient Holding Area
SSTN-10	Staff Station	Yes	1 x 8	1 x 10	Part of Inpatient Holding Area.
WCPT-4	Toilet – Patient, 4m2	Yes	1 x 4	1 x 4	
	Discounted Circulation		35%	35%	

CLINICAL SUPPORT – GENERAL

Note 11: Assumes much of the support space is shared between nuclear medicine and PET services but this will be dependent on Unit size and layout. In some cases, space may need to be duplicated.

ROOM CODE	ROOM / SPACE	SC/ SC-D	Qty x m ²	Qty x m ²	REMARKS
			2 Cameras	4 Cameras	
BLIN	Bay – Linen	Yes	1 x 2	2 x 2	Part of Inpatient Holding Area & for uptake rooms
BMEQ-4	Bay - Mobile Equipment, 4m2	Yes	1 x 4	2 x 4	
BMEQ-4	Bay - Mobile Equipment	Yes	1 x 2	1 x 2	e.g. Technegas machine & argon cylinder
BRES	Bay - Resuscitation Trolley	Yes	1 x 1.5	1 x 1.5	Space may instead be added to Stress Testing if located in this room
BWP	Bay - Wheelchair Park	Yes	1 x 4	1 x 6	Also for trolley/ bed storage
CLRM-5	Cleaner's Room, 5m2	Yes	1 x 5	1 x 5	May be shared with adjoining unit
DTUR-8	Dirty Utility	Yes	1 x 8	1 x 10	
DISP-8	Disposal Room, 8m2	Yes	1 x 8	1 x 8	May be shared with an adjoin unit in case of 2 camera service
STEQ-14	Store - Equipment	Yes	1 x 9	1 x 12	
CLUR-8	Clean Utility/ Medication Room - Sub	Yes	-	1 x 8	Located adjacent to Patient Holding/ Recovery. Will include storage for medications.
BES	Bay – Emergency Shower	Yes	1 x 2	1 x 2	For emergencies; radiation shielded.

	Viewing / Reporting Room		1 x 10	1 x 20	2 & 4 workstations near scanning rooms
	Discounted Circulation		35%	35%	

STAFF AREAS

ROOM CODE	ROOM / SPACE	SC/ SC-D	Qty x m2	Qty x m2	REMARKS
			2 Cameras	4 Cameras	
OFF-S12	Office- Single Person, 12m2	Yes	1 x 12	1 x 12	Unit Director
OFF-S19	Office- Single Person, 9m2	Yes	1 x 9	1 x 9	Administrative staff, registrars, medical typists, medical physicists, radiopharmacists etc Number dependent on staff establishment.
OFF-S9	Office – Workstation	Yes	5.5 (o)	5.5	Staff such as staff specialists, nursing manager, chief technologist, chief medical physicist etc. Number dependent on staff establishment
STRM-15	Staff Room	Yes	1 x 15	1 x 18	Includes beverage bay. Also used for large meetings
MEET-L-20	Meeting Room, 20m2	Yes	-	1 x 20	
MEET-9	Meeting Room, 9m2	Yes	-	1 x 9	
PROP-2	Property Bay – Staff	Yes	1 x 2	1 x 3	
SHST-3	Shower – Staff, 3m2	Yes	-	1 x 3	May be shared with adjoining unit
WCST-3	Toilet – Staff, 3m2	Yes	3	3	Number will depend on staff establishment
	Discounted Circulation		25%	25%	

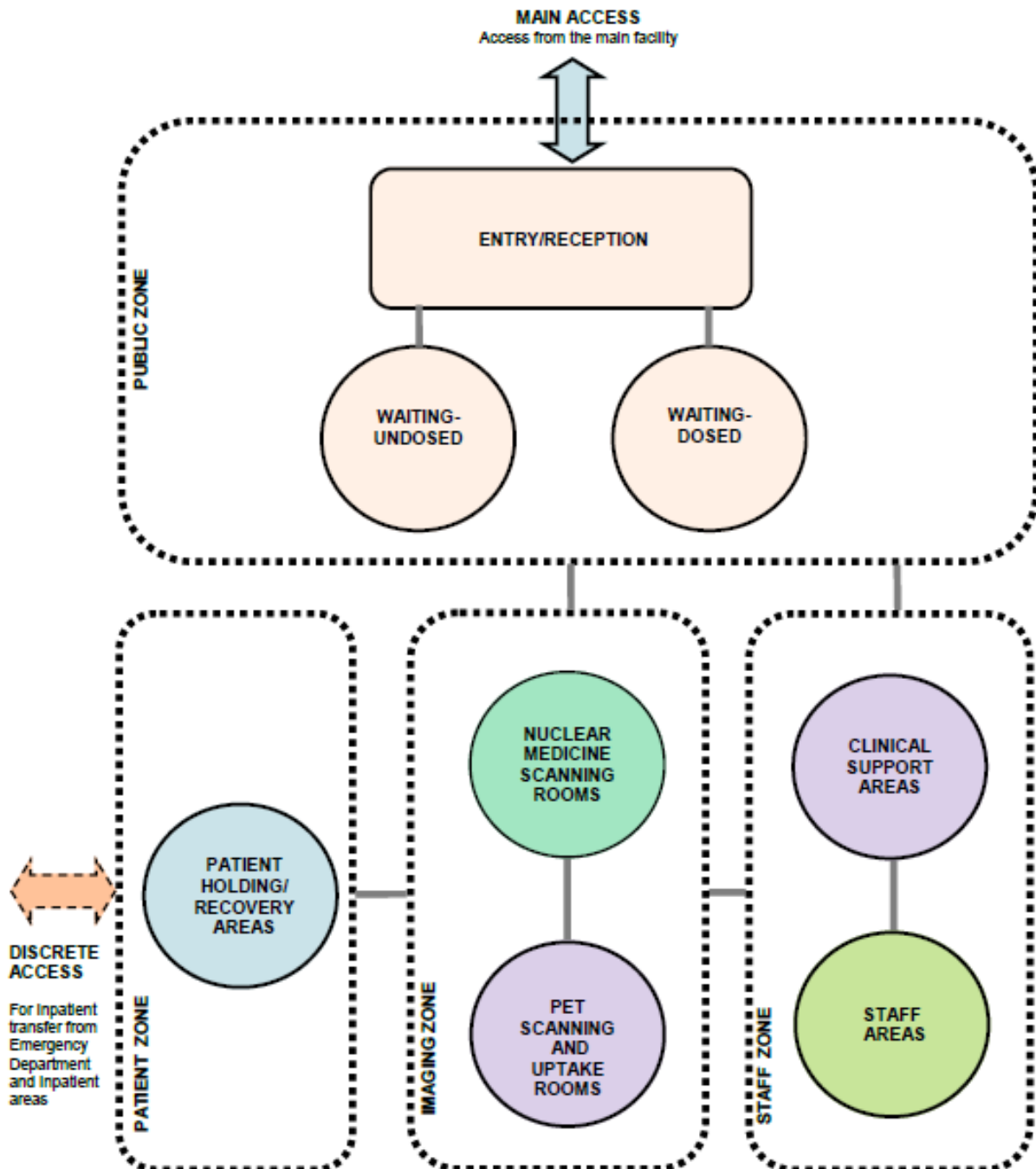
CYCLOTRON AND RADIOPHARMACEUTICAL SCIENCE LABORATORY

Note 12: Very few services across Australian and New Zealand will plan collocated cyclotron facilities. While notional space is provided below, it is recommended that planners refer to the most recently completed projects to better understand the latest technology and approaches to planning.

ROOM CODE	ROOM/ SPACE	SC/ SC-D	Qty x m ²	REMARKS
			1 PET Scanner	
	Cyclotron		1 x 50	Nominal size only; additional zone may be needed for equipment.
	Radiopharmaceutical laboratory		1 x 14	Nominal only
	Staff and technical support		1 x 18	Nominal only

AX.02 Functional Relationships / Diagrams

A diagram of key functional relationships is shown below.



AX.03 Checklists

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

AX.04 References

- Australasian Health Infrastructure Alliance, Part A: Introduction and Instructions for Use, 2016
- Australasian Health Infrastructure Alliance, Part B: Section 80, General Requirements, 2016
- Australasian Health Infrastructure Alliance, Part C: Design for Access, Mobility, OHS and Security, Australasian Health Facility Guidelines, 2016
- Australasian Health Infrastructure Alliance, Part D: Infection Prevention and Control, Australasian Health Facility Guidelines, 2016
- Australasian Health Infrastructure Alliance, AusHFG Part E: Building Services and Environmental Design, 2016
- Australasian Health Infrastructure Alliance, Part F: Section 680 Furniture Fittings and Equipment, Australasian Health Facility Guidelines, 2016
- American Association of Physicists in Medicine Task Group 108, PET and PET/CT Shielding Requirements in Medical Physics, Volume 33, No. 1, January 2006.
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Radiation Protection Series (RPS) No. 14 Radiation Protection in the Medical Applications of Ionizing Radiation, 2008
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Radiation Protection Series Publication No. 14.2 Radiation Protection in Nuclear Medicine, 2008
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Radiation Protection Series Publication No. 11 Security of Radioactive Sources, 2007
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Radiation Protection Series No 4, Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances, 2002
- Australian and New Zealand Society of Nuclear Medicine, Requirements for PET Accreditation, 2nd Edition, 2012
- Australian / New Zealand Standards 2243, Safety in Laboratories, 2006
- Department of Health and Ageing, 2009
- NSW Department of Health, Technical Series TS7 - Floor Coverings in Healthcare Buildings, 2009
- Radiology Society of North America (RSNA) & American College of Radiology 2010, The radiology information resource for patients, Radiology Society of North America, viewed 4 April 2016, www.radiologyinfo.org
- Stds Aust 1998b, AS 2896: Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems, SAI Global

FURTHER READING

- ARPANSA 2008c, Radiation Protection Series 16 - Safety Guide for the Predisposal Management of Radioactive Waste. Australian Radiation Protection and Nuclear Safety Agency.
- Australian and New Zealand Society of Nuclear Medicine Inc., Requirements for PET Accreditation (Instrumentation and Radiation Safety), 2nd Edition, 2012
- Government of Victoria, Radiation Act 2005
- Government of Victoria, Radiation Amendments Act 2013
- Government of Victoria, Radiation Regulations 2007

AX.05 Iodine I-131 Bedroom

IODINE-131

Iodine-131 (I-131) is used for the treatment of thyroid conditions including cancer. The radionuclide has a half-life of approximately eight days. Patients undergoing treatment are nursed in a radiation-shielded room for a period of three to four days. During this period, the patient is an external radiation hazard to others

nearby and an internal radioactivity hazard to those who may come in contact with the patient's body fluids including urine, saliva, sweat, vomit, and contaminated items and surfaces.

LOCATION OF RADIOACTIVE IODINE SEALED BEDROOM

Some patients who receive radioactive I-131 treatment will require inpatient management within a specially shielded inpatient single bedroom. This service is generally provided at tertiary facilities with up to two rooms provided within an inpatient unit.

RADIATION SHIELDING

Radiation shielding should be provided in accordance with regulations.

BEDROOM

The bedroom will be part of an inpatient unit but located so as to minimise passing traffic and consequent radiation exposure and therefore minimise shielding needs. This may be achieved by locating the room at the end of a corridor or by locating the dedicated ensuite and storage between bedroom and public corridor and/or adjacent to unoccupied areas.

During the planning phase, consideration should be given to positioning the room to achieve a short path of travel external to the bedroom, ideally with access to a small window bay in the corridor or a sitting area. This will assist to relieve, to some extent, the confinement and enable the patient to move about.

With the exception of the radiation shielding, the bedroom will be identical to other inpatient unit bedrooms with regard to furniture, fixtures and fittings. Refer to Standard Component - 1 Bed Room.

ENSUITE SHOWER / TOILET

A dedicated ensuite accessible from inside the bedroom is required. Connection to a delayed holding tank may be required by the local water or regulatory authorities. If required, the contents should be monitored before discharge to the sewerage system.

Should delay holding tanks not be required, it may be appropriate to consider radiation shielding of plumbing stacks particularly if the I-131 bedroom is located on an upper level with drainage lines passing through habitable accommodation areas of the floors below. Advice should be obtained from the Radiation Protection Officer.

Toilets should NOT be dual flush system as low volume flush may lead to blockage.

Installation of a water outlet suitable for use with a portable haemodialysis machine might be considered however, it is generally preferred to coordinate this therapy around dialysis treatments.

Refer to Standard Component Ensuite for details.

GENERAL DISPOSAL

A small cleaner's room should be provided to be accessed from the anteroom for dedicated cleaning equipment and supplies and slop hopper / sluice. Alternatively, the mops can be disposed of after use.

DELAY HOLDING TANKS

The issue of delay tanks for Iodine-131 treatment rooms is contentious. The information on disposal to sewer in the 1985 NHMRC Code is to be replaced by a Schedule in Version 2 of the National Directory of Radiation Protection (ARPANSA 2008b). Even so, a local water authority may have the right to require a hospital to install tanks even if the discharge level is exempt under NDRP.

These tanks accumulate the radioactive body substances such as urine, faeces, and vomit. After a period to allow radioactive decay, the contents are discharged into the sewerage system. Assess capacity based on bedroom occupancy.

To avoid leakage problems, the tanks should be located such that the drainage line from the toilet to the tanks does not cross a building expansion joint.

Where Iodine - 131 suites are provided, usually as part of inpatient unit, delayed holding tanks will be connected to the ensuite facility. Advice on the size of holding tanks will be provided by the Radiation Safety Consultant and local water authority requirements.

Refer to the Safety Guide on the Predisposal Management of Radioactive Waste (ARPANSA 2008c).