

Part B – Health Facility Briefing & Design

175 Medical Imaging-Nuclear Medicine Unit - PET



*i*HFG

International Health Facility Guidelines

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175 Medical Imaging-Nuclear Medicine Unit - PET

1 Introduction

Description

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.

The function of a PET Unit is to provide a safe environment to enable the delivery of radiopharmaceutical agents and scanning under carefully controlled conditions.

The Unit may be provided within the Nuclear Medicine Unit or Medical Imaging Unit. Inclusion of a radiopharmaceutical support laboratory is optional and dependent on the operational policy of the facility...

PET: Positron Emission Tomography

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 Computed Tomography (CT) technology is used extensively in cancer assessment and ongoing evaluation of treatment response. 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 the 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 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.

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 and 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 PET tracer production facility, including the cyclotron depends on the tracers to be produced and functional requirements of the facility and needs to be determined on an individual basis.

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

2 Functional and Planning Considerations

Operational Models

Hours of Operation

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

Models of Care

PET services are generally collocated with the Nuclear Medicine Unit or in smaller centres, with the Medical Imaging Unit, sharing support facilities. As PET is extensively used as an oncology diagnostic tool, it may be located in a comprehensive Cancer Centre.

The majority of patients undergoing 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.

Planning Models

Location

The location of the unit requires careful consideration of the following:

- the weight of the equipment
- the weight and extent of shielding requirements
- access required for installation and servicing of equipment
- access for delivery of radioisotopes (for outsourced supplies)

A ground floor location is preferred. 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.

Configuration

The layout and configuration of the PET suite should provide separation of dosed patients from un-dosed patients 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. 'Hot' and 'cold' areas should be geographically separated whenever possible. Planning and design should consider separate patient and staff corridor systems and provide separate entries for outpatients and for inpatients on beds/ trolleys.

The layout of the PET suite will need to address security of radioisotopes and radioactive waste and consolidate areas requiring costly radiation shielding.

PET 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.

Future Growth

Planning should provide for future growth of PET 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.

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 and the weight of the scanning unit is substantially greater.

Functional Areas

The PET Unit may consist of the following Functional Areas depending on the Operational Policy and service demand:

- Entry/ Reception incorporating:
 - Waiting (un-dosed patients and visitors)
 - Reception desk (which may be shared with Nuclear Medicine or Medical Imaging)
 - Office for clerical support
 - Storage for stationery, files and printing
 - Public amenities
- Patient and Imaging Areas:
 - Holding area for patients in beds (un-dosed)
 - Uptake Rooms also used as cool-down rooms
 - Uptake/ Induction room/s for patients requiring sedation or anaesthesia
 - PET/CT Scanning room/s, control room, computer equipment (technical) room
 - Hot Laboratory
 - Patient toilets (hot), with direct access to uptake rooms
- Support areas
 - Beverage bay
 - Emergency shower and eyewash
 - Storage for linen, resus trolley, mobile equipment, personal protective equipment (PPE)
 - Clean Utility
 - Cleaner's room
 - Dirty Utility
- 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.

Entry/ Reception/ Waiting Areas

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.

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. Un-dosed patients may wait in the general waiting area with their family/ supporters outpatients 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 radionuclides, the bed holding area is a 'cold' zone.

Patient/ Imaging Areas

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 will be required.

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.

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

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

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.

Hot Laboratory and Hot Store

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 Fluorodeoxyglucose (FDG) and other PET radiopharmaceuticals and will need to be readily accessible to the Uptake and PET Scanning rooms.

The room will be radiation shielded. 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.

The Hot Store is a secure, radiation shielded room for storage of sealed sources and radioactive waste, particularly sharps. 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 the relevant jurisdictional authorities.

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

Support Areas

Support areas include the following provisions:

- A beverage Bay as light refreshments are made available 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 linen, resuscitation trolley, wheelchairs, equipment used in the unit, sterile supplies and consumable stock; provision for recharging of equipment should be available
- 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 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.

Staff areas may be shared with a collocated Unit (Nuclear Medicine/ 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 manufacturing a range of radiopharmaceuticals used in scanning procedures 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.

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

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.

Functional Relationships

External

The Nuclear Medicine PET suite ideally will be located on the ground level with easy access from the Main Entry area for patients, staff and visitors. Externally the 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.

Internal

Internally, the PET suite will generally be a dedicated suite of rooms within a larger Unit typically Nuclear Medicine but also may be a component of an integrated Medical Imaging Unit.

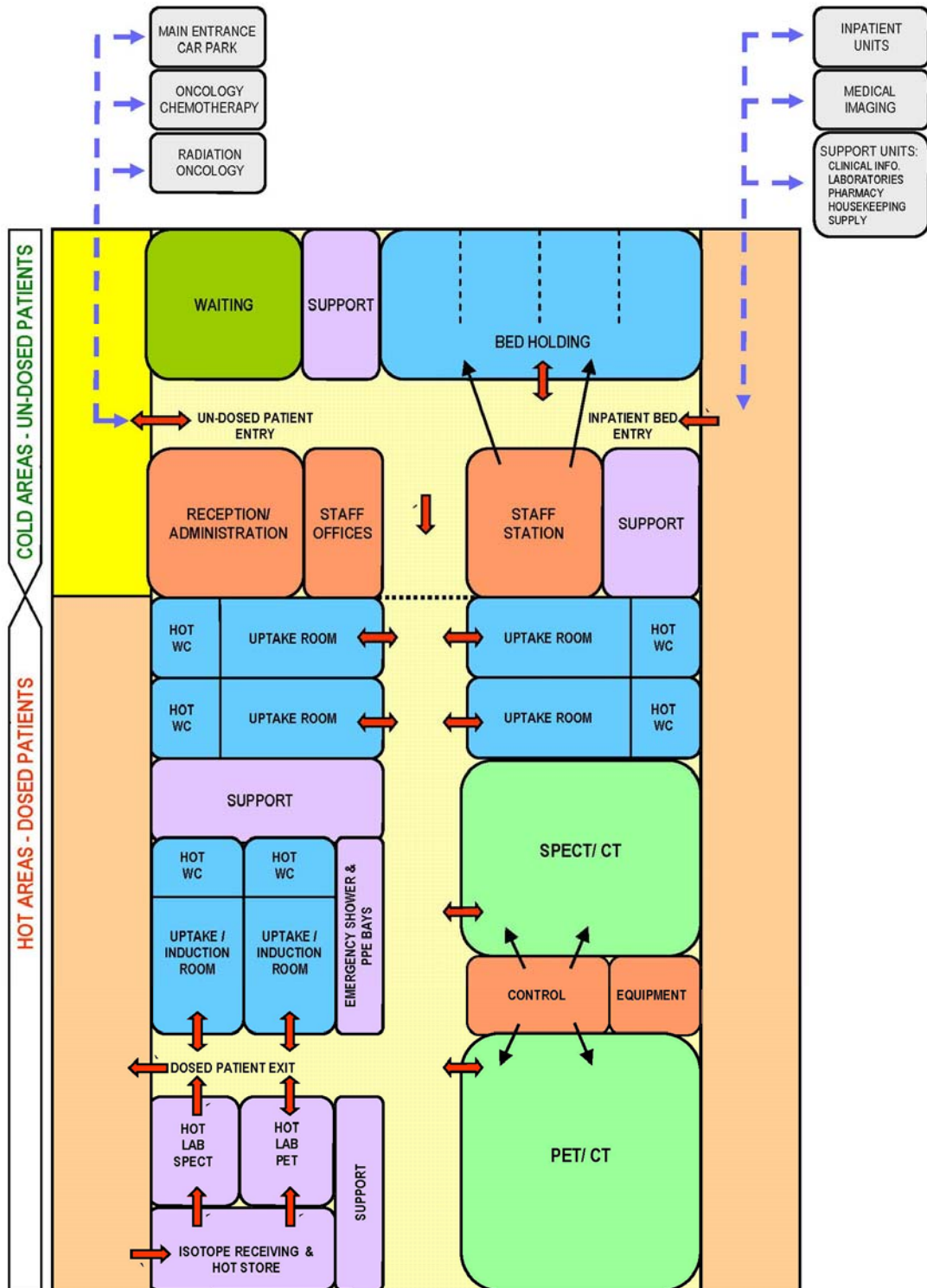
The Reception will provide an access control point and there will be clear separation of un-dosed - 'cold' and dosed - 'hot' areas of the Unit. There should be a clear path of travel for patients who arrive and wait in un-dosed waiting, then are transferred to Uptake rooms dosing, wait for uptake followed 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 single PET suite within a Nuclear Medicine Unit.



LEGEND

- | | | | | |
|---------------|------------------------|------------------|-----------------------|----------------|
| Patient Areas | Procedural Areas | Public Areas | Direct Relationship | Path of Travel |
| Support Areas | Circulation | Public Corridors | Indirect Relationship | Line of Sight |
| Staff Areas | Staff/Service Corridor | | Controlled Access | |

3 Design

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

Special attention is to be given to the following in the design of the PET suite:

- 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
- 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
- A tiled ceiling may be considered for ease of installation, service, and remodelling.

Standards & Codes

Radiological and radiopharmaceutical facilities are to comply with relevant local legislation, regulations, statutory and licensing requirements.

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.

Environmental Considerations

Acoustics

Sound attenuation should be provided in the following areas:

- Uptake and Uptake/ Induction rooms
- Scanning rooms
- Viewing/ Reporting room

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.

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

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 privacy is required in all Consult, Uptake, PET Scanning rooms and patient holding bed bays. Doors to screening rooms should be located to avoid patient exposure to circulation areas.

If patients change in the Uptake rooms, privacy from CCTV cameras while getting changed will be required.

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

Accessibility

Design should provide ease of access for wheelchair bound patients in all patient areas including Consult, Uptake rooms and PET Scanning rooms. Waiting areas should include spaces for wheelchairs (with power outlets for charging electric mobility equipment) and suitable seating for patients with disabilities or mobility aids. The Unit will require provision for bariatric patients.

Doors

Special consideration should be given to the width and height of doorways to ensure delivery and removal of PET/CT scanning 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 PET Scanning rooms should be a minimum of 1500 mm wide or larger to permit 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 PET suite. Workstations, sinks and Hot Laboratory benches should be provided at suitable working heights, whether seated or standing positions. Adjustable height work stations 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 handling 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
- PET 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 PET suite in terms of numbers of cameras will be determined by the clinical service plan that establishes the scope of the service.

A Schedule of Accommodation has been provided for a single PET scanner that may be incorporated within a larger unit, typically a Nuclear Medicine Unit.

Safety & Security

Safety

Management of Radioactive substances spills is a key safety consideration within the PET suite and will include the following measures:

- All surfaces including floors, bench tops, walls and junctions should be impermeable and easy to clean
- An emergency shower and eye wash for patients and staff should be readily accessible and located in close proximity to all areas of potential exposure
- A decontamination kit should be stored in the Hot Lab for quick access to contain and clean up radioactive spills

Radioactive Isotopes - Delivery

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 PET studies (FDG) 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 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 regulatory authority.

Due to the rapid decay of radioisotopes used for PET studies, very little solid waste will need to be stored except for syringes, needles, cannula etc. Specially designed lead-lined sharps bins are commercially available and should be readily accessible for use by the clinicians and technicians in the PET suite 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 PET suite 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
- 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.

Finishes

Finishes including floors, walls, ceilings, cornices, door protection, fittings and joinery should be selected with consideration to the following:

- Infection control and ease of cleaning
- Fire safety
- Durability
- Acoustic properties.

All surface finishes are to be washable including walls and ceilings. Floor surfaces should be impervious, easy to clean, sealed and coved at the edges.

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.

PET/CT and PET/MRI 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

Communications

Voice/ data installation may include:

- Patient booking and appointment systems
- Voice / data outlets and wireless networks, servers and communication room requirements
- Dictation or voice recognition system for reporting
- Picture Archiving Communications Systems (PACS)
- Patient or Clinical Information Systems
- Conferencing facilities for meeting rooms
- CCTV for patient viewing and security surveillance.

Nurse Call/ Emergency Call

Nurse call, Staff Assist and Emergency call buttons are required in Uptake rooms, patient-use toilets, holding bed bays, Scanning rooms and Waiting areas.

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 PET suite should be air-conditioned to provide a comfortable working environment for staff and patients. General air conditioning needs to cool equipment but outlets should not be placed directly over partially undressed patients on beds or trolleys. The temperature of the unit should

be maintained within a comfortable range not exceeding 25 degrees Celsius for optimal operating efficiency and patient comfort.

Medical Gases

The PET suite will require:

- Oxygen and suction in all Patient Holding bays, Uptake Rooms and Scanning rooms
- Provision of medical air to Uptake Rooms and patient recovery bays is optional.

Full anaesthetic capability is required within the Uptake/ Induction Room/s, 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 Non-Standard Components in this FPU, Standard Components Room Data Sheets and Room Layout Sheets for specific medical gases required.

Radiation Shielding and Radiation Safety

All rooms that are used for undertaking imaging procedures require radiation shielding including PET/CT scanning, Hot Labs, Hot Stores and any rooms holding patients injected with radionuclides. A certified physicist or qualified expert will need to assess the plans and specifications for radiation protection as required by the 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.

The PET suite may need to be registered or accredited by the relevant radiation or nuclear safety authority.

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:

- PET/CT 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.

It is recommended that in addition to hand basins, medicated hand gel dispensers be located strategically in staff circulation corridors.

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

4 Components of the Unit

Standard Components

The 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 m² 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 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.

PET/CT Scanning Room

The PET/CT Room size will be dependent on equipment manufacturer and layout. A minimum size of 50m² is recommended, however may be adjusted for increased complexity of procedures. The room will require radiation shielding assessment by a certified Physicist.

The PET/CT scanning equipment will be installed to manufacturer's specifications and room provisions will include the following considerations:

- Structural assessment will be required to ensure structural support for the equipment and the weight of radiation shielding to the room
- Services to suit the equipment provided, according to manufacturer's recommendations and may include an uninterrupted power supply to camera and control equipment.

- Patient Services panel with:
 - Oxygen, suction medical air, Nitrous oxide and gas scavenging outlets
 - Power outlets, a minimum of 6 for patient equipment and monitoring
 - Patient call, Nurse Assist and Emergency call buttons
- CCTV cameras located to view the patients from several different directions, with monitors in the Control Room
- A communication system between the PET/CT Scanning room and the Control room, intercom or speakers and microphones
- Clock positioned to be viewed by the patient
- Scrub basin for staff use with paper towel and soap fittings
- Bench with cupboards and shelving for storage of items used in the room
- Manual handling devices for assisting with patient transfers; hoists are not recommended as they may increase the time taken for patient transfer and expose staff to radiation
- Lighting should be colour corrected to ensure skin colour can be observed by staff and glare free

If the PET/CT room is also used for radiotherapy simulation, laser positioning lights will be required.

Hot Laboratory and Hot Store

The Hot Laboratory is a room for storage and preparation of radiopharmaceuticals while 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 scope of the service and space requirements for radionuclide holding, preparation and storage.

Refer to requirements noted in Standard Components - Hot Laboratory Room Data Sheets and Room Layout Sheet.

In addition the following may be provided:

- 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.

5 Schedule of Accommodation

PET facility located within a Nuclear Medicine/ Medical Imaging Unit

ROOM/ SPACE	Standard Component Room Codes											RDL ALL Qty x m ²	Remarks
												1 PET/CT	
Entry/ Reception													
Reception	recl-10-i											1 x 10	
Waiting	wait-10-i											2 x 10	May provide separate Male/ Family waiting
Consult Room	cons-i											1 x 14	
Office - 2 Person Shared	off-2p-i											1 x 12	Administrative support
Store - Stationery/ Photocopy	stps-8-i											1 x 8	Printing, stationery storage
Toilet - Accessible	wcac-i											1 x 6	May share with a collocated unit
Toilet - Public	wcpu-3-i											2 x 3	May share with a collocated unit
Patient & Imaging Areas													
Patient Bay - Holding	pbtr-h-10-i											2 x 10	Patients on beds, prior to injection
Uptake Room	NS											3 x 9	Radiation shielded; with recliner chair
Uptake Induction Room	NS											1 x 15	For administering anaesthetics or sedation to a patient on a bed or for recovery
PET/ CT scanning Room	NS											1 x 50	Size according to manufacturer's specifications
PET Control Room	ctcr-i similar											1 x 8	2 persons
PET Computer Equipment room	coeq-i similar											1 x 8	Size according to manufacturer's specifications
Hot Laboratory	htlb-i similar											1 x 8	Adjacent to Uptake rooms
Hot Store	NS											1 x 6	With external entry, holding of waste
Office - Workstations, QC	off-ws-i											2 x 5.5	Quality Control of radionuclides
Toilet - Patient, Hot	wcpt-i similar											4 x 4	Radiation shielded, direct access to uptake rooms
Support Areas													
Bay - Beverage	bbev-op-i											1 x 4	Located close to Waiting and Holding areas
Bay - Emergency Shower & Eyewash	bese-i											1 x 1	
Bay - Handwashing, Type B	bhws-b-i											1 x 1	For Bed Holding; 1 per 4 bays
Bay - Linen	blin-i											1 x 2	
Bay - Mobile Equipment	bmeq-4-i											1 x 4	
Bay - PPE	bppe-i											1 x 1.5	Radiation protection equipment, (gloves, gowns)

ROOM/ SPACE	Standard Component Room Codes									RDL ALL Qty x m ²	Remarks
										1 PET/CT	
Bay - Resuscitation Trolley	bres-i									1 x 1.5	
Bay - Wheelchair Park	bwc-i									1 x 2	Optional
Cleaner's Room	clrm-6-i									1 x 6	May be shared with adjoining unit
Clean Utility/ Medication	clur-s-i									1 x 8	
Dirty Utility	dtur-s-i									1 x 8	Radiation shielded if holding 'hot' waste
Staff Station	sstn-10-i									1 x 10	
Store - Equipment/ General	steq-6-i									1 x 6	Equipment and supplies
Viewing and Reporting	xrrr-i similar									1 x 12	Optional; 3 workstations
Staff Areas											
Meeting Room	meet-l-15-i									1 x 15	Shared with Nuclear Medicine/ Medical Imaging
Office, Single Person, 9m2	off-s9-i									1 x 9	Note 1; Manager/ Radiographer/ Physicist
Property Bay - Staff	prop-2-i									2 x 2	Separate Male & Female
Staff Room	srm-15-i									1 x 15	Shared with Nuclear Medicine/ Medical Imaging
Toilet - Staff	wcst-i									2 x 3	Separate Male & Female, may be shared
										361.0	
Circulation %										35	
Area Total										487.3	

Note 1: Offices to be provided according to the number of approved full time positions within the Unit

Cyclotron & Radiopharmacy (Optional)

Note: Inclusion and size will be dependent on the Service Plan of the facility.

ROOM/ SPACE	Standard Component Room Codes									RDL 6 Qty x m ²	Remarks
Radiopharmacy Laboratory	NS									40	
Cyclotron	NS									80	
Technical Support/ Staff										20	Will include staff amenities, PPE bays, Change rooms
Sub Total										140	
Circulation %										35	
Area Total										189.0	

Note the following:

- Areas noted in Schedules of Accommodation take precedence over all other areas noted in the FPU.
- Rooms indicated in the schedule reflect the typical arrangement according to the Role Delineation.
- Exact requirements for room quantities and sizes will reflect Key Planning Units identified in the 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.
- Office areas are to be provided according to the Unit role delineation and number of endorsed full time positions in the unit.
- Staff and support rooms may be shared between Functional Planning Units dependent on location and accessibility to each unit and may provide scope to reduce duplication of facilities.

6 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.

7 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.fgiguilines.org
- PET-MRI: Challenges and new directions, A Daftary, Indian Journal of Nuclear Medicine. 2010 Jan-Mar; 25(1): 3–5.



The International Health Facility Guidelines recommends the use of HFBS “Health Facility Briefing System” to edit all room data sheet information for your project.

HFBS provides edit access to all iHFG standard rooms, and departments, and more than 100 custom report templates.

HFBS Health Facility Briefing System



Briefing Module

The Health Facility Briefing System (HFBS) has numerous modules available via annual subscription. It suits healthcare Architects, Medical Planners, Equipment Planners Project Managers and Health Authorities.

Use the HFBS Briefing Module to quickly drag in health facility departments or pre-configured room templates from the iHFG standard, edit the room features such as finishes, furniture, fittings, fixtures, medical equipment, engineering services. The system can print or download as PDF more than 100 custom reports including room data sheets, schedules, and more...

To learn more about the HFBS web-based Healthcare Briefing and Design Software and to obtain editable versions of the “Standard Components” including Room Data Sheets (RDS) and Room Layout Sheets (RLS) offered on the iHFG website, signup for HFBS using the link below.

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