2021 International Nuclear Atlantic Conference – INAC 2021
Virtual meeting,Brazil,November 29 – December 2, 2021

ISBN: 978-65-594-1256-3

Proposal for a Professional Qualification Course in Radiation Protection for Obtaining the Registration of Individuals to Work in Teaching and Research Laboratories

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1. Introduction

The introduction of new technologies and the modernization of equipment expanded the spectrum of importance of radiological protection in services that use nuclear technology in the application of ionizing radiation. Thus, safety is extremely important in the construction of knowledge in radiological protection, being fundamental in the teaching-learning process in the area [1]. Therefore, to ensure the proper functioning of the equipment and properly manage the activities with ionizing radiation, training services for quality assurance and control must be offered. In this sense, the present work aims to demonstrate the technical requirements necessary for the implementation of a training course in order to obtain the registration of individuals for the preparation, use and handling of radioactive sources in research laboratories.

2.Metodology

A training course was held to obtain the Registration of Individuals for the Preparation, Use and Handling of Radioactive Sources, through the CNEN NN 6.01 Standard - CNEN Resolution 005/99. For this, a training program in Radiological Protection was necessary, according to the needs of the Laboratories and in compliance with NN 6.01 Standard for those professionals to have the basic knowledge of radiation protection [2-4]. The course was aimed at 12 professionals (teachers and technicians) from the Federal Technical University of Paraná (UTFPR), at the Fine Equipment Laboratory in October 2019. In this laboratory, a gas chromatograph equipped with a flame ionization detector and an electron capture detector. This type of detector has a sealed source inside that houses the 63Ni radioactive material. The equipment is used to analyze and quantify liquid samples in organic solvents of various compounds. It is currently used in teaching and research in various areas of knowledge, attending undergraduate courses in Environmental Engineering, Chemical Engineering and Food Engineering. It also serves *Lato Sensu* and *Stricto Sensu* Postgraduate Courses in Food Science and Technology and Environmental Engineering, in addition to meeting demands from other UTFPR campuses and other Universities in the region in different lines of research. The course was developed in conjunction with the University's Rectory, in view of the lack of qualified professionals to work with ionizing radiation in research and teaching laboratories.

3. Results and Discussion

This is because the supervision of radiological protection in research and teaching laboratories can be exercised by professionals registered with CNEN in accordance with CNEN NN 6.01 Standard (Requirements for the Registration of Individuals for the Preparation, Use and Handling of Radioactive Sources), becoming able to perform the SPR functions in the following options:

I - Group 4 facilities, which handle, store or use unsealed source with total activity up to 30 times the exemption level;
II- facilities of subgroups 3A and 7A, which use analytical techniques; 3A - Installations using sealed sources with activity less than or equal to 1/10 (one tenth) of the D / 7A reference value and ionizing radiation generating equipment that produce beam with energy less than or equal to 0.10 MeV Ex Ni 63 (10mCi) D=2,000 mCi;
III - Group 5 research laboratories that exclusively use reference sources for gauging or calibrating radioactive equipment and installations that handle, store or use an unsealed source with total activity between 30 times and 20,000 times the exemption level; and
IV - Group 2 A facilities, which use sealed sources in large self-armored equipment, which do not allow access to the sources or to the irradiation chamber, and in which there is no displacement of sources in routine operation.
The Course was normally developed at UTFPR facilities, for 40 hours (Table 1). The material was made available to students in media and print.

Table 1: The structure of the 40-hour course (each Module lasting 5 hours/class)

Module	**Content**
1- Radiations	1.1. Composition of matter and atomic theory 1.2. Structure of matter 1.3. Radiation origin 1.4. Radioactivity 1.5. Nuclear radiations 1.6. Radiation produced by the interaction of radiation with matter
2 – Natural and Artificial Sources of Ionizing Radiation	2.1. Natural sources 2.2. Artificial sources
3 – Interaction of Radiation with Matter	3.1. Ionization, excitation, activation and braking radiation 3.2. Directly and indirectly ionizing radiation 3.3. Interaction of electromagnetic radiation with matter 3.5. Interaction of directly ionizing radiation with matter 3.6. Interactions of electrons with matter
4 - Biological effects of radiation	4.1. Cell structure and metabolism 4.2. Interaction of radiation with biological tissue 4.3. Stages in the production of the biological effect by radiation 4.4. Tissue radiosensitivity 4.5. Classification of biological effects
5 - Radiological quantities	5.1. Conceptual evolution of magnitudes 5.2. Procedures for defining radiological quantities 5.3. magnitudes 5.4. Relation between quantities 5.5. New operational quantities
6 - Radiation detectors	6.1. Principles of Operation 6.2. Detectors using photographic emulsions 6.3. Thermoluminescent detectors
7 - Notions of Radiation Protection	7.1. Radiation protection principles 7.2. The radiation protection plan 7.3. Radiation protection service activities 7.4. Practical rules for radiological protection
8 - CNEN Standards	8.1. NN 6.01 Standard 8.2. NN 7.01 Standard

	8.3 NN 6.02 Standard

At the end, an evaluation of the proposed content was carried out. For researcher A., the course was important to learn the necessary requirements in the handling of radioactive material: "*With this course I believe that now we can prepare a working protocol for the use of radioactive material, in order to raise the issue radiological protection and the correct disposal of the material*.". After the training, a Registration of Individuals for the Preparation, Use and Handling of Radioactive Sources will be carried out with all the documentation proposed in d NN6.01Standar to obtain the Title issued by CNEN. With this certification, the professional now has a Register valid for 05 years in low-risk installations, classified according to the CNEN NN 6.02 Standard (Licensing of Radiative Installations).

4. Conclusions

It is understood that the professional qualification course with the objective of certification by CNEN is a differential that makes the candidate have a different employability from other competitors for a certain desired vacancy in today's increasingly competitive job market. The relevance of this work is to train professionals in radioprotection, not only to occupy space in companies focused on this area, as collaborators, but also to become multipliers. The aim of this research is to contribute to training in radiological protection, benefiting a greater number of professionals interested in this area of expertise. This research aims to contribute with new knowledge about radiological protection and thus improve safety in spaces where the use of radiation can be used, benefiting a greater number of people, both professionals and users of instruments that contain a radioactive source or use of some Radiopharmaceutical, for example.

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