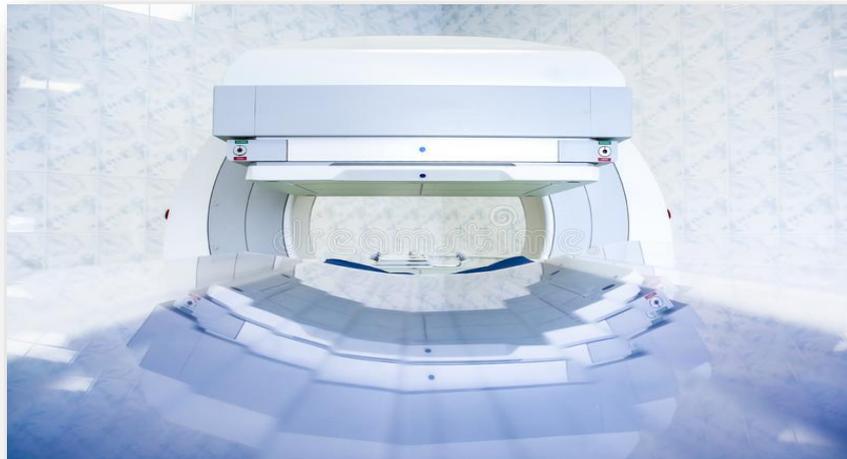




DOH Health Facility Guidelines 2019

Part B – Health Facility Briefing & Design
270 Medical Imaging – Nuclear Medicine Unit - PET



Executive Summary

This Functional Planning Unit (FPU) covers the requirements of a Medical Imaging – Nuclear Medicine and PET Unit which provides facilities for the administration of radiopharmaceutical agents to patients and patient imaging for diagnostic purposes and for treatment. The Nuclear Medicine and PET scanning may include SPECT scanning – Single Photon Emission Computed Tomography, formerly known as gamma cameras, SPECT combined with CT scanning, PET scanning – Positron Emission Tomography which may be combined with CT or MRI, Bone Densitometry and Stress Testing.

The Nuclear Medicine and PET Unit may be provided within the Medical Imaging Unit or as a freestanding Unit. The Unit will include a Hot Laboratory and optionally a Radiopharmacy Laboratory or Cyclotron. The size of a unit in terms of numbers and type of cameras will be determined by the service plan and clinical needs.

The layout and configuration of the Unit must be carefully planned to provide separation of dosed ('Hot') patients from un-dosed ('Cold') patients to ensure patients, staff and visitors are not exposed to radiation. Effective layout can also reduce the need for costly radiation shielding. The size of the Nuclear Medicine and PET Unit may vary dependent on the service plan and the scope of service, inclusion of PET and the demand for services.

The Schedules of Accommodation are provided using references to Standard Components (typical room templates) and quantities for typical Units with 2 and 4 SPECT rooms and 1 PET scanning room at Role Delineation Levels (RDLs) 5 and 6.

Further reading material is suggested at the end of this FPU but none are mandatory.

Users who wish to propose minor deviations from these guidelines should use the **Non-Compliance Report (Appendix 4 in Part A)** to briefly describe and record their reasoning based on models of care and unique circumstances.

The details of this FPU follow overleaf.

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1. Medical Imaging – Nuclear Medicine Unit - PET

1.1. Introduction

The Nuclear Medicine and PET Unit provides facilities for the administration of radiopharmaceutical agents to patients and patient imaging for diagnostic purposes and for treatment. Radiopharmaceuticals are radioactive isotopes attached to pharmaceutical substances.

The Nuclear Medicine and PET scanning may include the following imaging modalities:

- SPECT scanning – Single Photon Emission Computed Tomography, formerly known as gamma cameras; SPECT scanning may be combined with CT scanning
- PET scanning – Positron Emission Tomography which may be combined with CT or MRI
- Bone Densitometry
- Stress Testing

The Nuclear Medicine and PET 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 cameras will be determined by the service plan and clinical needs.

For radiation shielding requirement, it is governed and regulated by FANR (Federal Authority for Nuclear Regulation). A separate application and approval must be sought directly with FANR.

1.1.1 Description

Single Photon Emission Computed Tomography (SPECT)

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.

Positron Emission Tomography PET

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. PET scanning now involves 3 dimensional images using CT or MRI scanning at the same time, which provides information about the body structure. Images from metabolic scanning and the CT/MRI are reconstructed using computer analysis.

Cyclotron and Radiopharmacy Laboratory

The Cyclotron is an accelerator that uses proton beams to manufacture radioisotopes used in PET scanning. 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 PET/CT use and may provide services to other hospitals.

Note that for the purpose of this FPU, it is assumed that Radio-isotopes are outsourced.

1.2. Functional and Planning Considerations

1.2.1 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 and PET scanning.

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

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

1.2.2 Hours of Operation

The Nuclear Medicine and PET suite will generally operate during business hours from 8am to 5pm daily, or dependent on the opening hours of the Medical Imaging Unit if located within Medical Imaging. Urgent scans may be attended out of hours according to the Unit Operational Policy.

1.2.3 Model of Care

The majority of patients undergoing Nuclear Medicine and PET 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 studies in order to ensure images are not compromised by movement.

1.3. Unit Planning Models

A ground floor site is preferred but if this cannot be achieved, consideration should be given to 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.

If provided, the Bone Density 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.

1.3.1 Functional Zones

The Nuclear Medicine Unit consists of the following Functional Zones:

- Entry/ Reception/ Holding, a 'Cold' Zone incorporating:
 - Waiting (un-dosed patients and visitors)
 - Reception desk (which may be shared with Medical Imaging)

- Office for clerical support
- Interview room/s
- Patient Holding Bays for patients on beds
- Staff Station
- Storage for stationery, files and printing
- Patient amenities
- Imaging Areas:
 - Uptake Rooms also used as cool-down rooms
 - Uptake/ Induction room/s for patients requiring sedation or anesthesia
 - SPECT and SPECT/CT scanning room/s
 - PET and PET/CT 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 radionuclides
 - Separate Hot Labs for Nuclear Medicine and PET
 - Radioactive Waste Store
 - Workstations for quality control processes
- Support areas:
 - Beverage bay for patient refreshments
 - Emergency shower and eyewash
 - Storage for linen, resus trolley, equipment, consumable stock, 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, that may be 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 are briefly discussed below.

Entry/ Reception

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 patients may wait in the general waiting area with their family/ supporter's outpatients prior to scanning procedures. Inpatients may be taken directly into a bed Holding area or Uptake room.

Waiting Areas shall be divided into separate male and female/ family areas to meet cultural requirements and 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. All 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.

Outpatients should be separated from bed waiting areas for patient privacy; the bed holding area is a 'cold' zone for patients prior to injection with radionuclides. Bed Waiting Areas require a Staff Station for patient supervision.

Imaging Area

Uptake Room/s

The Uptake Room is a private, radiation shielded room where patients are injected with the radiopharmaceutical 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 'cool down' prior to discharge from the Unit. 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 are required.

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.

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. Scanning rooms require ready access from dosing rooms and dosed patient waiting areas.

Scanning rooms may be collocated with shared Control rooms to enable monitoring of two rooms simultaneously.

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.

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 Areas

Hot Laboratory/ Dispensary

The Hot Laboratory will be required for receipt, delivery, storage and dispensing/ preparation of radiopharmaceuticals. Radiopharmaceuticals may be supplied as unit doses from an external provider or from a Cyclotron facility within the campus and are drawn up or prepared ready for administration to the patient in the Hot Laboratory. The Hot Laboratory requires ready access from a service corridor for delivery of radiopharmaceuticals and will need to be readily accessible to the Uptake and scanning rooms.

The room requires radiation shielding. Space and equipment is 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 occur.

Radioactive (Hot) Waste Store

The Radioactive (Hot) Store is a secure, radiation shielded room for 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 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 FANR (Federal Authority for Nuclear Regulation).

Support Areas

Support Areas include the following provisions:

- A beverage Bay for light refreshments for patients undergoing 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
- Viewing and reporting, is an optional area for reviewing images and reporting and may be located within Control rooms

Staff Areas

Staff will need access to the following:

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

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, 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 and PET 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 and requirements will need to be assessed on a case by case basis where inclusion is proposed.

Installations will require compliance and registration with FANR (Federal Authority for Nuclear Regulation).

1.4. Functional Relationships

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

1.4.1 External Relationships

Externally the Nuclear Medicine & PET suite 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

1.4.2 Internal Relationships

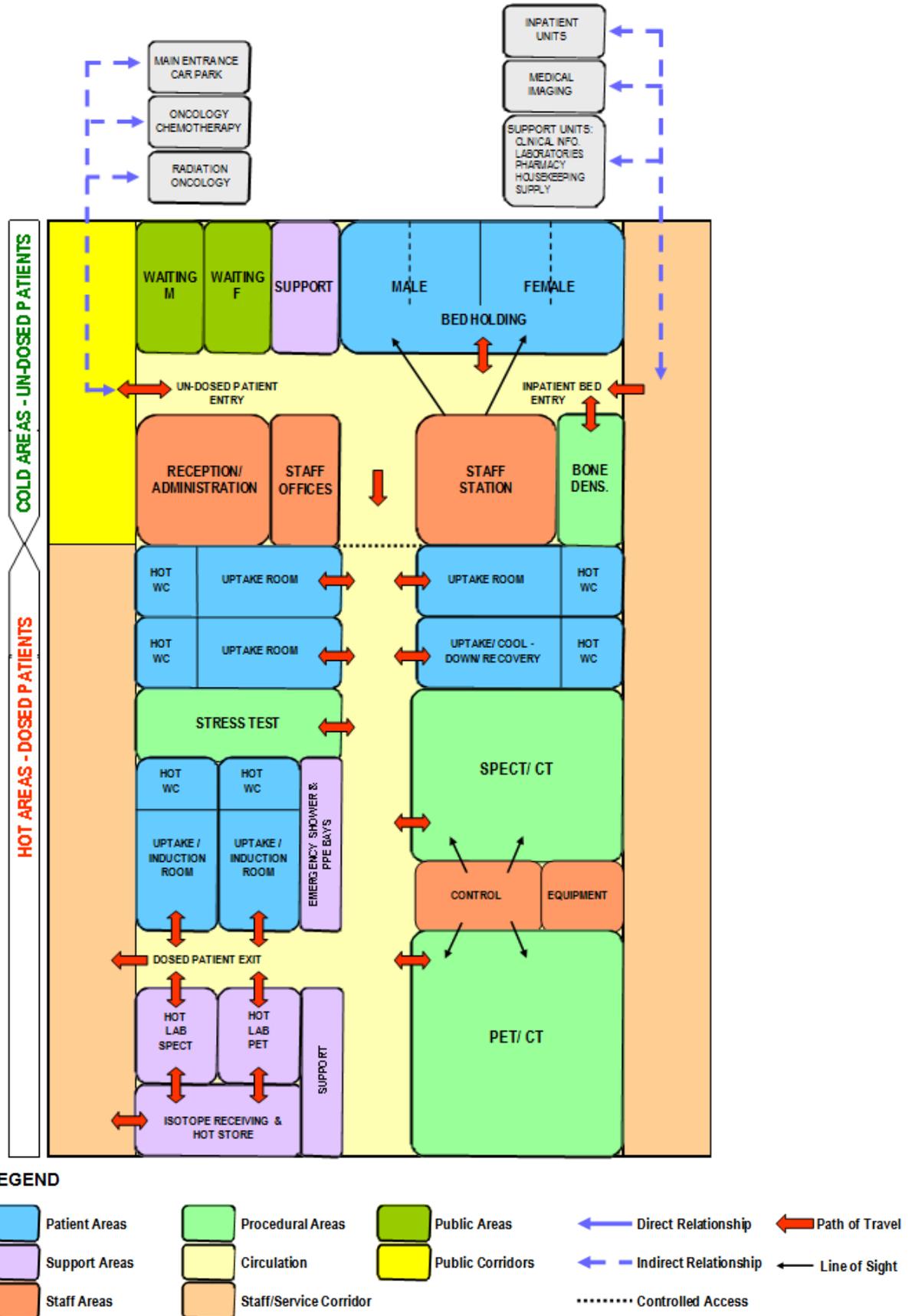
Internally, the Nuclear Medicine & PET Unit will be arranged in functional zones.

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 Internal 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' area

1.4.3 Functional Relationship Diagram



1.5. Design Considerations

1.5.1 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

1.5.2 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

1.5.3 Construction Standards

Construction Standards for a Nuclear Medicine & PET 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
- Floors and walls should be constructed of materials that are easily decontaminated in case of radioactive spills
- Walls should contain necessary support systems for either built-in or mobile oxygen and vacuum and; vents for radioactive gases
- Provision for cable trays, ducts or conduits should be made in floors, walls, and ceilings as required
- 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 3000mm 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

1.5.4 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 PET scanner.

1.5.5 Environmental Considerations

Acoustics

Acoustic treatment will be required to 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.

Refer also to acoustic requirements identified in Standard Components Room Data Sheets.

Refer to **Part G – Acoustics** of these Guidelines for more information.

Natural Light/ Lighting

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

Privacy

Visual 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.

1.5.6 Space Standards and Components

This section identifies unit specific services briefing requirements only and must be read in conjunction with **Part E - Engineering Services** for the detailed parameters and standards applicable.

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 920mm around three sides of the imaging table for patient access and transfers.

1.5.7 Accessibility

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

1.5.8 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 and bed movement is

not hampered. A minimum of 1500mm clear opening is recommended for scanning rooms doors 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.

1.5.9 Size of the Unit

The size of the Nuclear Medicine & PET Unit is dependent on the level of service and determined by the facility's Service Plan and Operational Policies. Schedules of Accommodation have been provided for typical Nuclear Medicine & PET Units in a hospital at role delineation Levels 2 (less complex services) to 6 (teaching/ research facilities).

1.5.10 Safety and Security

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
- 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, 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 based on the FANR
- 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

1.5.11 Finishes

The Nuclear Medicine & PET Unit finishes including fabrics, floor wall and ceilings should provide a calm and inviting impression. Finishes should be selected with consideration of the following:

- Infection control and cleaning
- Acoustic properties of the materials
- Durability, replacement of materials
- Fire safety 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 also to **Part C - Access Mobility, OH&S** in these Guidelines for further information on floors and ceilings.

1.5.12 Fixtures, Fittings and Equipment

Imaging equipment and the necessary services will require installation to the manufacturer's recommendations and specifications. Consideration should be given to long lead times when tendering and purchasing significant items of high technology equipment.

Refer to **Part C - Access Mobility, OH&S** of these Guidelines, the **Room Layout Sheets (RLS)** and **Room Data Sheets (RDS)** for more information

1.5.13 Building Service Requirements

Information and Communication Technology

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

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

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 urgent assistance.

The individual call buttons shall alert to an annunciator system. Annunciator panels should be located in strategic points visible from Staff Stations and audible in Staff Rooms and Meeting Rooms.

Heating, Ventilation and Air conditioning (HVAC)

The Nuclear Medicine & PET 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 40°C 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. However, if enclosed radio-iodine 131 is used in capsules, then the fume hood will not be required; the fume food is only required if radio-iodines are received in liquid form.

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 scanning procedures require radiation shielding including

- Reception and rooms adjacent to dosed patient rooms
- Dosing/ Consult Exam rooms
- Hot Lab/ Dispensing room, Hot Store and Radiopharmacy
- Pre-scan uptake rooms/ dosed waiting areas, patient toilets
- Scanning Room/s – SPECT, SPECT/CT, PET/CT
- 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 FANR (Federal Authority for Nuclear Regulation) Laws and Regulations. 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.

1.5.14 Infection Control

Standard precautions apply to the Nuclear Medicine & PET Unit to prevent cross infection between patients, staff and visitors. Paths of travel for inpatients should be separated from outpatients as far as possible.

Hand Basins

Hand basins will be located in each scanning room, uptake and Uptake/ induction room/s, patient holding, recovery areas as well as clinical support rooms including clean and dirty utilities. In holding and recovery areas the minimum provision is one hand basin per 4 bed or chair bays.

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

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 Prevention and 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 Prevention and Control** in these Guidelines.

1.6. Standard Components of the Unit

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
2	Provided by the Client and installed by the builder

3	Provided and installed by the Client
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- 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 Unit contains 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.

1.6.1 Non-Standard Rooms

Non-standard rooms are rooms are those which have not yet been standardised within these guidelines. These are identified in the Schedules of Accommodation as NS and are separately covered 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 9m² 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 15m² 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 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 room should be located in the 'Cold' zone to avoid patients 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 gowns, 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 bins 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 is optional.

1.7. 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 sum of the room areas is shown as the Sub Total as the Net Area. The Total area is the Sub Total plus the circulation percentage. The circulation percentage represents the minimum recommended target area for corridors within the Unit 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, 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 Schedule of Accommodation are developed for particular levels of services known as Role Delineation Level (RDL) and numbered from 1 to 6. Refer to the full Role Delineation Framework (Part A - Appendix 6) in these guidelines for a full description of RDL's.

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

Any proposed deviations from the mandatory requirements, justified by innovative and alternative operational models may be proposed and record in the **Non-Compliance Report** (refer to **Part A - Appendix 4**) with any departure from the Guidelines for consideration by the DOH for approval.

1.7.1 Medical Imaging - Nuclear Medicine Unit & PET

ROOM/ SPACE	Standard Component Room Codes					RDL 5-6 Qty x m ²	RDL 5-6 Qty x m ²	Remarks
Size						2 SPECT/1 PET	4 SPECT/1 PET	
Entry/ Reception/ Holding								'Cold' areas – Un-dosed Patients
Reception	recl-10-d similar					1 x 10	1 x 12	
Waiting	wait-15-d wait-20-d					2 x 15	2 x 20	Un-dosed; Separate Male/ Family waiting
Interview Room - Family	intf-d					1 x 12	2 x 12	Patient Consultation
Office - 2 Person Shared	off-2p-d						1 x 12	Optional, Administrative support
Patient Bay - Holding	pbtr-h-10-d					2 x 10	4 x 10	Un-dosed patients on beds
Staff Station	sstn-5-d sstn-14-d similar					1 x 5	1 x 10	For Bed Holding area
Store - Stationery/ Photocopy	stps-8-d similar					1 x 8	1 x 10	Printing, stationery storage
Store - Files	stfs-10-d similar					1 x 8	1 x 8	Optional

ROOM/ SPACE	Standard Component Room Codes			RDL 5-6 Qty x m ²	RDL 5-6 Qty x m ²	Remarks
Size				2 SPECT/1 PET	4 SPECT/1 PET	
Toilet - Accessible	wcac-d			1 x 6	1 x 6	
Toilet - Patient	wcpt-d			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/CT Scanning Room	spect-ct-d similar			1 x 48	2 x 48	
SPECT/CT Control Room	ancrt-d			2 x 14	4 x 14	May be shared between 2 scanning rooms
SPECT/CT Computer Equipment Room	coeq-d 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-d			1 x 15	1 x 15	
PET or PET/CT Scanning Room	pet-ct-d			1 x 48	1 x 48	Size according to manufacturer's specifications
PET/CT Control Room	ancrt-d similar			1 x 14	1 x 14	
PET/CT Computer Equipment room	coeq-d similar			1 x 18	1 x 18	Size according to manufacturer's specifications
Toilet - Patient, Hot	wcpt-d			3 x 4	5 x 4	Radiation shielded, direct access to uptake rooms
Treatment Room	trmt-14-d			1 x 14	2 x 14	Optional; may be located close to Hot lab
Hot Laboratory Areas						'Hot' Area
Entry Lobby - Isotopes	airl-6-d			1 x 6	1 x 6	Radiation shielding, external access to Hot Labs
Hot Lab - SPECT	htlb-d similar			1 x 8	1 x 8	Adjacent to Uptake rooms
Hot Lab - PET	htlb-d 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-d			1 x 5.5	2 x 5.5	Quality Control of radionuclides
Support Areas						

ROOM/ SPACE	Standard Component Room Codes			RDL 5-6 Qty x m ²	RDL 5-6 Qty x m ²	Remarks
Size				2 SPECT/1 PET	4 SPECT/1 PET	
Bay - Beverage	bbev-op-d			1 x 5	1 x 5	Located close to Waiting and Bed Holding areas
Bay - Emergency Shower & Eyewash	bese-1-d			1 x 1	1 x 1	Accessible to all 'Hot' areas
Bay - Handwashing, Type B	bhws-b-d			1 x 1	1 x 1	For Bed Holding; 1 per 4 bays
Bay - Linen	blin-d			1 x 2	1 x 2	
Bay - Mobile Equipment	bmeq-4-d or bmeqe-4-d			1 x 4	2 x 4	Optional, opened or enclosed bay
Bay - PPE	bppe-d			1 x 1.5	3 x 1.5	Radiation protection equipment, (aprons)
Bay - Resuscitation Trolley	bres-d			1 x 1.5	1 x 1.5	
Bay - Wheelchair Park	bwc-d similar			1 x 2	1 x 2	Optional
Cleaner's Room	clrm-6-d			1 x 6	1 x 6	May be shared with adjoining unit
Clean Utility/ Medication	clum-14-d similar			1 x 8	1 x 8	
Dirty Utility	dtur-s-d			1 x 8	1 x 8	Radiation shielded if holding 'hot' waste
Store - Equipment/ General	steq-10-d similar			1 x 6	1 x 10	Equipment and supplies
Viewing and Reporting	xrrr-d similar			1 x 15	1 x 20	Optional; 3 or 4 workstations
Staff Areas						
Meeting Room	meet-l-15-d				1 x 15	May be shared
Office, Single Person	off-s9-d			1 x 9	2 x 9	Manager/ Radiographer/ Physicist
Office – Workstation	off-ws-d			1 x 5.5	2 x 5.5	Qty as required
Property Bay - Staff	prop-3-d			2 x 3	2 x 3	Separate Male & Female
Staff Room	srm-15-d			1 x 15	1 x 15	May be shared
Toilet – Staff (Male/ Female)	wcst-d			2 x 3	2 x 3	Separate Male & Female; may be shared
Sub Total				525	755	
Circulation %				35	35	
Area Total				708.7	1019.2	

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 KPU and RDL
- 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

1.8. Further Reading

In addition to Sections referenced in this FPU, i.e. **Part C- Access, Mobility, OH&S, Part D - Infection Prevention and Control**, and **Part E - Engineering Services, Part G-Acoustics** readers may find the following helpful:

- FANR Regulations and Guides <https://fanr.gov.ae/en/rules-regulations/regulations-guides>
- Federal Authority for Nuclear Regulation, FANR. Refer to website: <https://fanr.gov.ae/en/operations/radiation-safety>
- International Health Facility Guideline (iHFG) www.healthdesign.com.au/ihfg
- Ministry of Health UAE, Unified Healthcare Professional Qualification Requirements, 2017, refer to website: <https://www.haad.ae/haad/tabid/927/Default.aspx>
- NHS Estates, Department of Health Estates and Facilities Division, 14-01, Pharmacy and Radiopharmacy, HMSO, London, 2008, refer to website: www.estatesknowledge.dh.gov.uk
- NHS Estates, Department of Health Estates and Facilities Division, HBN 6 Facilities for diagnostic imaging and interventional radiology, HMSO, London, 2001, refer to website: www.estatesknowledge.dh.gov.uk
- The Facility Guidelines Institute (US), Guidelines for Design and Construction of Hospitals, 2018. Refer to website: www.fgiguilines.org
- The Facility Guidelines Institute (US), Guidelines for Design and Construction of Outpatient Facilities, 2018. Refer to website: www.fgiguilines.org