DESIGN OF THE FIRST UNIT OF PET-CT IN MOROCCO
-BUILDING REQUIRMENT and SAFETY EQUIPMENT-

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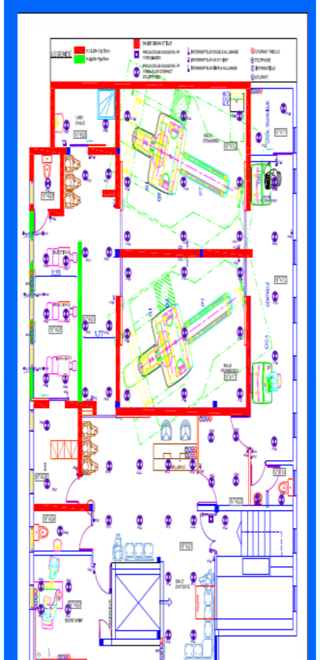
Unit Plan Of Anoual Radiology Center

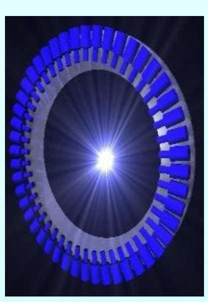


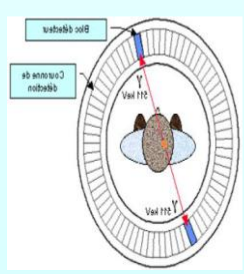
INTRODUCTION

Positron emission tomography, also called PET imaging or a PET scan, is a type of nuclear medicine imaging.

The facility should be designed in such a way that provisions for safety systems or devices are inherent to the equipment or the room in order to lower the probability of occurrence of undesirable radiation exposure.

The design of the facility should take into consideration the type of work to be done and the radionuclides (and their activity) intended to be used. The ICRP's concept of categorization of hazard and safety assessment should be used in order to determine the special needs concerning ventilation, plumbing, materials used in walls, floors and work benches.





MAIN POSITRONS EMITTING ISOTOPES CURRENTLY USED FOR MEDICAL APPLICATIONS

Nuclide	Half-life (min)	Positron emission (%)	Max.energy (Mev)	Productions
18F	109.8	97	0.633	Cyclotron
11C	20.4	99.8	0.959	Cyclotron
13N	9.96	100	1.194	Cyclotron
15O	2.04	100	1.738	Cyclotron

OBJECTIVES

SHIELDING CALCULATION OF THE PET TOMOGRAPH ROOM:

Two possible scenarios:

1) without absorption by the patient

2) With absorption bye standard patient

MATERIELS AND METHODS

⇨ Safety equipment

The safety equipment provided include protective clothes (lab coat, gloves, shoes, shoe covers etc.) adequate to prevent any contamination of the bodies of the persons for whom it is provided.

Every person engaged in work wear the personal protective equipment provided for his use in the course of that work.

After work ,personal protective equipment used must be placed in the accommodation provided for it and personnel must then wash their hands.

⇨ Compact Block Shield with built-in Dose Calibrator Shield

This unit provides convenient access and viewing of the work area and incorporates a built-in calibration chamber shield.

⇨ Syringe & Vial Shields :

Tungsten is lightweight for comfortable handling

⇨ Personale Radiation Protection :

⇨ *Automatic* Infusion System

a step in the optimisation of extremity doses and whole-body doses of nuclear medicine staff

RESULTS ANDDISCUSSION

A) Calculation of dose rate based on a point source (without absorption by the patient)

- Maximum injectable activity: 370 MBq (10 mCi)
- Dose rate at 1 m for an activity 1MBq: 0.160 µGy / h
- The use of the examination room (5 days / week or 40 hours / week)
- Dose rate at 1 m for an activity of 370 MBq per week: 59.2 µGy /

hr x 40 hours = 2369 µGy / week (midpoint of the gantry)

- CDA (Half-Value Layer) = 5 mm or 51 mm Pb concrete or 35 mm Concrete barium
- Occupancy Factor (T = 1)

Calculations :

-Dose rate at 1m for a 370 MBq source activity : 59,2 µGy/h x 40 hours = 2369 µGy/week

-Dose rate at à 5 m for a 370 MBq source activity: 2369/25 = 94,8 µGy/semaine

From 94,8 µGy/week, we must reach 20 µGy/week.

CDA = ln 2 / µ = 0,693/µ

20 / 94,8 = 0,21 =

ln 0,21 = -0,138 x

Results:

x= 1.13 cm of Pb (lead tichness to place)

or x=11,4 cm of concrete to place

B) Calculation of dose rate based on a real situation (standard patient):

The patient already strongly reduces the dose rate Measures in real situations indicate the following values:

received dose rate at 50 cm from the patient: 35 µGy / h

Data used:

- 18F Source
- Number of examinations: 15 examinations per day (30 inutes/patient)
- Consideration of radioactive decay (examination 1 hour after injection)
- The attenuation by the patient consideration (50%)
- The room is used 5 days / week or 40 hours / week
- Dose rate at 50 cm from the patient: 35 µGy / h

52.5 µGy / h to 50 cm⇒Consideration of a safety factor of 1.5

- Dose rate at 1 m over a week: 13.12 µGy / hr x 40 hours = 525 µGy / week (Central point of the gantry)
- CDA (Half-Value Layer) = 5 mm of Pb or 51 mm of concrete or 35 mm Concrete-barium
- Occupancy Factor (T = 1)

Results

Dose rate at 1 m over a week: 13.12 µGy / hr x 40 hours = 525 µGy / week (Central point of the gantry)

⇒ Dose Rate to 5 m over a week: 525/25 = 21 µGy / week

Dose limit to be respected: 20 mSv / week

⇒ The shielding at 5 m distance is not really required in these conditions at 5 m distance. For optimization, we can however recommend a minimum of shielding. For example one or two HVL ordinary concrete, which gives us 5 cm or 10 cm.

CONCLUSION

The shielding requirements for a PET facility are different from those of most other diagnostic imaging facilities. This is due to the high energy of the annihilation radiation and the fact that the patient is a constant source of radiation throughout the procedure. Meeting the regulatory limits for uncontrolled areas can be an expensive proposition. Careful planning with the equipment vendor, facility architect, and a qualified medical physicist is necessary to produce a cost effective design while maintaining radiation safety standards.