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Self-assessment Checklists for Internal Audits on Design Requirements in Italian PET Imaging Centers and Cyclotron Facilities

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Abstract: In this work the authors intend to provide a list of useful operational criteria to approach, with the best practice, the design of PET imaging centers and cyclotron facilities for the production of PET radioisotopes in Italy. Special attention is devoted to organizational and safety aspects. In order to prompt toward a systematic application of the proposed indications, the article presents them in form of a specific self-assessment checklist, consisting in a list of items which involve the design process in all the different phases. This checklist represents a useful toolkit during the design phase and subsequently for internal audits.

Key words: cyclotron, occupational safety, positron emission tomography, radiation protection, radiopharmaceutical

1. Introduction

Nowadays the use of radionuclides in the health sector is increasingly widespread in nuclear medicine applications, or in activities concerning the manufacture and use of radioactive sources for preparing radiopharmaceutical products.

In particular, positron emission tomography (PET) began to be used in the clinical practice as an imaging technique since the mid-90s, and today represents one of the most important practices in nuclear medicine, as can be seen both from the ever-increasing number of installations used for this purpose, and from the constant increase in the demand for the production of PET radiopharmaceuticals.

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The radioisotopes used in PET are mainly produced artificially through the use of cyclotrons.

The production of solid waste and liquid effluents containing radioactive substances as well as radioactive sources to be discarded is intrinsically connected to these activities. Furthermore, the release into the environment of radioactive substances, mainly solid waste produced after the administration of radiopharmaceuticals and liquid effluents consisting of the excreta of patients undergoing diagnostic treatment, is practically unavoidable as briefly described in ICRP 94 [1]:

> The majority of radioactivity discharged to the environment from excreta of nuclear medicine patients is from technetium-99m radiopharmaceuticals followed by iodine-131 (...) Due to its half-life of 8 days, iodine-131 can be detected in the general environment after medical use.

Environmental impact from these practices has not been measurable.

Handling, storage and disposal of sealed and unsealed radioactive sources can expose workers to both external radiation and internal contamination hazards. Therefore, the design of PET and cyclotron facilities requires the choice of features and equipment able to minimize the risks from ionizing radiation and contamination of workers, work environment and equipment, as well as the dispersion of radioactive material, thus ensuring also the protection of the population and the environment.

For this purpose, the design stage is a complex process that needs careful planning to meet technical and organizational requirements, such as [2]:

- careful organization of accesses and routes;
- optimized spatial arrangement and organization of premises;
- appropriate ventilation system;
- adequate choice of coatings;
- use of special equipment, shielding and monitoring systems;
- correct management of solid and liquid waste, as well as airborne and liquid effluents;
- working procedures for activities involving risk of exposure to ionizing radiation.

In the later stages of the facility's life, a systematic evaluation of the compliance with these requirements is necessary to ensure a continuous quality improvement; this can be achieved through internal audits, which are useful to check the safety of activities carried out and to identify any necessary corrective actions [3].

Directive 2013/59/Euratom [4], which lays down the basic safety standards for the protection against ionizing radiation, establishes clinical audit as "a systematic examination or review of medical radiological procedures which seeks to improve the quality and outcome of patient care through structured review". Since the use of ionizing radiation in medical facilities often favours promiscuous risk scenarios, in which the source that emits ionizing radiation could imply exposure of both the patient and the operator, internal audits can be useful also for occupational health and safety purposes.

2. Material and Methods

Several technical documents are available as reference guides for planning a PET scanning center and a cyclotron facility for producing radionuclides and/or manufacturing radiopharmaceuticals, also covering radiation protection issues [5-7].

In Italy a comprehensive guide for designing facilities where unsealed sources are handled has been issued in collaboration with one of the national regulatory authorities (INAIL — Italian workers compensation authority). In this document systematic criteria are provided to fulfill the national and international regulations and to guarantee safety of workers [8]. An accurate analysis of regulatory requirements and standards for good practice applicable to the field has been carried out in the paper "Review of operational indications on the design of facilities for radiopharmaceutical manufacturing in Italy" [9].

3. Results and Discussion

To facilitate the systematic application of the proposed criteria, this article presents specific self-assessment checklists for PET imaging centers and cyclotron facilities in Italy, consisting in lists of different sequential items, as a model that can be easily consulted and used by the facilities during internal audits.

These checklists are also used as a control tool for authorization purposes by INAIL when carrying out its authorization activity as a technical advisory body of the Italian Ministry of Health.

The approach used in the elaboration of the forms includes a list of key points and four levels of priority for every single point:

- M means "mandatory" according to Italian regulatory authorities;
- A stands for "advised/suggested" according to a panel of national experts in the field;
- R stands for "recommended" according to a panel of national experts in the field;
- E means "to be evaluated", if necessary, on the basis of the specific organization of the activities and the considerations of the radiation protection expert.

The checklists represent a useful toolkit to proceed, through a guided "audit" style, in the comparison between the design criteria of PET centers and cyclotron facilities and the "expected" ones, suggested from the technical documents mentioned above.

The final goal is on one hand stimulating quality assurance and control in the healthcare sector and on the other hand improving the adopted radiation protection strategy, in accordance with the ALARA principle.

Table 1 Checklist for pet imaging center.

M = MANDATORY A = ADVISED R = RECOMMENDED E = EVALUATE THE NECESSITY ON THE BASIS OF THE SPECIFIC ORGANIZATION OF THE ACTIVITIES AND THE CONSIDERATIONS OF THE RADIATION PROTECTION EXPERT			
Minimum Requirement of Premises			
Cold Area **Areas and premises not susceptible to contamination**			
M	"Cold" waiting room	YES	NO
M	"Cold" toilet also for disabled people	YES	NO
M	"Cold" changing rooms for staff adjacent to the filter area (separation of woman/man or, alternatively, procedures and systems to guarantee privacy; equipped with lockers)	YES	NO
Filter Area (Personnel Airlock) **Area that must be provided before accessing (or leaving) areas with contamination risk**			
M	Area equipped for decontamination operations	YES	NO
Hot Area **Areas and premises where there are risks of external exposure and contamination**			
M	Room for administration of radiopharmaceuticals	YES	NO
M	"Hot" waiting room	YES	NO
M	Imaging room, with changing room or area designated for this purpose	YES	NO
M	Control room or shielded area inside the imaging room with view glass	YES	NO
M	"Hot toilets" with entrance, if possible, from the "hot" waiting room	YES	NO
M	Toilets for personnel only, separate from those for patients	YES	NO
E	Temporary storage area for radioactive waste (solid waste)	YES	NO
M	Temporary storage area for radioactive waste (decay tanks and dedicated measuring system)	YES	NO
R	Janitorial room (including decontamination supplies)	YES	NO
E	Radiopharmacy laboratory, with access through a filter area	YES	NO
E	Quality Control laboratory	YES	NO
E	Technical room (heat exchanger, electronics, etc.)	YES	NO
Organization of the Premises			
M	"Cold" areas separated from "hot" areas	YES	NO
M	Hot areas delimited by fixed physical barriers, appropriately signaled and with access regulations	YES	NO
Routes For Personnel/Patients/Radioactive Material			
Patient Routes			
M	Regulated and controlled entrance	YES	NO

A	Dedicated exit, separated from entrance	YES	NO
A	Exit path minimizing intersection with "cold" areas	YES	NO
	Personnel Routes		
M	Regulated and controlled entrance	YES	NO
M	Entrance and exit through a filter area (personnel airlock)	YES	NO
	Handling of Radioactive Material		
A	Dedicated entrance/exit, with a minimum path from the radiopharmacy laboratory or from a possible lift	YES	NO
A	Room for administration of radiopharmaceuticals close to the radiopharmacy laboratory or to the room where the fractionation system is located	YES	NO
A	Presence of an airlock for the passage of radiopharmaceuticals from the hot cell to the administration room	YES	NO
	Handling of Radioactive Waste		
A	Identification of short routes in low attendance areas and times in order to minimize exposure of workers and population (coding of procedure)	YES	NO

Characteristics and Requirements of Premises and Systems

	Walls and Surfaces		
A	Floors of working areas made of smooth material, without interstices, roughness or imperfections that can trap radioactive contamination, resistant to corrosion by chemical agents, waterproof and, as far as possible, without interruption	YES	NO
A	Coding of a procedure for periodic evaluation of the state of conservation of these coatings and of the need for renovation	YES	NO
A	Surfaces of walls can be easily decontaminated and, as far as possible, without interruption	YES	NO
M	The joint of the floor with the walls is rounded, with a rise on the walls of about 20 cm	YES	NO
A	Work surfaces, where radionuclides are used or stored (benches, tables), are finished with a material which is hard, non-porous, waterproof, washable and resistant to heat, stains and chemicals and have raised edges	YES	NO
	Safety and Control Systems		
M	"COLD" CHANGING ROOM:		
	Hand – foot – clothes contamination monitor	YES	NO
	Sink with controlled drain	YES	NO
	Shower with controlled drain for a possible decontamination	YES	NO
	Container for contaminated clothes	YES	NO
M	Presence of a surface contamination monitor in the center	YES	NO
R	"FILTERING" AREA TO THE RADIOPHARMACY: Interlock system of the doors, provided with a mushroom switch for emergency opening	YES	NO
	RADIOPHARMACY:		
R	Doors with viewing panel	YES	NO
R	At least 3 m^2 of free surface available per person	YES	NO
M	Presence of a material airlock for the passage of radiopharmaceuticals from the radiopharmacy to the Quality Control laboratory	YES	NO
M	Presence of a material airlock for the passage of radiopharmaceuticals to the administration room *alternatively* coding of a procedure regulating the transport of radiopharmaceuticals by operators through short routes	YES	NO
	"HOT" WAITING ROOM:		
R	Supply/presence of mobile shields	YES	NO
	Ventilation		
M	The air flow must be directed from areas with lower potential contamination to areas with higher potential contamination, keeping the latter with negative pressure compared to the former.	YES	NO

	Compliance with GMP regulations must be ensured, for example by placing a filter area (at a negative pressure) between the Radiopharmacy laboratory and external areas [10]		
M	Number of air changes in the premises according to recent and specific international technical standards [5-7]	**YES**	**NO**
M	Adequate filtering systems for the air introduced into the premises	**YES**	**NO**
M	The air is expelled through high efficiency filters appropriate to the nature and quantity of the effluent [11]	**YES**	**NO**
M	Coding of a procedure for periodic replacement of filters	**YES**	**NO**
A	Dedicated and independent extraction system for the air of the premises composed of prefilters, charcoal filters (for specific radioisotopes) and/or absolute filters (possibly ULPA filters)	**YES**	**NO**
A	Filter container made of sealed steel and suitable for external maintenance in protected conditions	**YES**	**NO**
	RADIOPHARMACY:		
M	Access to the radiopharmaceutical preparation area through a filter area (personnel airlock) with interlocked doors, set in depression with respect to both the radiopharmacy and the external areas	**YES**	**NO**
M	Conditions of overpressure in the radiopharmaceutical preparation area	**YES**	**NO**
M	In case of radiopharmaceutical preparation, presence of a class A laminar flow hood in a class B room, or an isolator that guarantees a sterile environment in a grade D zone, according to the Italian Standards of Good Manufacturing of radiopharmaceuticals in nuclear medicine [12]	**YES**	**NO**
M	Material airlocks equipped with a ventilation system suitable to guarantee a classification of the environment of the same degree of the area dedicated to the preparation of radiopharmaceuticals	**YES**	**NO**
M	Material airlock with interlocked doors	**YES**	**NO**

Table 2 Checklist for cyclotron unit.

M = MANDATORY
A = ADVISED
R = RECOMMENDED
E = EVALUATE THE NECESSITY ON THE BASIS OF THE SPECIFIC ORGANIZATION OF THE ACTIVITIES AND THE CONSIDERATIONS OF THE RADIATION PROTECTION EXPERT

Routes for Personnel/Radioactive Material

Personnel Routes			
M	Regulated and controlled access	**YES**	**NO**
M	Entrance and exit through a filter area (personnel airlock)	**YES**	**NO**
Handling of Radioactive Material			
A	Dedicated entrance/exit, with the minimal route from the radiopharmacy	**YES**	**NO**
M	Automated target-positioning system *alternatively* coding of specific procedure for positioning the solid target	**YES**	**NO**
M	Presence of shielded underground transfer lines for radionuclides from the cyclotron to the synthesis modules *alternatively* coding of specific procedure for manual transport of solid targets	**YES**	**NO**
E	Possible lift for the transport of radionuclides produced by the cyclotron in solid form towards the radiopharmacy	**YES**	**NO**
Handling of Radioactive Waste			
A	Identification of short routes in low attendance areas and times in order to minimize exposure of workers and population (coding of procedure)	**YES**	**NO**

Minimum Requirement of Premises

Cold Area **Areas and premises not susceptible to contamination**			
M	"Cold" changing rooms for staff adjacent to the filter area (woman/man separation or, alternatively, procedures and systems to guarantee privacy; equipped with lockers)	**YES**	**NO**
Filtering Area (Personnel Airlock) **Area that must be provided before accessing (or leaving) areas with contamination risk**			

M	"Hot" changing rooms for staff (equipped with lockers for work clothes and containers for the collection of contaminated clothing) (woman/man separation or, alternatively, procedures and systems to guarantee privacy)	**YES**	**NO**
M	Area equipped for decontamination operations	**YES**	**NO**
	Hot Area **Areas and premises where there are risks of external exposure and contamination**		
M	Cyclotron vault	**YES**	**NO**
M	Control room for the cyclotron	**YES**	**NO**
M	Technical room for the cyclotron (heat exchanger, electronics, etc.)	**YES**	**NO**
M	Dedicated toilets	**YES**	**NO**
M	Temporary storage area for radioactive waste (solid waste)	**YES**	**NO**
E	Temporary storage area for radioactive waste (decay tanks and dedicated measuring system)	**YES**	**NO**
M	Janitorial room (including decontamination supplies)	**YES**	**NO**
E	Radiopharmacy laboratory, with access through a filter area (personnel airlock)	**YES**	**NO**
E	Quality Control laboratory	**YES**	**NO**
E	Packing room for all finished products prepared for shipping	**YES**	**NO**
E	Room where the products can be stored for subsequent use within the facility or for commercial release	**YES**	**NO**
E	Shipping room with regulated access for external operators	**YES**	**NO**

Characteristics and Requirements of Premises and Systems

	Walls and Surfaces		
M	Floors of working areas made of smooth material, without interstices, roughness or imperfections that can trap radioactive contamination, resistant to corrosion by chemical agents, waterproof and, as far as possible, without interruption	**YES**	**NO**
A	Coding of a procedure for periodic evaluation of the state of conservation of these coatings and of the need for renovation	**YES**	**NO**
M	Surfaces of walls can be easily decontaminated and, as far as possible, without interruption	**YES**	**NO**
M	The joint of the floor with the walls is rounded, with a rise on the walls of about 20 cm	**YES**	**NO**
M	Work surfaces, where radionuclides are used or stored (benches, tables), are finished with a material which is hard, non-porous, waterproof, washable and resistant to heat, stains and chemicals and have raised edges	**YES**	**NO**
M	The floor of the cyclotron vault is designed to withstand high loads	**YES**	**NO**
A	Floor equipped with drains for water, possibly connected to a collection system to control activity concentration before release into the sewer	**YES**	**NO**
A	Ducts that cross the wall to the passage of cables or pipes are angled or S-shaped and positioned in the lower part of the walls	**YES**	**NO**
A	Pipes of the transmission lines of radionuclides are made of plastic and inserted inside ducts large enough to allow easy replacement	**YES**	**NO**
A	Coding of a procedure for periodic evaluation/replacement of pipes of the transmission lines	**YES**	**NO**
	Safety and Control Systems		
	"COLD" CHANGING ROOM:		
M	Lockers for personal clothes	**YES**	**NO**
	"FILTER" AREA WITH "HOT" CHANGING ROOM:		
M	Lockers for working clothes	**YES**	**NO**
	Hand – foot – clothes contamination monitor	**YES**	**NO**
	Sink with controlled drain	**YES**	**NO**
	Shower with controlled drain for a possible decontamination	**YES**	**NO**
	Container for contaminated clothes	**YES**	**NO**
	"FILTER" AREA:		
M	Hand – foot – clothes contamination monitor	**YES**	**NO**

A	Interlock system that prevents the simultaneous opening of the access doors, provided with a mushroom switch for emergency opening	**YES**	**NO**
	RADIOPHARMACY:		
R	Doors with viewing panel	**YES**	**NO**
R	At least 3 m^2 of free surface available per person	**YES**	**NO**
A	Administration room positioned near the radiopharmacy for the passage of radiopharmaceuticals through material airlock *alternatively* provision of a lift *alternatively* coding of a procedure regulating the transport of radiopharmaceuticals by operators through short routes	**YES**	**NO**
E	Supply/presence of mobile shielding	**YES**	**NO**
	CYCLOTRON VAULT:		
M	Access to the vault via an angled maze with multiple turns or through a shielding door	**YES**	**NO**
R	Floor functioning effectively as a basin with drain channels directed to a containment system	**YES**	**NO**
E	Detection systems for the presence of people inside the cyclotron vault	**YES**	**NO**
A	Audio/video communication system between the cyclotron vault and the control room	**YES**	**NO**
A	Sequence of power cut-off switches according to a coded procedure of timed patrol	**YES**	**NO**
M	Control system allowing the cyclotron to start only after verification of all safety conditions	**YES**	**NO**
M	Indicator light at the vault access door indicating the cyclotron's operating status	**YES**	**NO**
M	Environmental radiation monitoring systems inside the cyclotron vault, the technical rooms, and the packaging room, equipped with an alarm system	**YES**	**NO**
M	Safety systems preventing access to the cyclotron vault during the operational phase and, subsequently, until the level of exposure are below appropriate safety constraints	**YES**	**NO**
M	Audible and visual signals indicating the cyclotron's operating status (different phases of the process) and door closure	**YES**	**NO**
A	Audible and visual signals indicating: • that the timed patrol inside the cyclotron vault has been completed • that the cyclotron is ready for operation (usually an intermittent signal) • the closure of the doors of the vault • that the cyclotron is in operation (usually this is a continuous low intensity signal that remains active throughout the operation) • exceeding of the pre-alarm and alarm dose rate thresholds set for the cyclotron vault • exceeding of the pre-alarm and alarm thresholds in the air extracted from the cyclotron vault • evacuation in the event of an emergency • other possible risk situations detectable by means of suitable sensors (flooding, release of cryogens, gas, etc.)	**YES**	**NO**
M	Emergency buttons both inside and outside the cyclotron vault (inside it is advisable to position them also near the floor): their actuation inhibits the door closure or, if it were already closed, to reopen and stop the operations	**YES**	**NO**
M	Photoelectric cells positioned inside the cyclotron vault which, if intercepted, stop the closure of the door	**YES**	**NO**
A	Double safety wire to stop the closure system when pressed or severed	**YES**	**NO**
M	Manual emergency opening system, which can be activated in the event of an electrical blackout	**YES**	**NO**
A	In case of radioactive release, the monitoring system of emissions through the exhaust pipes: closes the exhaust air ducts from the premises closes the air delivery ducts in the premises activates an alarm signal allows the release of the air of the premises only after the time necessary for the decay below the constraints of radioactivity concentration	**YES**	**NO**
R	Audible and visual alarms indicating possible risk situations	**YES**	**NO**
M	Coding of control procedures of all security systems	**YES**	**NO**

Ventilation			
M	The air flow must be directed from areas with lower potential contamination to areas with higher potential contamination, keeping the latter with negative pressure compared to the former. Compliance with the GMP regulations must be ensured, for example by placing a filter area (at a negative pressure) between the Radiopharmacy laboratory and external areas. [10]	YES	NO
M	Adequate filtering systems for the air introduced into the premises	YES	NO
M	The air is expelled through high efficiency filters appropriate to the nature and quantity of the effluent [11]	YES	NO
M	Coding of a procedure for periodic replacement of filters	YES	NO
M	Number of air changes in the premises according to the Italian technical standard UNI 10491 [13] or to recent and specific international technical standards [5, 6, 7]	YES	NO
A	Dedicated and independent extraction system for the air of the premises composed of prefilters, charcoal filters (for specific radioisotopes) and absolute filters (possibly ULPA filters)	YES	NO
A	Filter container made of sealed steel and suitable for external maintenance in protected conditions	YES	NO
	RADIOPHARMACY:		
M	Access to the radiopharmaceutical preparation area through a filter area (personnel airlock) with interlocked doors, set in depression with respect to both the radiopharmacy and the external areas	YES	NO
M	Conditions of overpressure in the radiopharmaceutical preparation area	YES	NO
M	In case of radiopharmaceutical preparation, presence of a class A laminar flow hood in a class B room, or an isolator that guarantees a sterile environmentin a grade D zone, according to the Italian Standards of Good Manufacturing of radiopharmaceuticals in nuclear medicine [12]	YES	NO
M	Material airlocks equipped with a ventilation system suitable to guarantee a classification of the environment of the same degree of the area dedicated to the preparation of radiopharmaceuticals	YES	NO
M	Material airlock with interlocked doors	YES	NO
	CYCLOTRON VAULT:		
M	Ventilation system activated immediately after shutdown and connected to a detection system to control accidental releases into the environment	YES	NO
M	Monitoring system of gaseous effluents in the stack, before filtration	YES	NO
M	Number of air changes suited to the use and the safety systems implemented	YES	NO
M	Air flow designed so that the cyclotron vault has the lowest pressure in the building (refer to the Italian technical standard UNI 10491 [13] or to recent and specific international technical standards [5-7])	YES	NO
A	Damper delivery and exhaust air ducts, connected to a radiation monitoring system so that the shutters are closed and the expulsion fan is turned off in case of an emergency	YES	NO
M	Systems for environmental radiation monitoring	YES	NO

Table 3 Checklist for management of solid waste intended for removal.

M = MANDATORY
A = ADVISED
R = RECOMMENDED
E = EVALUATE THE NECESSITY ON THE BASIS OF THE SPECIFIC ORGANIZATION OF THE ACTIVITIES AND THE CONSIDERATIONS OF THE RADIATION PROTECTION EXPERT

Minimum Requirement of Premises

Filtering Area (Personnel Airlock) Area that must be provided before accessing the temporary waste storage area			
E	Area equipped for decontamination operations	YES	NO
Hot Area Areas and premises where there are risks of external exposure and contamination			
M	Temporary storage area of adequate size for the volume and half-life of the waste produced	YES	NO

Organization of the Unit

M	The temporary storage area is within a confined perimeter area, with regulated access and the entrance door is equipped with a lock	YES	NO
M	Availability and periodic verification of a solid radioactive waste management procedure providing traceability of each container produced	YES	NO

Routes for Personnel/Radioactive Material

	Personnel Routes		
M	Regulated access to the waste storage area	**YES**	**NO**
	Handling of Radioactive Waste		
M	Presence of radiation monitors of adequate sensitivity	**YES**	**NO**

Characteristics and Requirements of Premises and Systems

Walls and Surfaces			
M	Floors and walls can be easily washed and decontaminated	**YES**	**NO**
A	Counter slope floor capable of conveying the results of any flooding to a drain, and/or the presence of a physical barrier of about 10 cm at the entrance	**YES**	**NO**
A	Absence of rain pipes inside the waste storage area	**YES**	**NO**
A	Waste storage area easily accessible and inspectable	**YES**	**NO**
R	Presence of shelves made of material that can be easily washed and decontaminated	**YES**	**NO**
Safety and Control Systems			
A	Presence of a sink	**YES**	**NO**
Ventilation			
M	Coding of a procedure for periodic replacement of filters	**YES**	**NO**
M	Dedicated and independent extraction system for the air of the premises with a system of charcoal filters (for specific radioisotopes) and/or absolute filters (possibly ULPA filters)	**YES**	**NO**

Table 4 Checklist for management of liquid effluents.

M = MANDATORY
A = ADVISED
R = RECOMMENDED
E = EVALUATE THE NECESSITY ON THE BASIS OF THE SPECIFIC ORGANIZATION OF THE ACTIVITIES AND THE CONSIDERATIONS OF THE RADIATION PROTECTION EXPERT

Minimum Requirement of Premises

FILTER AREA (PERSONNEL AIRLOCK) **Area that must be provided before accessing the areas with risk of contamination**			
M	Technical room equipped with radiation monitoring system with automatic sampling (alternatively, possibility of sampling to carry out an off-line measurement)	**YES**	**NO**
A	Area equipped for decontamination operations	**YES**	**NO**
HOT AREA **Areas and premises where there are risks of external exposure and contamination**			
M	Room hosting the delay tanks within a confined perimeter area, with regulated access and with entrance door equipped with a lock	**YES**	**NO**
M	Imhoff tanks and delay tanks in adequate number and volume	**YES**	**NO**

Routes for Personnel/Radioactive Material

	Personnel Routes		
M	Regulated access	**YES**	**NO**
	Handling of Radioactive Effluents		
M	Control system of the filling level of the delay tanks and automatic management of operation	**YES**	**NO**

Characteristics and Requirements of Premises and Systems

Walls and Surfaces			
M	Room hosting the tanks for liquid effluents: sealed floor with retaining wall	**YES**	**NO**
A	Room hosting the tanks for liquid effluents: raised grid on the surface of the containment basin for inspection and maintenance of the system	**YES**	**NO**
Ventilation			
A	Dedicated and independent extraction system for the air of the premises with a system of charcoal filters (for specific radioisotopes) and/or absolute filters (possibly ULPA filters)	**YES**	**NO**

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