Part B – Health Facility Briefing & Design

175 Nuclear Medicine Unit

iHFG

International Health Facility Guidelines

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175 Nuclear Medicine Unit

1 Introduction

Nuclear medicine imaging provides unique information that often cannot be obtained using other imaging modalities and offers the potential to identify disease in its earliest stages. Nuclear medicine imaging uses small amounts of radioactive materials (radioisotopes) called radiotracers that are typically injected into the bloodstream, inhaled or swallowed. The radiotracer travels through the area being examined and gives off energy in the form of gamma rays which are detected by a special camera and a computer to create images of the inside of the body in order to detect anomalies, such as various types of cancers at early stages. Nuclear medicine modalities are also used for cardiac and neurology specialties to a lesser extent.

Radiotracers are produced in devices known as Cyclotron.

The Nuclear Medicine may include the following imaging modalities:

- SPECT scanning – Single Photon Emission Computed Tomography, formerly known as a Gamma Camera. SPECT may be integrated with a CT scanner.
- PET scanning – Positron Emission Tomography which is usually integrated with a CT or MRI
- Bone Densitometry
- Stress Testing

The Nuclear Medicine Unit may be provided within the Medical Imaging Unit or as a freestanding Unit. The Unit will include a Hot Laboratory but may or may not include a Radiopharmacy Laboratory or Cyclotron. The size of a unit in terms of numbers and type of modalities will be determined by the service plan and clinical needs.

Description

SPECT: Single Photon Emission Computed Tomography

SPECT is a nuclear medicine tomographic imaging technique using gamma rays that is able to provide true 3D information. This information is typically presented as cross-sectional slices through the patient but can be freely reformatted or manipulated as required. To acquire SPECT images, the camera is rotated around the patient. Projections are acquired at defined points during the rotation, typically every 3-6 degrees. 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, but 15-20 seconds is typical. This gives a total scan time of 15-20 minutes. The most commonly used radioactive isotopes for clinical SPECT is Technetium-99m with a short half-life of 6 hours and Iodine-123 with a half-life of 13.2 hours.

SPECT/ CT: Single Photon Emission Computed Tomography/ Computed Tomography

The incorporation of a CT scanner with a gamma camera for combined SPECT/ CT imaging is designed to give anatomic signposts to clinicians so they can accurately locate and identify the effected tissue in a nuclear image. CT data can also help correct attenuation and be used for calcium scoring. However, these hybrid machines come with a high cost.

PET: Positron Emission Tomography

Positron Emission Tomography (PET) is a nuclear medicine technology that uses short-lived radionuclides (tracers) injected into the body allowing non-invasive imaging of metabolic, biochemical and/or physiological function within the body. The primary radioactive isotopes used for clinical PET is FDG - Fluorine-18 (Fluoro deoxy glucose) and Ga-68 manufactured in a cyclotron, with a half-life of 110 minutes. These isotopes can only be transported relatively short distances before use. Because of the short half-life of the supplied isotopes careful planning is needed with respect to patient scheduling and isotope deliveries that may require more than one delivery per day.

PET/ CT: Positron Emission Tomography/ Computed Tomography

Positron Emission Tomography (PET) with integrated Computed Tomography (CT) technology is used extensively in cancer assessment and ongoing evaluation of treatment response. Optionally,

the CT scan may also be used for radiotherapy simulation with the addition of laser positioning lights in the scanning room.

PET/ MRI: Positron Emission Tomography/ Magnetic Resonance Imaging

The PET/ MRI is an emerging hybrid imaging technology incorporating PET scanning with MRI scanning in one procedure. PET/ MRI scanning is predominantly performed in oncology, and to a lesser extent in cardiac and neurology specialties and provides a superior anatomical information.

Cyclotron and Radiopharmacy

The Cyclotron is an accelerator that uses proton beams to manufacture radioisotopes (radiotracers) used in nuclear medicine. The Cyclotron may be provided within the health facility or located off site and radioisotopes supplied by an external provider. Hospitals with a Cyclotron have Radiopharmacy Laboratories for their SPECT/ PET use and may provide services to other hospitals.

Design and specific requirements for a Cyclotron and Radiopharmacy are not included in this FPU. If a Cyclotron and Radiopharmacy are to be provided, the location and the spatial requirements will need to be assessed at a very early planning stage with particular emphasis on siting the facility in an access-restricted area and structural requirements to support the weight of the equipment as well as the radiation shielding needs. The shielding requirements for cyclotron and Radiopharmacy facilities will need to be coordinated between the equipment manufacturers and a radiation physicist.

The area required for the SPECT/ PET radiotracer production facility, including the cyclotron depends on the radiotracers to be produced and functional requirements of the facility as determined on an individual basis.

The Cyclotron and Radiopharmacy facilities will require compliance with relevant local and national radiation authority standards, guidelines and licensing requirements.

For the purpose of this FPU, it is assumed that Radio isotopes (radiotracers) are outsourced. The transportation of Radioisotopes must follow the requirement of the responsible environmental authorities. The transportation contractors must also follow the environmental regulations by the responsible authorities.

2 Functional and Planning Considerations

Operational Models

The Operational Model will depend on level of services provided as defined in the service plan and the inclusion of imaging modalities including Bone Densitometry, SPECT and PET scanning.

Smaller units with one or two scanning rooms may include Nuclear Medicine Unit within the Medical Imaging Unit. Large centres may provide a discrete unit.

Larger centres may include a Radiopharmacy Laboratory that will prepare its own radiopharmaceuticals for SPECT/ PET scanning.

Hours of Operation

The Nuclear Medicine Unit will generally operate during business hours from 8am to 5pm daily, dependent on the opening hours of the Unit it is located within, such as a stand-alone Nuclear Medicine Unit or Medical Imaging Unit. Urgent scans may be attended out of hours according to the Unit's Operational Policy.

Models of Care

The majority of patients undergoing Nuclear Medicine studies are treated on an outpatient basis. Patient appointments are booked in advance in order to ensure supplies of radionuclides are available at the time needed.

Appointments for paediatric patients will need to be coordinated with an anaesthetist as these patients require sedation or anaesthesia for PET/ SPECT studies in order to ensure images are not compromised/ distorted by patient's movement.

3 Unit Planning Models

A ground floor site is preferred but if this cannot be achieved, consideration should be given to other units above, below and adjoining the proposed location with regards to radiation shielding requirements, the weight of equipment and associated shielding and access for equipment and radioactive isotopes.

The Unit should not act as a thoroughfare to other units of the healthcare facility. The location of the Unit should prevent access by persons such as lost visitors and wandering patients from other units and ensure the security of radioisotopes held within the unit.

The layout and configuration of the Unit should provide separation of dosed ('Hot') patients from un-dosed patients ('Cold') to ensure patients, staff and visitors are not exposed to radiation. The path of travel of dosed patients' needs to be carefully planned, including Uptake Rooms, Toilets, Scanning Rooms and Hot Laboratories. Planning and design should consider separate patient and staff corridor systems and provide separate entries for outpatients and for inpatients on beds/ trolleys. Effective layout can also reduce the need for costly radiation shielding.

PET/ SPECT Scanning rooms should be planned in compliance with manufacturer's recommendations because area requirements may vary from machine to machine. Since technology changes frequently and from manufacturer to manufacturer rooms should be sized larger to allow upgrading of equipment in the future.

If provided, the Bone Densitometry Room should be located near the entry to the Nuclear Medicine Unit to ensure patients do not unnecessarily cross areas of radioactivity. The Bone Densitometry room should be located away from dosed patients by distance or shielding to avoid interference to the Bone Density Unit from high ambient radiation levels.

Future Growth

Planning should consider future growth of PET/ SPECT services which will be dependent on population increase and advances in technology. In cases where it is expected that population growth will require enhanced service capacity within a five-year period, the following issues need to be addressed with regard to future expansion of the Unit:

- Additional scanning rooms to allow for increased service demand
- Scanning rooms sized to provide sufficient space for upgrades to the equipment which may also require additional shielding, increased load bearing capabilities and services requirements
- Access for supply and installation of new equipment
- Increased numbers of bariatric patients
- Identification of expansion zones for increased staffing and support facilities to meet service demand and technological changes
- Provision of Shell Space or Soft Space for the installation of additional Nuclear Modalities in the future

Tertiary facilities may need to consider future accommodation for PET/ MRI scanning. Design of a scanning room to accommodate a hybrid PET/ MRI unit differs substantially from the PET/ CT unit, requiring radiation, radiofrequency and magnetic shielding. Furthermore, the weight of the scanning unit is substantially greater.

Functional Zones

The Nuclear Medicine Unit consists of the following Functional Zones depending on the Operational Policy and service demand:

- Entry/ Reception/ Holding, a 'Cold' Zone incorporating:
  - Waiting (un-dosed patients and visitors)
  - Reception desk (which may be shared with Nuclear Medicine or Medical Imaging)
  - Office for clerical support
  - Interview room/s
  - Patient Holding Bays for patients on beds
  - Staff Station
  - Storage for stationery, files and printing

- Public amenities

- Imaging Areas:
  - Uptake Rooms also used as Recovery rooms
  - Uptake/ Induction room/s for patients requiring sedation or anaesthesia
  - SPECT and SPECT/ CT scanning room/s, control room, computer equipment (technical) room
  - PET, PET/ CT, and PET/ MRI scanning room/s, control room, computer equipment (technical) room
  - Bone Densitometry room
  - Stress Testing
  - Patient toilets (hot), with direct access to uptake rooms
- Hot Laboratory Areas including:
  - Entry lobby for radio isotopes (radiotracers)
  - Separate Hot Labs for Nuclear Medicine (PET & SPECT)
  - Radioactive Waste Store
  - Workstations for quality control processes
- Support areas
  - Beverage bay
  - Emergency shower and eyewash
  - Storage for linen, resuscitation trolley, mobile equipment, personal protective equipment (PPE)
  - Clean Utility
  - Cleaner's room
  - Dirty Utility
  - Viewing and Reporting areas
- Staff Areas including
  - Office for Manager, Radiographer or Physicists
  - Staff Room that may be shared
  - Meeting Room, shared with adjacent areas
  - Toilets and lockers

The following optional inclusions are dependent on the Operational Policy of the Unit, determining how radioisotopes are to be manufactured, delivered and prepared:

- Cyclotron
- Radiopharmacy

These Functional Zones/Areas are briefly discussed below**.**

Entry/ Reception/ Waiting

The Reception is the receiving hub of the Unit where patients first present for their scheduled appointment and should therefore ensure the security of the entire department through access control.

The Reception and Waiting areas will receive and hold patients and visitors prior to dosing; these are 'cold' areas and require clear separation from 'hot' areas of the Unit where patients have been dosed and are awaiting scanning. Un-dosed outpatients may wait in the general waiting area with their family/ supporters prior to scanning procedures. Inpatients may be taken directly into a bed Holding area or Uptake room. Bed waiting areas should be separated from the ambulatory patient waiting areas for patient privacy; prior to injection with radiotracers, the bed holding area is regarded as a 'cold' zone.

Waiting areas may be divided into separate female/ family areas to meet cultural requirements and will require convenient access to public amenities. The Waiting areas should be designed for compliance with accessibility standards and be provided with a range of seating options for occupants of varying mobility including bariatric patients. Waiting areas should include a Beverage bay for patients to prepare refreshments, provisions for prams and a play area for children if paediatric services are included in the Operational Policy.

Imaging Areas

Uptake Room/s

The Uptake room is a private, radiation shielded room where patients are injected with the radiotracers on a recliner chair or bed and rest until uptake has occurred before the scanning procedure. Uptake may typically take 45 to 60 minutes, during which time the patient must rest quietly. The Uptake room requires direct access to a 'hot' toilet, preferably without accessing a common corridor and exposing staff and passing traffic to radiation. Following scanning procedures patients will return to the Uptake room to recovery or 'cool down' prior to discharge from the Unit. Ideally, the discharge route should not cross un-dosed patients or visitors.

The recommended ratio of Uptake rooms to Scanning rooms is 2 Uptake rooms per 1 Scanning room, if the rooms are also used for 'cool down' additional Uptake rooms will be required to achieve a ratio of minimum 3 Uptake rooms to 1 Scanning room and approved by MoH.

Refer to Non-Standard Components in this FPU for additional information.

Uptake/ Induction Room/s

The Uptake Induction room is provided for administering sedation or anaesthetic to patients on a bed prior to scanning procedures including paediatric patients. The room will include an anaesthetic machine, medical gases and patient monitoring. Patients may be returned to the Uptake/ Induction room to cool down prior to discharge.

Uptake/ Induction Rooms/s can be used flexibly as general Uptake/ Recovery rooms when not used for the induction of patients and will count as part of the total ratio of Uptake rooms to the Scanning rooms.

The Uptake room/s will require access for beds and trolleys.

SPECT and SPECT/ CT Scanning Room

A SPECT camera may be combined with a computerised tomography (CT) unit to form a hybrid system and fusion 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. Installation of equipment should be in accordance with manufacturer's recommendations. Room size may vary according to the equipment selected but no less than the area shown in the Schedule of Accommodation. Scanning rooms require ready access from the Uptake rooms.

Scanning rooms may be collocated with shared Control rooms to enable monitoring of two rooms simultaneously as long as the privacy of the patients can be assured. This means no line of sight from one scanning room to another via the Control room.

PET/ CT Scanning Room

The PET/ CT Scanning Room provides an enclosed, radiation shielded room with a hybrid PET camera and CT Scanning unit for non-invasive scanning procedures. Patients are usually fully awake for the procedure but may be sedated or occasionally under general anaesthesia (including paediatric patients). Scanning time varies between 10 and 25 minutes, following which patients are returned to an Uptake room or shielded private waiting space to 'cool down' prior to discharge home or transfer back to an inpatient unit. Bed and trolley access will be required to the PET/ CT scanning room.

Visibility to the PET scanner from the Control Room is preferred but not essential if patients are fully monitored via closed circuit television. Scanning equipment will be installed to manufacturer's specifications and may require service links to the Computer Equipment (Technical) Room and Control Room.

PET/MRI Scanning Room

The requirements are very similar to the PET/CT with the added requirements of an MRI room. For technical details, refer to the equipment manufacturers instructions.

Bone Densitometry Room

Bone densitometry is a non-invasive procedure using a special x-ray scanning machine to determine bone density or strength. It is used to identify those at risk of developing osteoporosis and to monitor change in bone density.

The room may have radiation shielding to walls and/ or glazing as advised by a Radiation Consultant.

Hot Laboratory Area

Hot Laboratory/ Dispensary

The Hot Laboratory will be required for receipt, delivery, storage and dispensing/ preparation of radiotracers. These may be supplied as unit doses from an external provider or from a Cyclotron facility within the campus. They are drawn up or prepared ready for administration to the patient in the Hot Laboratory. The Hot Laboratory should have separate rooms for PET and SPECT. The Hot Laboratory requires ready access from a service corridor for delivery of radiotracers. It also needs to be readily accessible to the Uptake rooms.

The Hot Laboratory rooms require radiation shielding. Space and equipment are required for dose calibration, computerised record keeping and quality control activities. A lead glass screen may act as a barrier behind which dispensing, and calibration occurs.

Radioactive (Hot) Waste Store

The Radioactive (Hot) Store is a secure, radiation shielded room for the storage of sealed sources and radioactive waste, particularly sharps. The Waste Store requires a sink and basin with hands-free taps for hand washing and equipment decontamination.

The Hot Waste Store should be located with convenient access from Uptake rooms, Hot Laboratory and exit for removal of waste when it is safe for disposal.

The Hot Laboratory and Hot Store will need to be accredited by the relevant environmental authorities.

The waste store may be centralized and remotely located, for example in basement or in an out building on the campus. If the main Waste Store is remotely located as a minimum a small Waste Store must be co-located with the Hot Lab for the immediate disposal purposes.

Stress Testing room

Stress Testing is usually required as part of the Nuclear Medicine services. Stress Testing room should have convenient access to the Uptake and Scanning rooms.

Support Areas

Support areas include the following provisions:

- A beverage Bay for light refreshments for patients undergoing SPECT/ PET and myocardial perfusion studies, due to the length of time patients are required to fast
- An emergency Shower and eyewash facility is required for chemical spills
- Dirty Utility room may require radiation shielding if hot waste is held in this room; refer to local radiation safety regulations
- Storage is required for:
  - Collimators and scanning phantoms, within the scanning rooms
  - Mobile equipment such as resuscitation trolley, wheelchairs, trolleys, lifters and ultrasound scanners
  - Technegas unit and large argon cylinder/s that may be located in an equipment bay; the Technegas unit and trolley is taken to patients in holding bays or in the camera rooms for patient to inhale Tc99m
  - Linen, medical consumables and sterile stock
  - Stationery and records/ files
- A staff station with supervision of Uptake rooms and bed holding areas
- Viewing and reporting, is an optional area for reviewing images and reporting and may be located within Control rooms or shared with an adjacent Unit

Staff Areas

Staff will need access to the following:

- Toilets, shower and lockers
- Staff room with beverage facilities
- Meeting room/s for meetings, education and training
- Offices for the Manager and senior staff

Staff areas may be shared with a collocated Unit (Medical Imaging).

Teaching, research and student facilities may be required depending on the role delineation and service plan of the facility including offices, workstations, dry laboratories, wet laboratories, student discussion areas and meeting rooms.

Optional Areas

Radiopharmacy Laboratory

The Radiopharmacy Laboratory is used for preparation, compounding, quality control and dispensing a range of radiopharmaceuticals used in diagnosis and treatment under strict controls and sterile manufacturing techniques or preparation of radiopharmaceuticals supplied from an adjacent Cyclotron. Inclusions in the Laboratory will be largely dependent on the range of radiopharmaceuticals to be produced.

This laboratory is not covered in detail by this FPU and requirements need to be assessed on a case by case basis. Only designated units will have an in-house Radiopharmacy Laboratory where cold kits are prepared for use in the hospital or supplied to other Nuclear Medicine and PET Units.

Many Nuclear Medicine Units (e.g. private practices) may receive a daily delivery of the radiopharmaceutical already prepared and dispensed as individual patient doses. Other isotopes/ radionuclides (e.g. gallium, thallium) are delivered weekly or monthly as required, pre-packaged into individual doses for dispensing.

Cyclotron

The Cyclotron accelerator manufactures radioisotopes and inclusion in the facility will be dependent on the service plan, operational policies and business case. Details of the Cyclotron are not covered in this FPU but an approximate square metre area is given in the Schedule of Accommodation to facilitate early planning where inclusion is proposed.

Installations will require compliance and registration with the appropriate local or national radiation and nuclear authority.

4 Functional Relationships

The Nuclear Medicine Unit should be located with ready access to the Medical Imaging Unit, Emergency Unit, Operating Unit and Critical Care areas. It requires easy access for ambulant patients and beds/ stretchers.

External Relationships

Externally the Nuclear Medicine Unit should have good access to:

- The entry point of the Hot Laboratory for delivery of externally provided radioisotopes in a route as direct as possible
- Radiation Oncology Unit and Chemotherapy Unit
- Inpatient Units particularly Oncology, Neurology and Cardiology
- Medical Imaging Unit
- Support Units including Clinical Information, Housekeeping, Linen, Laboratories, Pharmacy and Supply

The optimum external functional relationships are demonstrated in the diagram below including:

- Ambulant patients and outpatient access from a main circulation corridor with a relationship to the Main Entrance
- Separate entry and access for inpatients on beds and Medical Imaging Unit
- Access for service units via a service corridor with entry to the ‘cold’ area of the unit

Internal Relationships

Internally, the Nuclear Medicine Unit will be arranged in functional zones.

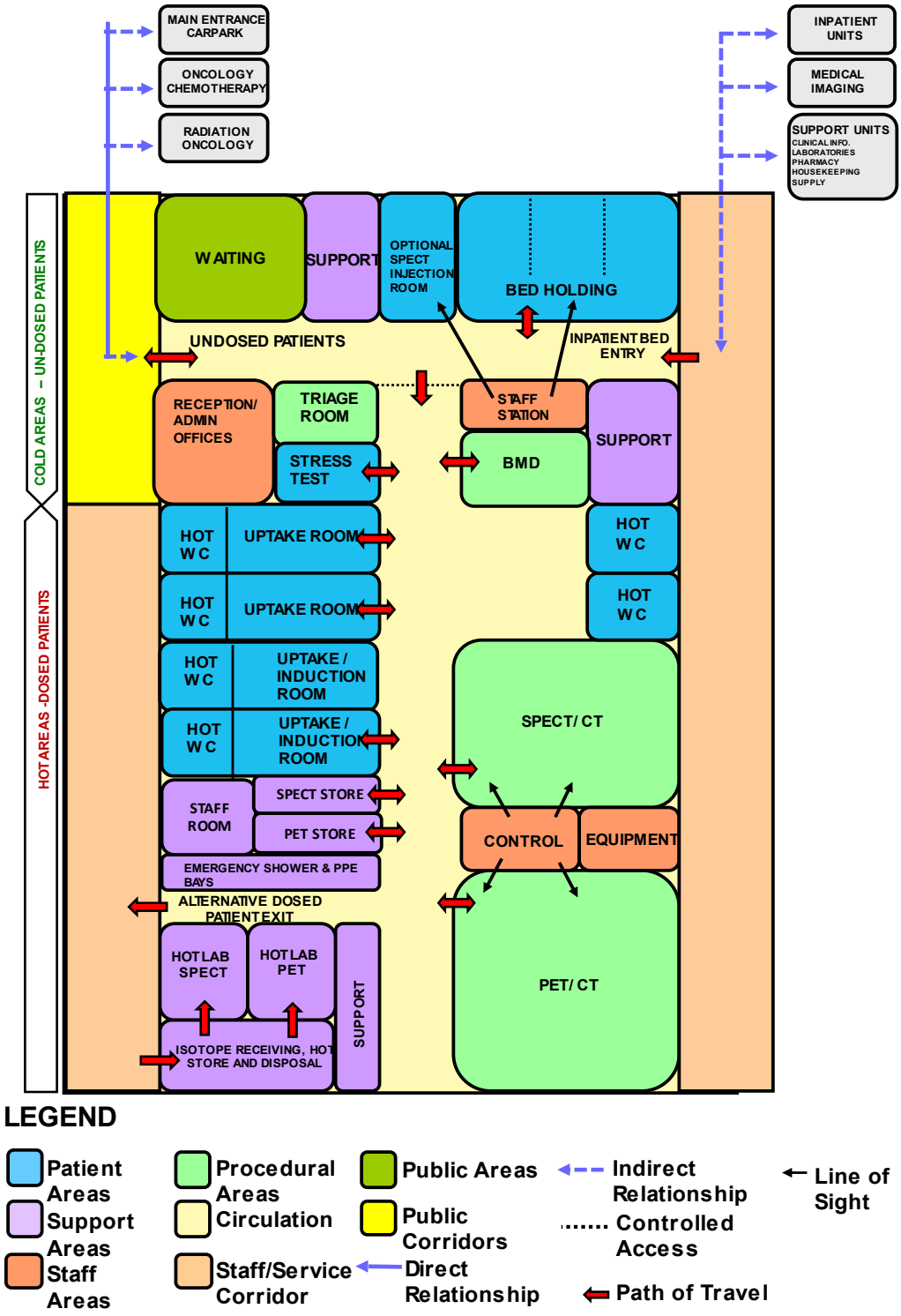
The Reception will provide an access control point and there will be clear separation of un-dosed - ‘cold’ and dosed - ‘hot’ areas of the Unit. There should be a clear path of travel for patients who arrive and wait in un-dosed waiting, then are transferred to Uptake rooms dosing, wait for uptake followed by scanning procedures, then return to Uptake rooms for a cool-down period waiting for radioactivity to dissipate prior to discharge, preferably through a separate exit, and not through areas where un-dosed patients and visitors are waiting.

The ideal relationships are demonstrated in the diagram below including:

- Reception at the entrance providing access control, with direct view of Waiting areas
- Staff Station with direct view of bed holding areas for un-dosed patients
- Separation and access control between un-dosed areas and dosed areas of the unit
- Support rooms located centrally to the scanning and patient areas for maximum convenience
- Emergency Shower located with close access to all 'hot' areas

Functional Relationship Diagram

The following diagram depicts a Nuclear Medicine Unit.



5 Design Considerations

General

Consideration needs to be given to the following during design:

- Rapid access and path of travel for isotope deliveries and disposal of radioactive waste
- Separation of outpatients' and inpatients' entries with entrances easily observed from the Reception and Staff Station
- Separation of 'cold' areas from 'hot' areas within the Unit

Car Parking

An identified parking area for vehicles delivering isotopes is required to enable rapid access to the Hot Lab. Patients and visitors will use the public parking facilities with access to drop-off areas and disabled parking.

Construction Standards

Construction Standards for a Nuclear Medicine Unit include the following:

- Structural support for equipment; floors must be able to support the weight of equipment and shielding which is significant (the weight may range from approximately 3 tons (PET/ CT) to approximately 9 tons (PET/ MRI)
- Level floor for equipment positioning and safe patient movement
- Walls should contain necessary support systems for either built-in or mobile oxygen and vacuum and; vents for radioactive gases
- Floors and walls should be constructed of materials that are easily decontaminated in case of radioactive spills
- Provision for cable support trays, ducts or conduits may be made in floors, walls, and ceilings and the impact on room space of large diameter electrical cable trays (to floors or surface mounted on walls)
- Ventilation for heat generating equipment and extraction for Hot Labs
- Procedure timing (clocks)
- Task lighting/ dimming and room blackout, as required
- Ceiling heights shall suit the equipment to be installed, but shall not be less than 3000 mm for ceiling tube mount installations; ceilings may be higher if required
- Ceiling mounted equipment should have properly designed rigid support structures located above the finished ceiling; a tiled ceiling should be considered for ease of installation, service and future remodelling

Patient Treatment Areas

Patient Monitoring

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

Environmental Considerations

Acoustics

Sound attenuation should be provided in the following areas:

- Uptake and Uptake/ Induction rooms
- Scanning rooms (hybrid units may be noisy)
- Viewing/ Reporting room
- Consulting rooms

In addition, acoustic separation should be provided between Offices, Meeting Rooms, Consult Rooms and adjacent corridors to reduce transfer of noise between rooms and minimise conversations being audible outside the room.

Natural Light/ Lighting

Natural light is desirable in all patient areas, Offices and Staff Room to provide for patient and staff comfort. Lighting should be controllable in reporting rooms to allow for work with high resolution images on screens. External windows provided in scanning and uptake rooms will need assessment by a Radiation Consultant for shielding requirements. In practice, it may be difficult to shield windows equal to wall shielding levels.

Privacy

Visual patient privacy is an important consideration to be addressed in the design of imaging rooms and waiting spaces. Doors to imaging and screening rooms should be located to avoid patient exposure to circulation areas. Change rooms should be located adjacent to imaging rooms so that a patient is not required to cross corridors to access them. If patients change in the Uptake Rooms, privacy from CCTV cameras while getting changed will be required. Privacy screening is required to all Patient Bed Bays.

Interior Décor

Interior décor refers to colour, textures, surface finishes, fixtures, fittings, furnishings, artworks and atmosphere. It is desirable that these elements are combined to create a calming, non-threatening environment.

Colours should be used in combination with lighting to ensure that they do not mask skin colours in Scanning and Uptake rooms where patients are under direct observation and are compatible with CCTV monitoring of patients.

Space Standards and Components

Interventional Imaging rooms

The size of imaging rooms will be influenced by the following:

- Ease of movement in and around the room for patients, staff, equipment, bed and trolley access
- The number of staff required in and around the room to operate the equipment and support the patient
- The equipment to be installed; design will need to consider the manufacturer's recommended room sizes, equipment placement and services requirements
- Potential future upgrading of equipment
- Scanning rooms should be sized to allow a clear dimension of 920 mm around three sides of the imaging table for patient access and transfers

Accessibility

Wheelchair access is required in all patient areas including Waiting, Consult, Uptake and Scanning Rooms. Waiting areas should include space and power outlets for charging electric mobility equipment along with suitable seating for patients with disabilities or mobility aids and bariatric patients.

Doors

Special consideration should be given to the width and height of doorways to ensure delivery and removal of equipment is not impeded or prevented, and that patient trolley, bed movement and wheelchair access is not hampered.

Doors to Uptake rooms should permit trolley and bed access and should be a minimum of 1200 mm wide. Doors to Scanning rooms should be a minimum of 1500 mm clear opening for equipment access.

Where provided, vision panels in doors to Uptake, Scanning Rooms and Hot Labs must have the same level of shielding as the adjoining walls.

Also refer to Part C - Access, Mobility, OH&S of these Guidelines.

Ergonomics/ OH&S

Consideration should be given to ergonomic functionality in the Nuclear Medicine Unit. Workstations, sinks and Hot Laboratory benches should be provided at suitable working heights, whether seated or standing positions. Adjustable-height workstations are recommended where possible.

The following occupational health and safety issues should be addressed during planning and design for staff safety and welfare:

- Location and handing of radionuclides and provision of safety shower and eyewash facilities for chemical spills (refer to local regulations); design should ensure patients, staff and visitors are not unnecessarily exposed to radiation hazards
- Manual handling of heavy equipment; storage of heavy equipment close to point of use recommended
- Scanning rooms must be sized to suit the design requirements of the equipment to be used, to provide a safe working environment and to allow the effective movement of staff and patients.

Refer to Part C – Access, Mobility, OH&S of these Guidelines for more information.

Size of the Unit

The size of the Nuclear Medicine is dependent on the level of service and determined by the clinical service plan and Operational Policies.

Schedule of Accommodation has been provided for a typical Nuclear Medicine Unit in a hospital at role delineation Level 2 (less complex services) to 6 (teaching and research facilities).

Safety & Security

Safety

The Nuclear Medicine Unit shall include a safety shower with an eyewash station for use in the event of radioactive spills. Design should consider the following issues:

- Access control to the unit which may be provided at Reception
- Provision of personal dosimeter
- Zones within the unit should be organised to allow patients to access the intended area only and prevent patients and visitors entering unrelated areas
- CCTV camera surveillance of Scanning rooms, Hot Labs, waiting area, access and exit points
- Reception area and staff station must have duress alarm buttons in obscure but easily accessible locations; there should be a combination of fixed and personal duress alarms
- Radiation Monitoring equipment required
- Doors to the perimeter of the Unit and all offices should be lockable
- Rooms used for storing equipment and files and records should be lockable

Radioactive Isotopes - Delivery

SPECT/ PET Units will receive radioactive isotopes, delivered to a licensed person and will be required to handle and store these as described within the local Radiation Protection guidelines.

Deliveries of isotopes for SPECT/ PET studies with their short half-life will usually be once or twice daily depending on workload, direct to the Hot Laboratory in the Unit for dispensing by technologists. In some facilities, unit doses may be supplied from an on-site Radiopharmacy.

Radiation Protection and Monitoring - Personnel

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

In addition to fixed radiation shielding in walls, mobile lead screens may be provided for use in Uptake Rooms for administering radiopharmaceuticals and in the SPECT/ PET Scanning rooms for positioning the patient.

Radioactive Waste Management

Radioactive waste is waste that contains radioactive substances and may be solid, liquid or gaseous. The radioactivity diminishes with time, so waste products may be held until considered safe for routine disposal. Radioactive waste is no longer deemed to be radioactive once lead shielded and allowed to decay to a safe level as set by the environmental authorities.

Due to the rapid decay of radioisotopes used for SPECT/ PET studies, very little solid waste will need to be stored except for syringes, needles, cannula etc. Specially designed lead-lined sharps bins are commercially available and should be readily accessible for use by the clinicians and technicians in the Nuclear Medicine Unit as required by relevant authorities. Radioactive waste will be held in the Hot Store until decayed and removed to general waste holding areas.

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

Security

Security of radioactive material is important and subject to radiation safety regulations. Security measures for the Nuclear Medicine Unit will include the following:

- Access control to the Unit and in particular the 'Hot' areas within the Unit, the Hot Lab and Hot Store with a combination of reed switches, electric strike/ magnetic locks and card readers
- Controlled staff access after hours

Finishes

The Nuclear Medicine Unit finishes including fabrics, floors, walls, ceilings, cornices, door protection, fittings and joinery should be selected with consideration to the following:

- Infection control and cleaning
- Fire safety of the materials
- Durability, replacement of materials
- Acoustic properties of the materials
- Movement of equipment

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

Wall protection should be provided where bed or equipment movement occurs including corridors, bed bays and imaging rooms.

Refer to Part C - Access, Mobility, OH&S of these Guidelines and Standard Components for more information on interior finishes.

Fixtures, Fittings & Equipment

Due to the complexities of tendering for and purchasing significant items of high technology equipment, there can be a 12-18 month timeframe before the final equipment selection takes place. As the equipment is not generally known at the time of the initial design, a generic design should be undertaken whereby all major manufacturers equipment can be accommodated. This also allows for easy future replacement without major renovation costs.

Scanning equipment will require services and installation according to manufacturers' specifications, in particular:

- Space requirements may vary according to equipment selected

- Space requirements for maintenance of equipment must be considered
- Structural assessment will be required
- Doors will need to be sized to allow passage of equipment

All furniture, fittings and equipment selections for the Unit should be made with consideration to ergonomic and Occupational Health and Safety (OH& S) aspects.

Refer to Part C - Access, Mobility, OH&S of these Guidelines for further information.

Building Service Requirements

Information and Communications Technology

The Nuclear Medicine Unit requires reliable and effective IT/ Communications service for efficient operation of the service. The IT design should address:

- Patient booking, appointment and queuing systems
- Patient or Clinical Information Systems and electronic records
- Picture Archiving Communications Systems (PACS) and storage for digital archives
- Voice/ data cabling and outlets for phones, fax, computers
- Network data requirements and wireless network requirements to support remote reporting
- Video and teleconferencing capability, including connection to imaging rooms for educational purposes
- Reporting and recording system that may include dictation or voice recognition system for reporting
- CCTV surveillance If indicated
- Patient, staff, emergency call, duress alarms and paging systems
- Communication rooms and server rooms

Staff Call

Patient, Staff Assist and Emergency call facilities shall be provided in all patient areas (e.g. Holding bays, Recovery bays, Preparation rooms, Change Rooms, Toilets and Imaging rooms) in order for patients and staff to request for an urgent assistance.

The individual call buttons shall alert to an annunciator system. Annunciator panels should be located in strategic points visible from Staff Stations, circulation corridors and audible in Staff Rooms, and Meeting Rooms. Annunciator panels in corridors must be located for optimum viewing.

Heating, Ventilation and Air conditioning

The Nuclear Medicine Unit should be air-conditioned to provide a comfortable working environment for staff, patients and visitors.

Additional cooling and ventilation will be required to Scanning Rooms and associated computer equipment rooms as the equipment is sensitive to excessive ambient heat, but outlets should not be placed directly over partially undressed patients on beds or trolleys. Some scanners may require chilled water for cooling. Large temperature changes (greater than 400C per hour) within scanning rooms need to be avoided to reduce the risk of crystal fracture in gamma cameras. Additional air extraction or exhaust may be required to Camera Room/s where ventilation agents such as Technegas are administered.

In the restricted areas of Patient Examination Room and Storage and Preparation areas, if radioactive gas Xenon is being used, special ventilation is required. Ventilation requirements would be in accordance with relevant Guidelines. The restricted area should be kept under negative pressure by exhausting at least 15 % more air than supply air. Recirculation of air from these spaces should not be permitted.

It is recommended that the Storage and Preparation areas be generally equipped with a special radioisotope fume hood. This system may need to be fabricated from non-ferrous materials. Exhaust registers should be located at floor and ceiling levels.

General air conditioning inpatient and staff areas needs to be adjustable for patient and staff comfort; the temperature of the Unit should not exceed 25°C.

Smoke detectors in treatment rooms should be sensitive to radiation.

Hot Lab room air should be negatively pressured and exhausted, not recirculated. The Hot Lab may include a fume cabinet which will require exhausting.

Rooms in which Technegas is used should be negatively pressured to the rest of the Unit.

Refer to Part E - Engineering Services in these guidelines and to the Standard Components, RDS and RLS for further information.

Medical Gases

Medical gas is that which is intended for administration to a patient in anaesthesia, therapy, or diagnosis.

The Unit requires oxygen and suction in Patient Holding bays, Uptake Rooms and Scanning rooms. The Provision of medical air to patient holding/ recovery bays and Uptake rooms is optional.

Full anaesthetic capability is required within Uptake/ Induction rooms, including systems for the delivery of nitrous oxide and the 'scavenging' of gases that have been exhaled by the patient that should not be breathed in by any medical personnel.

Refer to Part E - Engineering Services in these guidelines and to the Standard Components, RDS and RLS for further information.

Radiation Shielding

All rooms that are used for dosed patients or for undertaking imaging procedures require radiation shielding including:

- Reception and rooms adjacent to dosed patient rooms
- Dosing/ Consult Exam Rooms
- Scanning Room/s – SPECT, SPECT/ CT, PET/ CT, or PET/ MRI
- Hot Labs/ Dispensing room, Hot Stores and Radiopharmacy
- Pre-scan uptake rooms/ dosed waiting areas and patient toilets
- Cardiac Stress Testing Room
- Post scanning waiting areas
- Bone Densitometry Room
- Holding areas for patients injected with radionuclides

A certified physicist or qualified expert needs to assess the plans and specifications for radiation protection as required by the MoH or relevant local Radiation/ Nuclear Safety Authorities. A radiation protection assessment will specify the type, location and amount of radiation protection required for an area according to the final equipment selections, the layout of the space and the relationship between the space and other occupied areas.

The radiation protection requirements are to be incorporated into the final specifications and building plans. Radiation requirements should be re-assessed if the intended use of a room changes during the planning stages, equipment is upgraded, or surrounding room occupancy is altered. Consideration should be given to the provision of floor and ceiling shielding when rooms immediately above and below are occupied.

Hydraulic Services

Ceiling spaces above SPECT cameras and specialty scanning units should not be used for hydraulic services or air-conditioning ducts, to avoid damage to equipment from leakages.

The need for delayed holding tanks within the Nuclear Medicine Unit will require assessment by the Radiation Consultant.

Infection Control

Infection control measures include prevention of cross infection between patients, visitors and staff. Paths of travel for inpatients should be separated from outpatients as far as possible.

Hand Basins

Hand hygiene is an essential element of infection control and handbasins will be required in:

- SPECT/ PET Scanning room/s
- Uptake and Uptake/ Induction Room/s
- Clean and Dirty Utility rooms
- Bed Holding areas in a ratio of 1 basin per 4 bed bays
- Corridors and adjacent to Staff Station

Hand basins should comply with Standard Components for Bay - Handwashing. Refer to the Standard Components, RDS and RLS of these guidelines for additional information.

For further information refer to Part D – Infection Control in these Guidelines.

Antiseptic Hand Rubs

Antiseptic hand rubs should be located so they are readily available for use at points of care, at the end of patient beds and in high traffic areas.

The placement of antiseptic hand rubs should be consistent and reliable throughout facilities. Antiseptic hand rubs are to comply with Part D - Infection Control, in these guidelines. Antiseptic Hand Rubs, although very useful and welcome, cannot fully replace Hand Wash Bays, both are required.

For further information related to Infection Control refer to Part D – Infection Control in these Guidelines.

6 Components of the Unit

Standard Components

Standard Components are typical rooms within a health facility, each represented by a Room Data Sheet (RDS) and a Room Layout Sheet (RLS).

The Room Data Sheets are written descriptions representing the minimum briefing requirements of each room type, described under various categories:

- Room Primary Information; includes Briefed Area, Occupancy, Room Description and relationships, and special room requirements)
- Building Fabric and Finishes; identifies the fabric and finish required for the room ceiling, floor, walls, doors, and glazing requirements
- Furniture and Fittings; lists all the fittings and furniture typically located in the room; Furniture and Fittings are identified with a group number indicating who is responsible for providing the item according to a widely accepted description as follows:

Group	Description
1	Provided and installed by the Builder/ Contractor
2	Provided by the Client and installed by the Builder/Contractor
3	Provided and installed by the Client

- Fixtures and Equipment; includes all the serviced equipment typically located in the room along with the services required such as power, data and hydraulics; Fixtures and Equipment are also identified with a group number as above indicating who is responsible for provision
- Building Services; indicates the requirement for communications, power, Heating, Ventilation and Air conditioning (HVAC), medical gases, nurse/ emergency call and lighting along with quantities and types where appropriate. Provision of all services items listed is mandatory

The Room Layout Sheets (RLS's) are indicative plan layouts and elevations illustrating an example of good design. The RLS indicated are deemed to satisfy these Guidelines. Alternative layouts and innovative planning shall be deemed to comply with these Guidelines provided that the following criteria are met:

- Compliance with the text of these Guidelines
- Minimum floor areas as shown in the schedule of accommodation
- Clearances and accessibility around various objects shown or implied
- Inclusion of all mandatory items identified in the RDS

The Nuclear Medicine/ PET suite will contain Standard Components to comply with details in the Standard Components described in these Guidelines. Refer to Standard Components Room Data Sheets and Room Layout Sheets.

Non-Standard Components

Non-Standard rooms are identified in the Schedule of Accommodation as NS and are described below.

Uptake Room

The Uptake room is for patients to receive intravenous radiopharmaceuticals and rest until uptake has occurred before transfer from the scanning room or to 'cool-down' following scanning procedures waiting for the radiation to dissipate prior to discharge. Patients will change into a hospital gown for scanning procedures within this room. The room will be radiation shielded and a mobile lead screen may also be used by staff when attending patients. CCTV will be used to monitor patients who have been injected and are awaiting uptake. The Uptake room should have direct access to a shielded patient toilet to prevent injected patients accessing common corridors unnecessarily and exposing staff to radiation. A communications system between the Uptake Room/s and the Control room may be included as required.

The Uptake room should be a minimum of 9 m^2 and include:

- Privacy screening to the doorway allowing the patient to change in the room

- A recliner chair or bed; doors must allow bed access
- Handbasin with paper towel and soap fittings
- Services panel including
  - Oxygen and suction outlets
  - Patient Call, Staff Assist call and Emergency call buttons
  - General power outlets including power for motorised beds/ chairs
- Dimmable lighting to allow the patient to rest
- Ceiling mounted examination light
- Lead shielded sharps and waste containers for radioactive waste

Uptake/ Induction Room

The Uptake/ Induction room is an Uptake Room that may also be used to administer anaesthetics or sedation to patients particularly paediatric patients. The Uptake/ Induction room should be a minimum of 15m^2 with an adjoining shielded patient toilet and have close access to the Scanning room.

In addition to requirements for an Uptake room the Uptake/ Induction room will include:

- Patient bed/ trolley
- Services for administering anaesthetics and sedation:
  - Oxygen, Suction, Medical Air, Nitrous Oxide and anaesthetic gas scavenging outlets
  - Anaesthetic machine with patient monitor
  - Bench with cupboard and drawers for storing supplies and stock

Bone Densitometry

The Bone Densitometry Room is for bone density imaging studies. The rooms should be located in the 'Cold Zone' to avoid patient entering 'Hot' (dosed) areas with ready access to Waiting Areas. The room will require radiation shielding as assessed by a Radiation Consultant.

The room includes:

- A control console and computer workstation
- Handwashing basin with fittings
- Shelving for gown, pillows etc

Radioactive Waste/ Hot Store

The Hot Store will hold waste radionuclides awaiting decay in order to return to general waste. The rooms will ideally be located with a direct entry from the corridor. The room may be sized to accommodate the space requirements for radionuclide holding and storage.

The room requirements include:

- Doors with access control and radiation shielded glazing as required
- Radioactive warning signs on doors
- Lead-shielded sharps bins and a bin for general radioactive waste may be located under a bench in shielded cupboards
- A wall or ceiling-mounted hoist for lifting heavy transport containers from floor to bench, if required.

Radiopharmacy Laboratory

A Radiopharmacy Laboratory may be provided for the manufacturing of sterile radiopharmaceuticals that have been produced in a cyclotron, according to local authority standards.

The room will be sized according to the scope of the service and the range of radiopharmaceuticals to be manufactured and may be located directly adjacent to a Cyclotron.

The Laboratory will comprise:

- General work area with benches and shelving
- Sterile Manufacturing area incorporating a Clean Room for cell labelling and in-house manufacture, including biosafety cabinets Class 2 or 3

- Kit production area (PET Hot Lab)
- Quality Control Lab
- Radioactive supplies store
- Emergency shower and eyewash station and spill kit in the event of radioactive chemical spills

Refer to local authority's requirements and standards.

7 Schedule of Equipment (SOE)

This Schedule of Equipment (SOE) below lists the major equipment required for the key rooms in this FPU.

Room Name	
SPECT or SPECT/ CT, Room Code (spect-ct-i)	
Air flowmeter	Monitor: cardiac
Lead screen: mobile	Suction adapter
Oxygen flowmeter	Scanning unit: SPECT or SPECT/ CT
PET/CT, Room Code (pet-ct-i)	
Air flowmeter	Monitor: cardiac
Injector: contrast media, CT	Oxygen flowmeter
Lead screen: mobile	Scanning unit: PET/ CT
Lead screen: mobile, PET	Suction adapter

8 Schedule of Accommodation

The Schedule of Accommodation (SOA) provided below represents generic requirements for this unit. It identifies the rooms required along with the room quantities and the recommended room areas. The simple sum of the room areas is shown as the Sub Total. The Total area is the Sub Total plus the circulation percentage. The circulation percentage represents the minimum recommended target area for internal corridors in an efficient and appropriate design.

Within the SOA, room sizes are indicated for typical units and are organised into the functional zones. Not all rooms identified are mandatory therefore, optional rooms are indicated in the Remarks. These guidelines do not dictate the size of the facilities such as the total number of Scanning rooms. Therefore, the SOA provided represents a limited sample based on assumed unit sizes. The actual size of the facilities is determined by Service Planning or Feasibility Studies.

Quantities of rooms need to be proportionally adjusted to suit the desired unit size and service needs.

The table below shows two alternative SOA's for 2 cameras and 4 cameras, both including 1 PET scanning room, at role delineations from RDL 4 to 6.

Any proposed deviations from the mandatory requirements, justified by innovative and alternative operational models may be proposed within the departure forms included in Part A of these guidelines for consideration by the health authority for approval.

Nuclear Medicine Unit

ROOM/ SPACE Size	Standard Component Room Codes	RDL 5-6 Qty x m2 2 SPECT/1 PET			RDL 5-6 Qty x m2 4 SPECT/1 PET			Remarks
Entry/ Reception/ Holding								**'Cold' areas – Un-dosed Patients**
Reception	recl-10-i recl-15-i similar	1	x	10	1	x	12	
Waiting	wait-15-i wait-20-i	2	x	15	2	x	20	Separate Male/ Family waiting
Interview Room - Family	intf-i	1	x	12	2	x	12	Patient Consultation
Office - 2 Person Shared	off-2p-i				1	x	12	Optional, Administrative support
Patient Bay - Holding	pbtr-h-10-i	2	x	10	4	x	10	Un-dosed patients on beds
Staff Station	sstn-5-i sstn-14-i similar	1	x	5	1	x	10	For Bed Holding area
Store - Stationery/ Photocopy	stps-8-i similar	1	x	8	1	x	10	Printing, stationery storage
Store - Files	stfs-10-i similar	1	x	10	1	x	10	Optional
Toilet - Accessible	wcac-i	1	x	6	1	x	6	
Toilet - Patient	wcpt-i	2	x	4	2	x	4	
Scanning Areas								'Hot' Areas – Dosed Patients
Uptake Room	NS	2	x	9	4	x	9	Radiation shielded; with recliner chair; 2 Uptake rooms per scanning room
Uptake Induction Room	NS	1	x	15	1	x	15	For administering anaesthetics or sedation to a patient on a bed or for recovery
SPECT or SPECT/CT Scanning Room	spect-ct-i	1	x	48	2	x	48	
SPECT/CT Control Room	ancrt-i similar	2	x	14	4	x	14	May be shared between 2 scanning rooms
SPECT/CT Computer Equipment Room	coeq-i similar	2	x	18	2	x	18	Shared between 2 scanning rooms
Bone Densitometry	ns	1	x	16	1	x	16	Locate near the entry in the 'Cold – Un-dosed' area
Stress Testing	strt-i	1	x	15	1	x	15	
PET or PET/CT Scanning Room	pet-ct-i	1	x	48	1	x	48	Size according to manufacturer's specifications
PET/CT Control Room	ancrt-i similar	1	x	14	1	x	14	
PET/CT Computer Equipment room	coeq-i similar	1	x	18	1	x	18	Size according to manufacturer's specifications

ROOM/ SPACE Size	Standard Component Room Codes	RDL 5-6 Qty x m2 2 SPECT/1 PET			RDL 5-6 Qty x m2 4 SPECT/1 PET			Remarks
Toilet - Patient, Hot	wcpt-i similar	3	x	4	5	x	4	Radiation shielded, direct access to uptake rooms
Treatment Room	trmt-14-i	1	x	14	2	x	14	Optional; may be located close to Hot lab
Hot Laboratory Areas								'Hot' Area
Entry Lobby - Isotopes	airl-6-i similar	1	x	6	1	x	6	Radiation shielding, external access to Hot Labs
Hot Lab - SPECT	htlb-pet-i similar	1	x	8	1	x	8	Adjacent to Uptake rooms
Hot Lab - PET	htlb-pet-i similar	1	x	8	1	x	8	Adjacent to Uptake rooms
Radioactive Waste/ Hot Store	NS	1	x	6	1	x	6	With external entry, holding of waste
Office - Workstations, QC	off-ws-i	1	x	5.5	2	x	5.5	Quality Control of radionuclides
Support Areas								
Bay - Beverage	bbev-op-i	1	x	5	1	x	5	Located close to Waiting and Bed Holding areas
Bay - Emergency Shower & Eyewash	bese-1-i	1	x	1	1	x	1	Accessible to all 'Hot' areas
Bay - Handwashing, Type B	bhws-b-i	1	x	1	1	x	1	For Bed Holding; 1 per 4 bays
Bay - Linen	blin-i	1	x	2	1	x	2	
Bay - Mobile Equipment	bmeq-4-i or bmeqe-4-i	1	x	4	2	x	4	Optional; opened or enclosed bay
Bay - PPE	bppe-i	1	x	1.5	3	x	1.5	Radiation protection equipment, (aprons)
Bay - Resuscitation Trolley	bres-i	1	x	1.5	1	x	1.5	
Bay - Wheelchair Park	bwc-i similar	1	x	2	1	x	2	Optional
Cleaner's Room	clrm-6-i	1	x	6	1	x	6	May be shared with adjoining unit
Clean Utility/ Medication	clum-14-i similar	1	x	8	1	x	8	
Dirty Utility	dtur-s-i	1	x	8	1	x	8	Radiation shielded if holding 'hot' waste
Store - Equipment/ General	steq-10-i similar	1	x	6	1	x	10	Equipment and supplies
Viewing and Reporting	xrrr-i similar	1	x	15	1	x	20	Optional; 3 or 4 workstations
Staff Areas								
Meeting Room	meet-l-15-i				1	x	15	May be shared
Office, Single Personw	off-s9-i	1	x	9	2	x	9	Manager/ Radiographer/ Physicist
Office – Workstation	off-ws-i	1	x	5.5	2	x	5.5	Qty as required
Property Bay - Staff	prop-3-i	2	x	3	2	x	3	Separate Male & Female
Staff Lounge	srm-15-i	2	x	15	2	x	15	May be shared
Toilet - Staff	wcst-i	2	x	3	2	x	3	Separate Male & Female may be shared
Sub Total		**497**			**692**			
Circulation %		**35**			**35**			
Area Total		**670.95**			**934.2**			

Please note the following:

- Areas noted in Schedules of Accommodation take precedence over all other areas noted in the Standard Components.
- Rooms indicated in the schedule reflect the typical arrangement according to the sample bed numbers.
- All the areas shown in the SOA follow the No-Gap system described elsewhere in these Guidelines.
- Exact requirements for room quantities and sizes shall reflect Key Planning Units (KPU) identified in the Clinical Service Plan and the Operational Policies of the Unit.

- Room sizes indicated should be viewed as a minimum requirement; variations are acceptable to reflect the needs of individual Unit.
- Offices are to be provided according to the number of approved full-time positions within the Unit.

9 Future Trends

Future trends for PET scanning are centred on advances in technology including:

- Increasing use of molecular imaging
- Improved tracer chemicals to allow more precise scanning of particular tissues and diseases
- Improved PET/CT scanning with better image quality, identifying smaller tumours and monitoring the response to therapy
- PET/ MRI is an emerging technology that will increase in application and use in the future. This advance in technology offers a more precise diagnosis of diseases of the brain and organ cancers and can be used to study how drugs and tracers are taken up by tumours. The combination of PET and MRI enables imaging of organs in motion, not previously possible. This will contribute to major advances in cancer treatment in future.

10 Further Reading

In addition to iHFG Sections referenced in this FPU, i.e. Part C- Access, Mobility, OH&S and Part D - Infection Control, readers may find the following helpful:

- AHIA, Australasian Health Facility Guidelines, Part B Health Facility Briefing and Planning, HPU 0500-Nuclear Medicine / PET Unit, Revision 6, 2016, refer to website: https://healthfacilityguidelines.com.au/health-planning-units
- Canadian Nuclear Safety Commission, Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms,(May 2010); Canadian Nuclear Safety Commission, May 2010, refer to website: http://nuclearsafety.gc.ca/pubs_catalogue/uploads/GD-52_Design_Guide_for_Nuclear_Substance_Laboratories_and_Nuclear_Medicine_Rooms.pdf
- Department of Health UK, NHS Estates, HBN 14-01 Designing pharmacy and radiopharmacy facilities, 2013, Refer to website: https://www.gov.uk/government/publications/guidance-on-the-design-and-layout-of-pharmacy-and-radiopharmacy-facilities
- Department of Health UK, NHS Estates, HBN 06 Facilities for diagnostic imaging and interventional radiology, 2001, Refer to website: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/149183/HBN_6_V1_DSSA.pdf
- Department of Veteran Affairs, US, VA Design Guide Nuclear Medicine, 2008 refer to website https://www.cfm.va.gov/til/dGuide.asp
- Guidelines for Design and Construction of Hospitals and Outpatient Facilities; The Facility Guidelines Institute, 2014, refer to website www.fgiguidelines.org
- PET-MRI: Challenges and new directions, A Daftary, Indian Journal of Nuclear Medicine. 2010 Jan-Mar; 25(1): 3–5.