

# REINTEGRATION OF AREAS OF THE IPEN'S DISMANTLED NUCLEAR FUEL CYCLE PILOT PLANTS AS NEW LABORATORIES OF THE CQMA

**Paulo E. O. Lainetti<sup>1</sup>, Marycel E. B. Cotrim<sup>1</sup>, Francisco M. F. Vasques<sup>1</sup>, Robson de J. Ferreira<sup>1</sup>, Maria Aparecida F. Pires<sup>1</sup>**

<sup>1</sup> Instituto de Pesquisas Energéticas e Nucleares IPEN – CNEN/ SP  
Av. Professor Lineu Prestes 2242  
05508-000 São Paulo, SP

[lainetti@ipen.br](mailto:lainetti@ipen.br)  
[mecotrim@ipen.br](mailto:mecotrim@ipen.br)  
[mapires@ipen.br](mailto:mapires@ipen.br)  
[fvasques@ipen.br](mailto:fvasques@ipen.br)  
[rojefer@ipen.br](mailto:rojefer@ipen.br)

## ABSTRACT

IPEN has faced the problem of the dismantling of their Nuclear Fuel Cycle old facilities. 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 interrupted the activities more than ten years ago, 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. The reasons to promote as soon as possible the dismantling of the IPEN's Nuclear Fuel Cycle Pilot Plants elapse mainly from the need of physical space for new activities, since the R & D in the nuclear fuel cycle area were interrupted and from the loss of personnel that set up and operated the referred units, one of the most concerning aspects in case of the postponement of the dismantling process. One of these new activities is the IPEN's Environmental Program. In the building where there was the Uranium Dissolution and Purification Pilot Plant, already dismantled, it was decided to settle the Laboratory of Chemical and Environmental Analyses, being necessary its total liberation from the point of view of radioactive contamination. 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.

## 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 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.

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.

## **2. REASONS AND PRIORITIES FOR DISMANTLING AND DECOMMISSIONING**

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).

### **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<sub>4</sub> 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 . The previous dismantling activities were described in [1 a 5].

The ADU Dissolution and Uranyl Nitrate Purification Pilot Plants have been reintegrated as the new laboratories of the IPEN’s Environmental Program. The Thorium Pilot Plant and the UF<sub>4</sub> Production Pilot Plant (Aqueous Route) have been reintegrated as the new laboratories of the IPEN’s Polymers Program. In the figure 1 it can be observed the localization of the nuclear fuel cycle facilities in the IPEN plan. In the figure 2 some pictures of the dismantling operations of the ADU Dissolution and Uranyl Nitrate Purification Pilot Plants are presented. In the figure 3, some pictures of floor and walls decontamination in the facility’s building are showed and in the figure 4, the new laboratories are presented.

### **4. CONCLUSIONS**

A private company was hired to decontamination activities, conditioning of the radioactive wastes and rebuilding. Before the beginning of the tasks, 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. 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  $\leq 0.3$  mSv.y-1.



**Figure 1: Localization of the IPEN's fuel cycle facilities (inside the red circle) and the ADU Dissolution and Uranyl Nitrate Purification building (arrow).**



**Figure 2: Dismantling operations of the ADU Dissolution and Uranyl Nitrate Purification Pilot Plants.**



**Figure 3: Facility decontamination.**



**Figure 4: The new laboratories of CQMA after rebuilding.**

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### **REFERENCES**

1. Lainetti, P. , Freitas, A., Ferrari, E., Ferreto, H., Ayoub, J. Seneda, J., Bergamaschi, V., “Plano de Ação para Desmontagem das Unidades do Ciclo do Combustível”, *IPEN’s Internal Report*, São Paulo, February, 2002.
2. Lainetti, Paulo Ernesto de O., Freitas, Antônio A., “Desmontagem das Unidades de Dissolução e Purificação de Urânio do Ciclo do Combustível – Bloco I do CQMA”, *IPEN’s Internal Report*, São Paulo, March, 2003.
3. Lainetti, P., “Decommissioning of Nuclear Fuel Cycle Facilities - IPEN’s Experience” , *Proceedings of the 7th Enan Meeting on Nuclear Applications*, INAC 2005, Santos, SP, Brasil, setembro, 2005.
4. Lainetti, P., “Decommissioning of Nuclear Fuel Cycle Facilities at IPEN (Brazil), IAEA Research Project BRA-12800”, *Research Coordination Meeting Innovative and Adaptive Technologies in Decommissioning of Nuclear Facilities*, Halden, Norway, 4- 8 April, 2005.
5. Lainetti, P., “Status of the Programme and Progress in R&D Activities in Support of: Decommissioning of Nuclear Fuel Cycle Facilities at IPEN (Brazil), IAEA Research Project BRA-12800”, *Research Coordination Meeting Innovative and Adaptive Technologies in Decommissioning of Nuclear Facilities*, Keswick, UK, 13-17 Nov, 2006.