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Decommissioning of Uranium Pilot Plants at IPEN-CNEN/SP: Facilities Dismantling, Decontamination and Reuse as New Laboratories for Strategic Programs

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Abstract: From beginning of 90's, the Brazilian nuclear policy has been changed radically. This determined the interruption of most R&D fuel cycle activities and the facilities shutdown at Nuclear and Energetic Research Institute (IPEN). The existence of those facilities also implicated in the need of constant surveillance, representing additional obligations, costs and problems. The reasons to promote the dismantling of the IPEN's Nuclear Fuel Cycle Pilot Plants elapsed mainly from the need of physical space for new activities, since the R&D in the nuclear fuel cycle area were interrupted. In the last decade, IPEN has changed its "nuclear profile" to a "comprehensive and multidisciplinary profile". With the end of most nuclear fuel cycle activities, the former facilities were distributed in four different centers. Each center has adopted a different strategy and priority to face the D&D problem. The available resources depend on the specific program in each area's development (resources available from other sources, not only from Brazilian National Nuclear Energy Commission (CNEN). One of those new activities is the IPEN's Environmental Program. This paper describes the procedures, problems faced and results related to the reintegration of the former pilot plant areas as new laboratories of the Chemical and Environmental Technology Center—CQMA of the IPEN.

Key words: Decommissioning, dismantling, decontamination, pilot plants, reuse.

1. Introduction

Radical changes of the Brazilian nuclear policy, in the beginning of 90's, determined the interruption of most R&D fuel cycle activities and the facilities shutdown at IPEN. Those facilities already played their roles of technological development and personnel's training, with transfer of the technology for institutions entrusted of the "scale up" of the units. Most of the pilot plants had the activities interrupted until 1992-1993, due to the lack of resources for the continuity of the research. The appropriate facilities maintenance has been also harmed by the lack of resources, with evident signs of deterioration in structures and equipments. The existence of these facilities also implicates in the need of constant surveillance, representing additional obligations, costs and problems.

Since then, IPEN has faced the problem of facilities dismantling and/or decommissioning. Immediately after the nuclear R&D program interruption, the uncertainties related to an eventual retaking of the program created some political hesitation about the dismantling decision. As the retaking of the R&D Nuclear Program is now discarded, the decommissioning seems to be the obvious choice. The decommissioning strategy for the old facilities

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dedicated to the technological domain of the Nuclear Fuel Cycle follows an approach of advancing gradually in dismantling, since the resources and technical conditions are available.

2. Reasons and Priorities for Dismantling and Decommissioning

The reasons of such approach are the need of political decisions related to the destiny of the facilities, lack of financial resources and of specialized personnel in the decommissioning issue, besides the fact that decommissioning is not an institutional priority in the present. As some facilities had the activities suspended for about twelve to fifteen years, also constitute relevant problems the equipment deterioration and personnel's loss, due retirements and transfers for other activities and increasing difficulties related to the availability of operational reports, drawings and descriptive memorials.

Some factors affecting the decision and the strategy of dismantling and decommissioning should be mentioned: the IPEN is located in the Sao Paulo City, in the Campus of Sao Paulo University, in an area of nearly 500,000 square meters; the space occupied by the old facilities constitutes a very valuable area; nowadays, the surroundings are a very populated area, in opposition to the past (when the facilities were built); the localization is an important aspect determining the reuse of the space and buildings of the former fuel cycle facilities.

Besides this, the reasons to promote the dismantling of the IPEN's Nuclear Fuel Cycle Pilot Plants as soon as possible elapses of three main aspects: need of physical space for new activities and priorities as, for example, the Fuel Cells Program, since the activities of R&D in the area of the nuclear fuel cycle were interrupted, not having perspectives of retaking of the Program; need to take advantage, as soon as possible, of the researchers' knowledge, mainly from those were indeed involved with the project, assembly and operation of the different facilities, since it comes happening a gradual loss of personnel for retirements and transfers; the long period since the interruption of the activities in above mentioned facilities has been taking to an increase in the difficulty of tracking documents and reliable information, besides to evident deterioration of structures, increasing the concerns related to the risk of liberation of radioactive compounds and/or risks for their chemical toxicities.

On one hand, in the beginning of the activities, it was considered the problem of the costs related to facilities maintenance/surveillance and of the gradual loss of knowledge accumulated (because of retirement or dispersion of the personnel former involved with the different nuclear fuel cycle processes). As the activities were interrupted in most facilities, IPEN has promoted a professional recycling of the remaining personnel with emphasis in other Institution different priorities such as radioisotope production or research reactor operation and fuel production or environmental applications of the existent experience (chemical processes). On the other hand, there was the problem of dismantling costs, mainly considering that there was no experience/expertise in this field at all at IPEN. Another problem was the evaluation of the facilities status in terms of chemical and radiological contamination levels for equipment/soil/buildings, after more than ten years since the facilities shutdown. Last, but not least, it should be mentioned the problem of the exhausted capacity of radioactive waste storage in the IPEN.

An aspect considered in the beginning of the activities was the lack of experience or expertise in the dismantling and decommissioning area at all at IPEN. Besides this, it was necessary to recovery reliable data/drawings about the facilities. It was very clear that would be necessary to improve all steps involving decommissioning, such as planning, regulatory requirements, cost estimating, cost-benefit analysis, need for and extent of decontamination, selection of decontamination techniques, assessment of the waste amount from the dismantling, dismantling techniques,

staff training and so on.

In the last decade IPEN has changed its "nuclear profile" to a "comprehensive and multidisciplinary profile". During this period, IPEN has been restructured in 13 Research Centers. With the end of most nuclear fuel cycle activities, the former facilities were distributed in four different centers: Environmental and Chemical Technology Center, Fuel Cell Center, Materials Science and Engineering Center, Nuclear Fuel Center. Each center has adopted a different strategy and priority to face the D&D problem and to reintegrate the areas. The resources available depend on the specific program developed in each area (resources available from other sources, not only CNEN). In the Fig. 1, it can be observed the localization of the nuclear fuel cycle facilities in the IPEN plan.

3. Reuse of Dismantled Nuclear Facilities

Some Brazilian governmental and strategic programs are: Fuel Cells, Nanotechnology, Biomaterials, Environment and Polymers. Considering all aspects mentioned before, the old facilities, and the occupied area, constitutes a significant and useful resource, since they can be fully or partially reutilized for a variety of purposes and programs. Besides the full release of some facilities as "green areas" (priority programs), some buildings can also be used as interim storage facilities (for equipment and wastes). It should be mentioned that the decision regarding the reuse of the different facilities has been made on a case-by-case basis.

In 2000/2001, it was dismantled part of Thorium and UF_4 Production (aqueous route) Pilot Plants-Building 2/CQMA and in 2002/2003 it were dismantled the ADU Dissolution and the Uranyl Nitrate Purification Pilot Plants-Building 1/CQMA. In the Fig. 2, some pictures of the dismantling operations of the ADU Dissolution and Uranyl Nitrate Purification Pilot Plants are presented. The previous dismantling activities were described in [1-5].

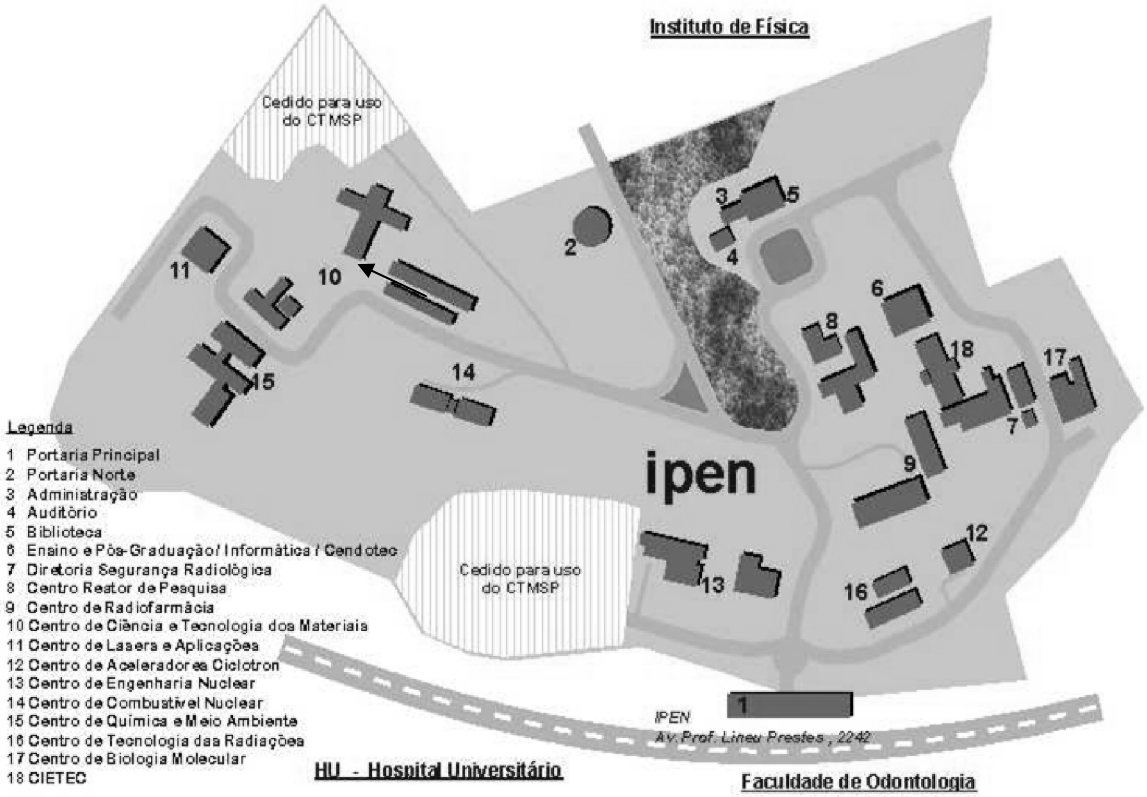

Fig. 1 Localization of the IPEN's fuel cycle facilities (left) and the ADU dissolution and uranyl nitrate purification building (arrow).

Fig. 2 Some pictures of dismantling operations of the ADU dissolution and uranyl nitrate purification pilot plants.

Fig. 3 Some pictures of facility decontamination.

The ADU Dissolution and Uranyl Nitrate Purification Pilot Plants have been reintegrated as the new laboratories of the IPEN's Environmental IPEN's program. The Thorium Pilot Plant and the UF_4 Production Pilot Plant (Aqueous Route) have been reintegrated as the new laboratories of the Polymers Program. In the Fig. 3, some pictures of floor and walls decontamination in the facility's building are showed.

4. Radioactive Wastes in the Operations

The main practical difficulty associated to the task of the dismantling and decommissioning of the old Nuclear Fuel Cycle facilities of the IPEN was the large amount of radioactive waste generated in the dismantling operations. The waste was mainly in the form of contaminated carbon steel structures. In the IPEN, the presence of contamination in the equipments, structures and buildings, although restricted to low and average activity levels, constituted an important concern due, on one hand, to the great volume of radioactive wastes generated during the operations. On the other hand, it should be outstanding that the capacity of stockpiling the radioactive wastes in IPEN found been exhausted. Basically, for the dismantling operations of the units, the main radionuclides of interest, from the radioprotection point of view, are U of natural isotopic composition and the thorium-232.

Several methods have been applied for the minimization of radioactive waste [6-10]. The choice of a coating removal process for radioactive material in the form of carbon steel pieces must have into account, among other factors, that it is not necessary a high

quality of finishing, since the main objective is the release of the material as iron scrap. Different from other applications, where the main objective is to recover the component for reworking (appliances industry, for instance), the reduction of waste volume and the consequent need of expensive containers and space for storage are the driving forces.

It was decided to explore the former experience with molten salts in the thermal decomposition of radioactive organic wastes to investigate the possibility of its application as a potential method to solve the problem of the radioactive waste generated during the dismantling operations of the Nuclear Fuel Cycle Pilot Plants of the IPEN.

In spite of the use of molten salt has already been developed for some industrial coating removal process, it has not been found references in the literature about its use for radioactive superficial contamination removal. The molten salt stripping process relies on chemical oxidation of the coating by a molten salt bath. A new process for radioactive contamination removal from metallic surfaces was developed and a patent privilege request was submitted to analysis in the Brazilian Industrial Property Institut—INPI: related to the Process for Radioactive Decontamination of Parts Components and Metallic Structures in Molten Salt Baths

5. Conclusions

A private company was hired to the building decontamination activities, conditioning of the radioactive wastes and rebuilding. Beginning from the work to the end of the task, medical examination and clinic analysis for the personnel in charge of the job (from hired companies), in accordance with the requirements of IPEN. Besides this, a training of the company team was supplied by the IPEN's radiological protection staff.

During the pilot plant dismantling activities a new process for radioactive decontamination of complex steel structures was developed [11-14]. After the conclusion of the activities it was realized a radioactive monitoring of the laboratories and they were full released by Radiation Protection Area Dose ≤ 0.3 mSv.

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