

Activities of Institute of Radiation Protection and Dosimetry/Brazil as Technical and Scientific Support Organization on Occupational Radiation Protection.**F.C.A. Da Silva, P.R. Ferreira, L.E.C. Matta, M.A.L. Peres, J.M. Godoy, M.A.V. Alencar, M.T. Carlos, D. Souza-Santos, J. C. Leocadio, M.S. Oliveira.**

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Abstract. There are, in Brazil, about 126,000 workers registered on National Dose Registry System (SRD/IRD) as occupationally exposed. They work on 4,000 radioactive installations, 20 nuclear fuel cycle installations and with 90,000 x-ray diagnostic devices. There are two main Regulatory Authorities to license and control these installations on nuclear and radioactive areas, and another Regulatory Authority that is responsible for safety and health protection of workers on their labour activities. Belonging to structure of the National Commission of Nuclear Energy (CNEN-Brazil) there is an Institute dedicated to radiation protection, dosimetry and metrology of ionizing radiation, that is the Institute of Radiation Protection and Dosimetry (IRD). This paper presents two main IRD activities related to occupational radiation protection that can be seen as example of technical and scientific support to Regulatory Authorities: the Radiation Overexposure Analysis that is performed by the Radiation Overexposure Analysis Group (GADE) and the Approval of Individual Monitoring Services and Calibration Laboratory of Equipment used in Radiation Protection that is performed by the Committee for the Evaluation of Essay and Calibration Services (CASEC).

1. Introduction

Brazil has a relevant number of nuclear and radioactive installations. On the nuclear area, that involves the nuclear fuel cycle, Brazil has two Nuclear Power Plants, four Nuclear Research Reactors, two Nuclear Mining and Milling Industrial Complexes, one Industrial Complex with two units related to the Nuclear Fuel manufacturing, one Industrial Complex belonging to the Navy and five CNEN Research Institutes. Besides the nuclear installations, Brazil has many radioactive installations on medical and industrial areas. Nowadays, it has almost 4,000 radioactive installations, which cover five areas: Medical (Radiotherapy and Nuclear Medicine) with 1,398 installations, Industry with 1,450 installations, Services with 256 installations, Research with 79 installations; and Commerce and Distribution with 77 installations [1]. On the Medical X-Ray Diagnostic area, Brazil has almost 90,000 devices [2].

To license and control the installations on nuclear and radioactive areas, Brazil has two Regulatory Authorities. The National Commission of Nuclear Energy (CNEN), which is responsible for installations related to nuclear and radioactive materials and, the National Agency of Sanitary Surveillance (ANVISA), which is responsible for the medical x-ray diagnostic devices [3,4]. There is another Regulatory Authority, the Ministry of Labour and Employment (MTE), that is responsible for safety and health protection of workers on his labour activities [5].

Nowadays, there are almost 126,000 workers registered on Brazilian Occupational Database (SRD/IRD) as occupationally exposed [6].

2. The Institute of Radiation Protection and Dosimetry – IRD [7]

The Institute of Radiation Protection and Dosimetry (IRD), that is one Institute of the National Commission of Nuclear Energy (CNEN-Brazil), was officially created in 1972 with the aim of environmental monitoring, calibration of area monitors and training of professionals in the medical area in radiation protection and clinical dosimetry. Nowadays, with a staff of about 300 professionals, it is considered to be one of the most important bodies in Latin America dedicated to radiation protection, dosimetry and metrology of ionizing radiation. The IRD's mission is to act with excellence in the areas of radiation protection, dosimetry and metrology, generating and disseminating knowledge and technology for the safe use of the ionizing radiation and nuclear technology, in order to improve the quality of life in the Country. The basic research activities carried out by the IRD have contributed to the development of knowledge, new technologies and solutions of problems of radiological protection, dosimetry and metrology of ionizing radiation. Due to the specificity and quality of the work developed, the IRD is considered to be a national reference center and a source of knowledge, strengthening the activities of education and qualification. The IRD has also a significant participation in normative and technical committees in Brazil and abroad.

The IRD main objectives are:

- a) To carry out scientific research and to develop technologies in the areas of radiation protection and metrology of ionizing radiation specifically on medical physics, dosimetry, radioecology, radiation biophysics and metrology.
- b) To assure the traceability of measurements for the units related to the ionizing radiation of the International Systems to the National and International Metrology Networks. The IRD is recognized by the International Atomic Energy Agency (1976, IAEA) as a Secondary Standard Dosimetry Laboratory (SSDL). Through its Laboratory for Metrology of Ionizing Radiation, the IRD is assigned by the National Institute of Metrology, Normalization and Industrial Quality (1989, INMETRO) as the Brazilian representative of the International System of Metrology of Ionizing Radiation.
- c) To maintain a team trained and integrated to respond to radiological and nuclear emergency situations in Brazil. The IRD is the coordinator of the World Health Organization Collaborating Center for Radiation Protection and Medical Preparedness for Radiation Victims (1999, WHO). The IRD is also nominated by the IAEA the "National Warning Point" and the "National Competent Authority for Accidents Abroad" (2000, IAEA).
- d) To promote the qualification of human resources in the areas of radiation protection and metrology of ionizing radiation. The education and training activities developed at IRD are mainly the Short Courses and Post-Graduate Program of Master degree in Radiation Protection and Dosimetry that is implemented in the areas of Radiation Biophysics, Medical Physics, Radioecology and Metrology.
- e) To offer services of calibration, dosimetry and assays. The IRD offers services of photographic, thermo luminescent, and biological dosimetry. Methods of bioanalysis (radiochemistry and whole body counting) are still offered to verify the internal contamination due to radionuclide in specific parts of the human body. The IRD also offers assay services for radionuclide determination in food and other environmental samples. The IRD belongs to the international measurements system associated to the Comprehensive Nuclear Test Ban Treaty (1996, CTBT).

3. Occupational Radiation Protection Activities as Technical and Scientific Support to Regulatory Authority.

3.1- Radiation Overexposure Analysis [8]

Since 1985, the IRD/CNEN has been operating an officially competent service carried out by a multi-disciplinary group, named Radiation Overexposure Analysis Group (GADE). This Group, composed by specialists in radiation protection and dosimetry, has as its main purpose to take coordinated actions to investigate occupational overexposure cases occurring all over Brazil. GADE's hierarchy is composed of a coordinator and experts in: (a) cytogenetic dosimetry; (b) industrial radiation safety; (c) medical radiation safety; and (d) external dosimetry.

The main objectives of GADE are: (a) to investigate all radiation overexposure cases above 100 mSv recorded by personal external monitoring; (b) to assess the real worker's dose and provide this information for medical actions; (c) to find out the true causes of the event and recommend measures to prevent further cases; (d) to modify or ratify the exposure recorded in the Brazilian database of personal monitoring register; (e) to publish scientific information about the overexposure cases investigated; and (f) to maintain a database of all occupational radiation overexposure cases occurring in Brazil.

Whenever the personal external dosimeter from a worker presents an equivalent dose equal to or higher than 4 mSv in a monthly period, the Individual Monitoring Services are obliged to write a high dose communication report. This report has to be sent to the National Dose Registry System (SRD), located at IRD/CNEN, which is a database of all doses received by workers in Brazil. If the dose equivalent is equal to or higher than 100 mSv, this report of a high dose has to be sent within 24 hours to IRD/CNEN. It triggers the GADE activities. This value of 100 mSv is twice the annual limit adopted by the Brazilian Regulatory Authorities (CNEN and ANVISA).

The worker suspected of having had an overexposure will then be submitted to a strict investigation. Otherwise, if the dose is lower than 100 mSv, a simpler procedure is adopted by IRD/CNEN: GADE sends a formal communication to the installation and to the Regulatory Authorities (CNEN and ANVISA) to investigate the dose.

From 1985 to 2009, the Radiation Overexposure Analysis Group (GADE) investigated 508 persons suspected of having been overexposed. Cytogenetic dosimetry was performed whenever the reports of the investigations showed the need. Sometimes the reports would be enough to elucidate the case, e.g. when both the worker and the Radiation Protection Officer state that during the period in question the subject was in vacation or did not perform activities involving radiation work during the period.

3.2- Approval of Individual Monitoring Services and Calibration Laboratory of Equipment used in Radiation Protection [6,9]

In Brazil, occupationally exposed workers can only use personal dosimeters and radiation equipments provided by Services approved by the National Commission of Nuclear Energy (CNEN/Brazil). This requirement is postulated in the national regulations of Brazilian Regulatory Authorities, such as the CNEN, the National Agency of Sanitary Surveillance (ANVISA) and the Ministry of Labour and Employment (MTE).

The responsibility to provide the formal approval of operation for Individual Monitoring Services (SMIE) and Calibration Laboratories of Equipment (LCI) has been delegated to the Institute of Radiation Protection and Dosimetry (IRD) since 1995 by CNEN.

A formal Committee named Committee for the Evaluation of Essay and Calibration Services (CASEC) has now the responsibility of defining the requirements for approval, auditing the laboratories, organizing inter-comparison exercises, certifying the technical heads of the laboratories and of recommending the approval or cessation of laboratories activities to the Director of the Institute.

Actually, eleven Individual Monitoring Services are approved to provide personal dosimeters to the workers. The system covers the 126,000 occupational workers and the techniques enrolled in this system are photographic film dosimetry (30%) and thermoluminescent dosimetry (70%). The Individual Monitoring Service must comply with a series of requirements to obtain the approval. After approved, they must participate in a Follow-up Program in which the Individual Monitoring Services are required to send five dosimeters monthly to be irradiated at the IRD's Secondary Standards Dosimetry Laboratory, with doses chosen by CASEC in a blind.

Seven Calibration Laboratories of Equipment are approved to perform calibration on radiation equipment. Each Calibration Laboratory has been audited according to some minimum requirements. In order to receive an approval, at that stage, the Calibration Laboratory should present calibrated standards that could be traced back to international standards, a list of minimum equipment and a Quality Assurance System. Their technical responsible person should have an appropriate curriculum, and they would have to participate in laboratory intercomparison and receive periodic auditing.

During the recent years technical requirements, based on ISO/IEC 17025 standard, were developed and delivered to the Individual Monitoring Services (SMIE) and Calibration Laboratories of Equipment (LCI) for harmonization and agreement.

4. Conclusion

These two IRD activities, Radiation Overexposure Analysis and Approval of Individual Monitoring Services and Calibration Laboratories of Equipment used in Radiation Protection, performed by the Radiation Overexposure Analysis Group (GADE) and the Committee for the Evaluation of Essay and Calibration Services (CASEC), can be considered a very good example of technical and scientific support to any Regulatory Authority.

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