

## RADIATION PROTECTION TRAINING AT IEN/CNEN

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### ABSTRACT

Training in radiation protection is one of the most hard and important task in an occupational radiation protection program. The Radiological Protection Service of the Nuclear Engineering Institute of the Brazilian Nuclear Energy Commission (IEN/CNEN) organized several radiation protection courses suitable for research personnel, radiation workers, radiation protection specialists and non-radiation workers. All of the courses have practical exercises, simulating real situations. It has been noted the general necessity of inicial basic training on foundations of atomic and nuclear physics.

### INTRODUCTION

The main activities and researches developed at the Nuclear Engineering Institute (IEN), involves the operation of an Argonaut research reactor, a CV-28 cyclotron, a radioisotope production laboratory, radiochemistry laboratories, a radwaste treatment laboratory and a type test laboratory. IEN has a staff of about 200 non-radiation workers and about 170 radiation workers. According to the activity, the associated radiological risks involve exposure to beta, gamma and neutron radiation of wide energy spectrum and external and internal contamination. From 1984 to 1990, the highest collective dose of IEN workers belongs to the cyclotron laboratory workers mainly due to the handling of the cyclotron activated parts during its maintenance<sup>(1)</sup>.

The occupational radiation protection program consists<sup>(2)</sup>, as usual, of individual monitoring, surface, air and area monitoring, radiation protection equipment testing, decontamination and training. In order to implement this programa, the Radiological Protection Service of IEN has an infrastructure that includes a radiation measurement laboratory,

equipment testing laboratory, decontamination laboratory, laundry, radwaste provisory deposit, liquid effluent treatment installation and a staff that consists of 1 MSc, 2 physicists, a chemistry engineer and 7 technicians, all with specialization in radiation protection.

In Brazil, there are very few schools or universities that provide training in radiation protection. The courses on radiation protection at IEN are based on a standard curriculum, and depending on the worker category, relevant subjects are emphasized or included, or some subjects can be omitted. Beside the training courses, every worker receives the "IEN's Internal Regulation on Radiation Protection" that informs about responsibilities, attributions, classification of areas and operational limits.

#### STANDARD CURRICULUM

The basic curriculum consists of the following subjects. It is also indicated the duration of each lecture. All theoretical lecture ends with exercises and at the end of the course there is an evaluation. Those who are not successful have another chance by an oral interview. The on-the-job follow up is very important in a sense that it helps to evaluate the efficiency of the training and is a opportunity to correct any failure.

- FUNDAMENTAS OF RADIOACTIVITY (1h)
- RADIATION INTERACTION WITH MATTER (1h)
- PRINCIPLES WITH RADIATION PROTECTION (1h)
- RADIATION QUANTITIES AND UNITS (1h)
- ICRP SYSTEM OF DOSE LIMITATION (2h)
- BIOLOGICAL EFFECTS OF IRRADIATION (1h30)
- EXTERNAL RADIATION CONTROL, DOSE CALCULATION, SHIELDING DESIGN (2h)
- INTERNAL RADIATION CONTROL, ICRP MODELS, DOSE CALCULATION (2h)
- RADIATION MEASUREMENT TECHNIQUES, STATISTICS (3h)
- PRACTICE ON RADIATION MEASUREMENTS (6h)
  - AREA SURVEY WITH SEVERAL EQUIPMENTS
  - SURFACE CONTAMINATION MEASUREMENTS (FIXED AND NON-FIXED)
  - EQUIPMENT CALIBRATION
- OCCUPATIONAL RADIATION PROTECTION (1h)
- ENVIRONMENTAL RADIATION PROTECTION (1h)
- VISIT TO THE RESTRICTED AREAS OF IEN WITH EMPHASIS IN THE RADIATION PROTECTION ASPECTS OF EACH AREA (2h)

- PRACTICE ON DECONTAMINATION (1h)
- RADIOACTIVE WASTE - VISIT TO THE PROVISORY DEPOSIT (2h)
- RADIOACTIVE MATERIAL TRANSPORTATION (1h)
- RADIOLOGICAL ACCIDENTS (1h)

#### RADIATION PROTECTION BASICAL COURSE

The purpose of this course is to prepare technicians in charge of radiation survey and also to provide basic technical knowledge essential for those who develop activities in restricted areas. The curriculum is the standard one described above.

#### FOUNDATIONS OF NUCLEAR ENERGY COURSE

This course is offered by IEN for those students that must have a six month practical experience to complete the technical college. One of the subject of this course is radiation protection. The curriculum is the standard one but dose calculation and theory of radiation detection is not so deeply explored.

#### INTRODUCTION TO NUCLEAR ENGINEERING COURSE

This course is offered by IEN for those who have finished a technological graduation course and will begin to research in the nuclear area. One of the subject of this course is radiation protection. This subject is offered for IEN research personnel. The curriculum is the standard one without notion of radioactivity. A lecture on Optimization of Radiation Protection and an Emergency Planning are included and the exercises are mathematically more complex.

#### SEMINAR ON RISKS AND BENEFITS OF NUCLEAR ENERGY

This seminar is given to non-radiation workers. It is explained in a simple way what is ionizing radiation, the biological effects of irradiation, the pacific uses of nuclear energy, practical rules of radiation protection, basic emergency training and a brief description of the restricted areas of IEN. The main purpose is to divulgate de benefits of nuclear energy and avoid misunderstandings such as "the individual dosimeter is a radiation protector" or "X-ray contaminates" or

panic in case of an unusual event inside a restricted area.

1. Silva, J.J.G. and Fajardo, P.W. 1991. Occupational Radiation Exposure of the Staff of the Nuclear Engineering Institute from 1984 to 1990.
2. Fajardo, P.W., Pastura, V.F.S., Santos, I.H.T., 1991. Programas e Procedimentos em Radioproteção Ocupacional do IEN - 1991.