*2007 International Nuclear Atlantic Conference - INAC 2007*
*Santos, SP, Brazil, September 30 to October 5, 2007*
*ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN*
*ISBN:* 978-85-99141-02-1

# DECONTAMINATION AND DISMANTLING OF A METALLOGRAPHY LABORATORY AT IPEN – A RADIATION PROTECTION APPROACH

**Francisco M. Feijó Vasques, Paulo Antonio Mestre, and Robson de Jesus Ferreira**

[3] Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
fvasques@ipen.br
pamestre@ipen.br
rojefer@ipen.br

## ABSTRACT

Dismantling and decontaminating even a small laboratory, that handled enriched uranium along the years, is not an easy and simple task. It requires a careful and detailed planning, involving many teams. The first step is to get the radiological inventory of the area. In this case, the Laboratory of Metallography at the Instituto de Pesquisas Energéticas e Nucleares - IPEN, where uranium oxides, enriched up to 19.75%, were manipulated during many years. A radiation protection approach requires many steps: planning, radiological inventory, monitoring of the radiation levels of the area, training and monitoring personnel, dismantling, decontamination, transportation, radioactive waste disposal, final monitoring of the area, evaluation of the personnel monitoring, of the people involved, and at last, liberation of the area for others purposes. During the process, nevertheless, not always, all planned steps can be followed as a whole. Several decisions must be taken to solve appearing problems during the dismantling and decontaminating process. In the present work, we describe these steps, and introduce the results of the planned monitorings, to get the highest standards of radiation protection safety

## 1. INTRODUCTION

For a nuclear facility, or even a small laboratory, decommissioning is the last phase of its life-cycle. Usually nuclear facilities are designed, and specially constructed, and licensed for the handling of radioactive and nuclear material. It is not always the case of small laboratories. In this case, the laboratory was adapted and prepared for handling limited amounts of nuclear materials. Along the years enriched uranium up to 19.75% was manipulated in the laboratory. Administrative changes and rationalizing measures eventually led to the necessity of transference of the activities developed in this place, to another facility, and the use of the laboratory for others purposes, not involving the handling of nuclear and radioactive material. In this way, decommissioning means actions taken at the end of the useful life of a facility in retiring it from service with adequate regard for the health and safety of workers and members of the public.

It is usual to divide these actions in three stages [1]:

Stage I – To close down the facility, with a minimum removal of radioactive material and with continuous surveillance

Stage II – Decontamination to acceptable levels of radiation. Removal of radioactive material to the extent that the restricted site release

Stage III – Removal of radioactive material to the extent that the facility or site becomes available for use without restriction

## 2. METHODOLOGY

Based on norms issued by the national regulatory authority [2,3], and on the international recommendations of the International Atomic Energy Agency - IAEA, for the decommissioning of nuclear facilities [1, 4, 5] it was developed a plan for the dismantling and decontamination of the Laboratory of Metallography. This small laboratory – see laboratory layout at figure 2 - of less than 20 square meters, was located apart from the main fuel cycle facilities of IPEN. Containing several machines and equipments, such optical microscope, metal cutter, polishing machines, and furnishings appropriated for this kind of laboratory, it was located inside a huge building used for other purposes.

First the radiation protection team made the radiological and chemical inventory of the material, as well as the identification of the contaminant radionuclides of the area. The second step was to make the radiological survey of the laboratory, taking into account radiation levels of the area.

Preparing personnel for the dismantling and decontamination tasks was the next step. Dosimeters for the radiation levels were prepared, and initial urinalysis were made for the people involved in the tasks. Training people was an important item too, and a training program was implemented for the workers involved in these tasks. This program included intensive lectures on the operational radiation protection, procedures, on-the-job trainings and decontamination techniques.

During the activities of dismantling and decontamination, it was necessary the use of monitoring badges (termoluminescent dosimeters), and properly personal protective equipments. Internal monitoring was required for some people, for the assessment of uranium levels, by urine analysis, before and after the tasks, what permitted to evaluate the intake of uranium. Our aim was guided by national regulatory norms, taking into account radiation exposure levels of the workers involved, internal contamination levels, as well, radiation levels of the area, including equipments and furnishings, after the decommissioning process.

The steps followed here [4], were:

- Description of the facility
- Inventory of the radioactive material and non-radioactive chemicals of the laboratory
- Radiation Protection Programme
- Dismantling planning
- Decontamination planning
- Waste management
- Safety assessment
- Final radiation survey

## 3. DISMANTLING AND DECONTAMINATION TASKS

A team of people involved in the dismantling and decontamination tasks was organized. People that worked in the laboratory, radiation protection, new users of the area, safety staff, and radioactive waste managers were involved to join forces, to solve the problems related to the decommissioning.

Following the decommissioning plan, and after training people and the initial radiation monitoring of the area, the next step was the dismantling and decontamination tasks, in this way it was followed the course below.

- Removal of all materials that were not radioactive or nuclear, including chemicals

- Removal of all equipments not contaminated
- Transfer of all solid radioactive waste to the waste management facility
- Identification, quantifying and transfer of all liquid radioactive waste to the waste management facility
- Remaining nuclear material was moved to the new laboratory, that replaced the old one
- Decontamination of the remaining equipments
- Decontamination of the remaining furnishings using not aggressive methods
- Decontamination of the walls and other barriers
- Decontamination of the floor

Initial monitorings indicated a low-level contamination of the floor, furnishings and equipments of the laboratory, thus it was established the need of the use of personal protective equipment for the teams involved in the dismantling and decontamination tasks.

### 3.1. Personal Protective Equipment

In the dismantling and decontaminating activities, it was necessary, as mandatory, the use of this personal protective equipment:

- Protective Overalls
- Rubber Gloves
- Boots
- Overboots
- Plastic cap

Besides, for some tasks were required additional PPE, in accordance with the tasks developed and risks related, such as additional gloves, dust masks, filter masks, safety goggles, and plasticized paper overalls.

### 3.2. Radioactive Waste Management

The usual activities developed in the laboratory resulted in low-level radioactive bag of solid waste, containing things like worned-out gloves, rubber, pieces of cotton and paper, scraps, all of them impregnated with natural uranium. Liquid waste was generated too, and three plastic vessels containing uranium should be properly disposed. For this, small samples were collected and analysed. The waste staff was concerned with this problem, for the safely and appropriated remove and disposal of the radioactive waste.

**Figure 1. Decontaminating Teams in action at the Laboratory of Metallography**

## 4. MONITORING RESULTS

Radiation levels monitoring results are presented below, before and after the dismantling and decontamination process

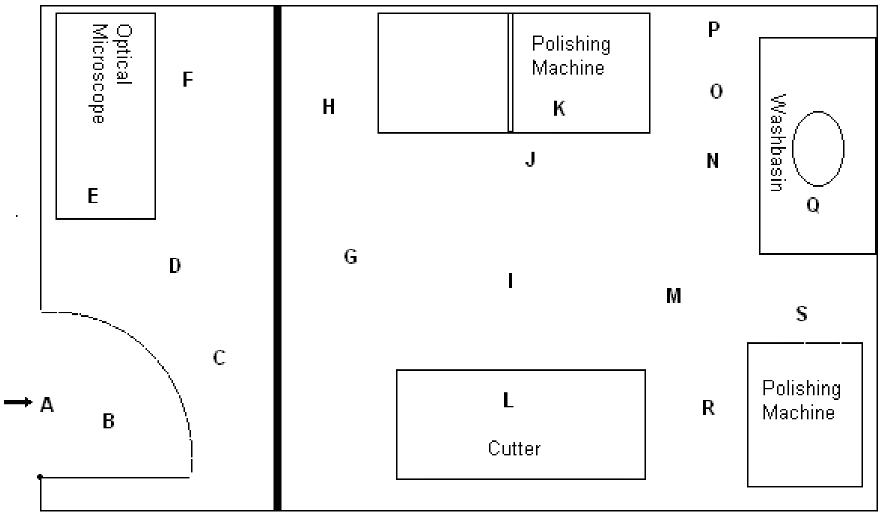


**Figure 2. Layout of the Laboratory of Metallography and the Monitoring Points (A-S)**

**Table 1. Dose Laboratory Levels before and after dismantling and decontamination process**

| Monitoring Points | Dose Levels before Decontamination ($\mu Sv.h^{-1}$) | Dose Levels after Decontamination ($\mu Sv.h^{-1}$) |
|---|---|---|
| A | 0.30 ± 0.05 | 0.20 ± 0.05 |
| B | 0.40 ± 0.05 | 0.20 ± 0.05 |
| C | 0.40 ± 0.05 | 0.20 ± 0.05 |
| D | 0.40 ± 0.05 | 0.20 ± 0.05 |
| E | 0.40 ± 0.05 | 0.20 ± 0.05 |
| F | 0.50 ± 0.05 | 0.20 ± 0.05 |
| G | 0.40 ± 0.05 | 0.20 ± 0.05 |
| H | 0.40 ± 0.05 | 0.20 ± 0.05 |
| I | 0.40 ± 0.05 | 0.20 ± 0.05 |
| J | 0.40 ± 0.05 | 0.20 ± 0.05 |
| K | 0.40 ± 0.05 | 0.20 ± 0.05 |
| L | 0.50 ± 0.05 | 0.20 ± 0.05 |
| M | 0.40 ± 0.05 | 0.20 ± 0.05 |
| N | 0.50 ± 0.05 | 0.20 ± 0.05 |
| O | 0.40 ± 0.05 | 0.20 ± 0.05 |
| P | 0.50 ± 0.05 | 0.20 ± 0.05 |
| Q | 0.40 ± 0.05 | 0.20 ± 0.05 |
| R | 0.60± 0.05 | 0.20 ± 0.05 |
| S | 0.50± 0.05 | 0.20 ± 0.05 |

**Figure 3. Monitoring equipment for liberation**

## 5. CONCLUSIONS

Dismantling, decontamination and decommissioning are issues that will even become more frequently. Born after World War II, nuclear industry with thousands of facilities spreaded around the world, aging fast, many of which must be closed, bringing challenges to be surpassed. Small laboratories, obviously are easier to be decommissioned, than huge facilities. We think that this is the way to be followed. Learning with small facilities, to be prepared when big and huge facilities must be decommissioned. Our experience with dismantling and decontaminating laboratories and small facilities, that manipulated natural uranium and thorium, pointed out that planning, as well training, are very significant and essential items, that must be seriously appreciated before the beginning of any decommissioning task.

## ACKNOWLEDGMENTS

We thank here to the *Centro de Ciência e Tecnologia de Materiais* of IPEN, especially to Ph.D. Ana Helena Bressiani, and to Ph.D. Alberto Saburo Todo from Centro de Metrologia das Radiações of IPEN, for his decisive and valuable contribution for the writing of this work.

## REFERENCES

1. International Atomic Energy Agency – *Decontamination of Nuclear Facilities: Decontamination, Disassembly and Waste Management – Technical Report Series* 230 (1983)
2. Comissão Nacional de Energia Nuclear, Norma CNEN N.N. 3.01 – *Diretrizes Básicas de Proteção Radiológica*, (2005)
3. Comissão Nacional de Energia Nuclear, Norma CNEN N.E. 6.05 – *Gerência de Rejeitos Radioativos em Instalações Radiativas*, (1985)
4. International Atomic Energy Agency – *The Regulatory Process for the Decomissioning of Nuclear Facilities* – Safety Series 105, (1990)
5. International Atomic Energy Agency – *Decommissioning of Small Medical, Industrial and Research Facilities - Technical Report Series* 414 (2003)