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RADIOPROTECTION CONSIDERATIONS ON THE EXPANSION PROJECT OF AN INTERIM STORAGE FACILITY FOR RADIOACTIVE WASTE

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ABSTRACT

The Radioactive Waste Management (GRR) of the Nuclear and Energy Research Institute (IPEN–CNEN/SP) receives, treats, packs, characterizes and stores institutional radioactive wastes generated at IPEN-CNEN/SP and also those received from several radiological facilities in the country. The current storage areas have been used to store the treated radioactive waste since the early 1980's and their occupation is close to their full capacity, so a storage area expansion is needed. The expansion project includes the rebuilding of two sheds and the enlargement of the third one in the area currently occupied by the GRR and in a small adjacent area. The civil works will be in controlled area, where the waste management operations will be maintained, so all the steps of this project should be planned and optimized, from the radioprotection point of view. The civil construction will be made in steps. During the project implementation there will be transfer operations of radioactive waste packages to the rebuilt area. After these transfer operations, the civil works will proceed in the vacant areas. This project implies on radiological monitoring, dose control of the involved workers, decontamination and clearance of areas and it is also envisaged the need for repacking of some radioactive waste. The objective this paper is to describe the radioprotection study developed to this expansion project, taking into account the national radioprotection and civil construction regulations.

1. INTRODUCTION

The Radioactive Waste Management (GRR) of the Nuclear and Energy Research Institute (IPEN–CNEN/SP) is an interim radioactive waste storage that receives, treats, packs, characterizes and stores institutional radioactive wastes generated at IPEN-CNEN/SP and also the radioactive material received from several radiological facilities in the country. The treatment and conditioning of the radioactive material work towards its removal to a repository or, eventually, for a further reuse, in accordance to the national regulations [1].

Since its creation, GRR has already received and treated about one thousand cubic meters of solid waste and eight thousand spent sealed radioactive sources from practices in industry, medicine and research, totaling more than 100 TBq. There are also fifteen thousand radioactive lightning rods and twenty two thousand radioactive smoke detectors stored. The

current storage areas have been used to store the treated radioactive waste since the early 1980's and their occupation is close to their full capacity, so a storage area expansion is needed. The expansion project includes the rebuilding of two sheds and the enlargement of the third one in the area currently occupied by the GRR and in a small adjacent area. The specific feature of this civil engineering project is its location in the vicinity of the interim storage facility, within the controlled area. The setting up of such construction site in this area requires a particular attention in radiological safety field. The civil works will be in controlled area, where the waste management operations will be maintained, so all the steps of this project should be planned and optimized, from the radioprotection point of view. After a brief description of the project, of its environment and radiological safety provisions, this report details the peculiarities of the site and the safety measures that will be put in place.

2. THE FACILITY

The GRR is composed of five main buildings in a fenced area, shown in Fig. 1.

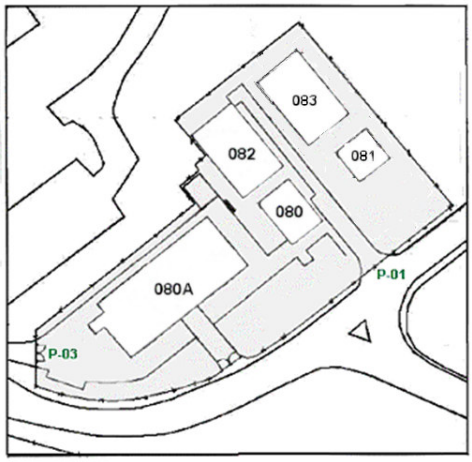

Figure 1. Sketch of the GRR fenced area with the main buildings.

The facility areas where there is no risk of exposure to radiation above the limit for the members of the public are classified as free areas and there are no access restrictions from the point of view of radioprotection. Unlike the free areas, the controlled areas have restricted access, because they present radiation hazards that have to be controlled by protection and safety measures described in the radioprotection plan of the facility. On the other hand, in supervised areas the occupational exposure conditions are kept under supervision, but specific measures of protection and safety usually are not necessary.

The GRR free areas are the external access ramp to the 080A building and the upper floor of that building. The other GRR workplaces present radiation hazards and they are classified as controlled or supervised areas, depending on the degree of risk they offer. That classification

is made taking into account the requirements of the basic radioprotection guidelines [2] and radioprotection services regulations [3].

The 080, 082 and 083 buildings are controlled areas, where there is risk of receiving radiation doses above the limit for members of the public, which are used for the storage of solid radioactive waste. The fenced area of GRR and the 081 building are classified as supervised areas because of the irradiation of adjacent buildings.

The access to the IPEN-CNEN/SP surveilled area is done with the use of two gates permanently controlled by guards. Entry is permitted to workers and staff upon presentation of their identification badges. The visitors are only allowed to enter the surveilled area after identification and approval by a staff member. The fenced area, shown in Figure 1, is the protected area of the GRR. The movement of radiation sources is only allowed through the gates P-01 and P-03, with overseeing of the GRR operators and the radioprotection service. The access of persons is done exclusively by the upper floor of the 080A building, excepted by vehicle drivers that access the protected area through the gates P-01 and P-03.

The access of workers or visitors to supervised and/or controlled areas follows specific procedures and has to be authorized by the manager of the facility and controlled by the radioprotection service. The entry and exit of persons from restricted areas in the ground floor are made through changing rooms, with locks released by the badges of the workers, located on the top floor of the 080A building. The rooms have suitable sites for decontamination of persons, if necessary. After the changing rooms there is a lobby with radiation monitors to verify radioactive contamination on persons and objects, as well as if there is any radioactive source being taken out of the facility.

Each laboratory in the ground floor of the 080A building has a door that remains locked when it is not in use. Under normal conditions the keys are in charge of the GRR operators but, in intervention situations, the respective keys of the affected sites are responsibility of the radioprotection service.

Access of visitors to restricted areas is preceded by identification and provision of individual dosimeters and the records are made in a book in the facility. The necessary individual protective equipments are also provided. It is not allowed to visitors perform tasks in the supervised and/or controlled areas other than knowing the facility and processes. During the visit to these areas, the visitors are always be accompanied by a GRR operator or a member of the radioprotection service.

By procedure and by a safety culture it is not allowed persons to entry or exit through the gates P-01 or P-03 because it increases the probability of exposure of persons and the potential dispersion of radioactive contamination by undue access to the facility.

3. THE EXPANSION PROJECT

The expansion project will be divided into three distinct phases. The first phase is the demolition of the 081 shed and the building of a new shed occupying its area and an adjacent area as shown in Fig. 2. The second phase involves the transfer of radioactive waste from the 083 building to the new shed and a comprehensive reform of the 083 building, unifying the

two buildings. The third stage includes the transfer of radioactive waste from the 080 and 081 buildings to the 083 building and their reforms.

The design, construction, installation, licensing, operation and inspection of interim radioactive waste storages and repositories are responsibilities of the Nuclear Regulatory Authority [4]. The new sheds of GRR will comply with the radioactive waste management requirements, such as impermeable wall and floor, ventilation, exhaustion and filtering systems, tanks and floor drains to collect liquids from leaks and decontaminations, and rely on means to prevent the spread of radioactive materials by animals [5].

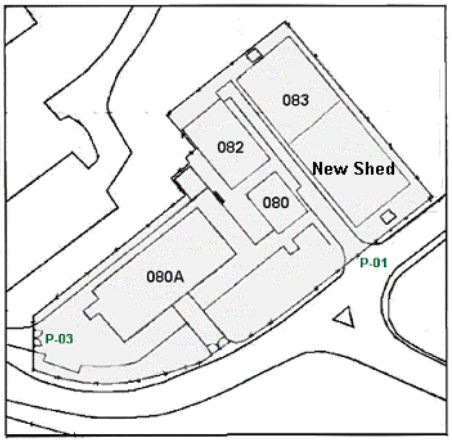

Figure 2. Sketch of the GRR fenced area after the expansion project.

4. RADIOPROTECTION PLANNING

The radioactive material basically offers two different types of risk to individuals occupationally exposed to ionizing radiation (IOE), the irradiation and radioactive contamination. Even if there is not physical contact with the radioactive material, the radiation emitted by the material reaches the IOE, resulting in radiation doses by external exposure. In case of radioactive contamination, the IOE has physical contact with radioactive material and part of this material is deposited on his hair, skin or clothing, or it may be taken into the body, resulting in radiation doses by external and internal exposure.

To avoid contamination, it is necessary to avoid physical contact with the radioactive material. In order to achieve this, the radioprotection planning provides the removal of any radioactive material from the construction site, such as radioactive sources or waste or radioactive contamination in the area, before releasing the site to work. As the regulations of civil construction already requires 2.20 m height fence around the construction site to avoid undue access to the workplace [6], this physical barrier will prevent access to the local of radioactive materials storage from the construction site. This isolation measure between those areas results that it will not be needed the control to prevent radioactive contamination or radioactive material dispersion at the construction site during the work.

Those measures will also prevent the previous monitoring for contamination of materials or persons that access only the construction site, which allows having an access point in that site directly, independent of the access through the changing room. Access to other areas of the GRR will continue to follow the routine procedures, so it will keep the radioactive contamination control.

With regard to external exposure, the construction site of the first building already has radiation dose rates that would result in doses above the limit for members of the public, however, below the limit for IOE therefore the construction site will be classified as a controlled area, with restricted access to trained and authorized persons. These dose rates have their origin in the radioactive waste stored in other buildings of the facility. The removal of such waste to another location is unfeasible because there is not place to store such volume of material and it would result in larger doses in the IOE responsible for this removal.

The working plan requires that the placement of fencing should be made as far as possible from the other buildings, so the workers of the construction site would remain far from the radiation sources, minimizing their exposures.

A program for the monitoring of the workplace will be implemented so the periodic radiometric survey will determine any necessary time control to comply the dose limits. The radioprotection plan contemplates individual monitoring using thermoluminescent dosimeters with monthly replacement to all IOE who have routinely access to the construction site. This measure aims to ensure that the protection and safety measures are being effective and to protect the institution from any labor issue. Additionally, when a task to be performed anticipates a daily accumulated dose larger than 0.1 mSv, or when there are possibilities of significant dose rate changes during operation, an alert dosimeter will be supplied to the IOE.

The civil works will be performed by a third-party company and overseen by the institute staff, thus there will be IOE linked directly to the licensee and others connected to employers. The licensee, when decides to outsource services that involve or may involve exposure to a radiation source under his responsibility, has to ensure that the employers are aware of their responsibilities in relation to the IOE, and that the facility meets the regulatory requirements for radiological protection [2], so all information about protection and safety that the employers require will be provide before, during and after the hiring of such services.

On the other hand, the IOE should follow the radioprotection rules and procedures specified by employers and licensee, including participation in training on safety and radioprotection that allows conducting their work in safe. They should also provide to the licensee or employer information about their past and current work, including dose history, or if they had been or are being subjected to medical treatment or diagnosis that uses ionizing radiation. Moreover, the IOE should refrain from any actions that can put them or third parties at risk. [2].

The licensee and the employers are responsible for protecting their employees in activities involving occupational exposures and it will be ensured that IOE or individuals eventually exposed to radiation, which origin is not directly related to their work, will be treated as members of the public and receive the same level of protection [2].

In Brazil, the civil construction is ruled by technical regulations of the Ministry of Labor and Employment and several technical standards. These regulations provide standards and requirements that building companies should comply. These requirements set the minimum parameters that should exist in a construction site, covering from locker rooms, canteen, resting areas, and including the organization, cleanness, sanitary conditions and comfort in these locations, up to the safety measures in the work environment [6, 7].

These regulations provide that companies that contract third-parties for services in their facilities should extend to the hired employees the same hygiene and comfort conditions offered to their own employees [7], so there will be a lounge area, with resting places, bathrooms and pantry that will be located in another area away from the restrict areas of the facility.

It is also established in those regulations that all workers in civil construction shall receive admittance and regular training to ensure the execution of their activities in safe conditions [6]. The admittance training shall has a minimum duration of six hours to be carried out within the work time and before the workers start their activities, consisting of information about the work conditions, its environment and the collective protective equipment, inherent risks of their function and appropriate use of individual protective equipments. The regular training should be given whenever it becomes necessary and in the beginning of each work phase [6]. During the training, the workers should receive copies of the safety procedures to perform the activities.

The IOE will be trained in radioprotection to recognize the risks that they may be exposed and how to avoid them. This training includes not only the knowledge about radiation and its effects, but also the radioprotection procedures applied in the facility, including the emergency conduct. Therefore, this training will be coordinated by the GRR radioprotection officer. The radioprotection planning requires previous training to each IOE that will routinely access the construction site.

The effectiveness of the radioprotection signing depends on the knowledge level of the intended public. The IOE should know and understand the information provided by the signing and comply with its determinations. The construction site will have elaborate radioprotection signs, in order to reach the construction workers who are not accustomed to work in radiological areas.

The licensee and employers shall implement an occupational health program, for initial and periodic assessment of the IOE fitness, based on the general principles of occupational health, with reference to the Program of Medical Control of Occupational Health required by the Ministry of Labor and Employment [2]. This program shall include the mandatory medical examinations in admittance, regular during the work, return to work, change of function and dismissal. In the case of IOE, these exams should be half-yearly and include clinical, physical and mental assessment and additional hemogram and platelet count [8].

The IOE work permit in restricted areas is given only after their inclusion in the occupational health and individual monitoring programs; the radioprotection and operation trainings. If the worker does not meet these requirements, the access to supervised or controlled areas will be given as visitor, and he is not authorized to perform tasks in those areas. Although international recommendations allow occupational exposures during the training of people

over 16 years [9], the national regulation does not allow occupational exposures in people younger than 18 years, however, it admits that people over 16 years old access controlled or supervised areas as visitors [2], therefore such people may visit the construction site, but they will not be allowed to perform any occupational activity during the visit.

The degree of required access control is proportional to the radiological hazards. In each access of working areas signing is provided indicating their radiological classification. Signs, devices and administrative controls are used in order to ensure the access control in restricted areas. The administrative control requires the written work permit to perform tasks in supervised or controlled areas.

5. FIRST PHASE OF THE EXPANSION PROJECT

In the first phase of the expansion, the 081 shed was demolished and the debris generated was monitored and released. Part of the fence surrounding the construction site was removed to allow earthworks for leveling of the site. In this step it was required the strengthen of the local security surveillance. Then new fences were placed to enclose the construction site, indicated in yellow in Fig. 3. The work is in the stage of excavation and implementation of the new shed foundation.

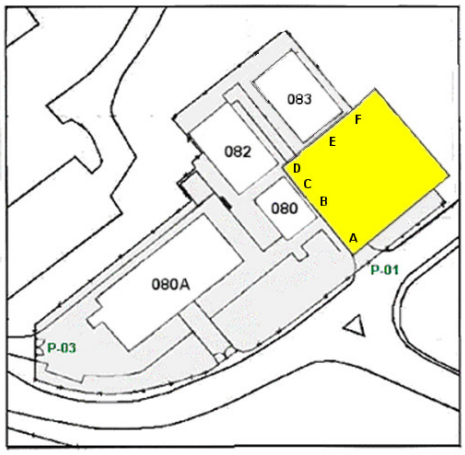

Figure 3. Sketch of the construction site in the first phase of the expansion project.

The program for the monitoring of the workplace has already been implemented and some results are shown in Table 1. The monitoring points are indicated in the Fig. 3. Since there was no significant movement of radioactive waste in the buildings near the construction site, there was no change in the measured dose rates.

Initially fourteen outsourced workers for civil works were trained, but in the first month three of them had already left their employment. It indicates that there will be a high turnover of workers, what is common in civil construction [10]. Besides the need of training for the new

workers and the delay in the construction, this turnover results in a higher cost on the individual monitoring program, as the dosimetric records must be kept until the IOE reach the age of 75 years and, at least, 30 years after the end of their occupation, even if they pass away [2].

Table 1. Gamma dose rate in the construction site.

Point	Dose Rate (μSv/h)	
	July/09	August/09
A	1.9	2.0
B	98.0	97.0
C	12.0	13.0
D	9.5	9.5
E	40.0	42.0
F	16.0	10.0

BG = 0.2 μSv/h

Radiation protection inspections are periodically conducted at the construction site and there were indications that certain instructions given in the training, such as not consuming food and beverages and no smoking in controlled area, were not obeyed. The contractor was informed about the presence of cigarette packs, disposable cups and leftover food at the construction site and all workers on the site were instructed again to follow the safety requirements and pay attention to the additional safety signing that was provided.

Meetings between the GRR operators, members of the IPEN-CNEN/SP engineering department, the head of the construction company and radioprotection supervisors are held weekly. In these meetings details of the civil works and radiation safety points that have arisen in the period are discussed and implemented. One example is that, despite the construction regulations requires that the construction site should be fenced, it was necessary that the radioprotection service asked the timely implementation of this requirement or the fence would be implemented later, since the priorities of the contractor are different from the radiation safety.

6. CONCLUSIONS

The expansion project of the GRR interim storage facility for radioactive waste is essential for the management of radioactive waste in the country. The project will be implemented according to civil construction and nuclear regulations to ensure the protection and safety of workers and members of the public.

The radioprotection planning of a civil work in supervised or controlled area should be done with proper anticipation, because there are several points to be considered and that require prior actions. This planning should be flexible to cover the possible design adjustments required during the construction, however, without undermining the safety.

In general, the civil construction workers are not familiar with the radioprotection concepts and controls, then, a solid training is essential to reduce anxiety, transmit the needed safety feeling and the radioprotection requirements be known and complied.

Elaborate radioprotection signing in the construction site is a tool to warn the workers about the existence of radiological risks, it reinforces the knowledge acquired during the training and it also refrains the workers from doing any actions that can put them or third parties at risk in the workplace.

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