

Radiological Protection and Radioactive Waste Management

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The Radiological Protection and Radioactive Waste Management Group (PRGRR) has pursued in developing the main activities mentioned in previous Annual Reports.

Concerning the radioactive waste management activities, about 135 requests for collection, segregation and treatment for interim storage were received at the Pavilhão para Armazenamento Interino de Resíduos Radioactivos, PAIRR, (Radioactive Waste Interim Storage Facility, RWISF) during 2006. The licensing requests (entrance in national territory, possession, transport and transfer) of sealed sources for industrial, research and medical proposes, analyzed by ITN/DPRSN/PRGRR reached the number of 263 in the current year.

Eight (8) events related to the detection of radioactive substances in scrap metal were reported by the industry and controlled by PRGRR.

Seventeen (17) verifications of the radiological conditions and the detection of radioactive contamination on medical, research and industrial facilities were carried out in 2006.

The development of monitoring programmes for radioactive liquid discharges from hospitals in the public sewage of Lisbon Borough Council (CML) was continued in 2006 as well as the monitoring of radioactive liquid discharges of the ITN *Campus* before being released into Estação de Tratamento de Águas Residuais Residual, ETAR, (Residual Water Treatment Plant, RWTP). A proposal to carry out a complete revision of the existent facility Estação de Controlo das Descargas dos Efluentes Líquidos Radioactivos, ECoDELiR, (Radioactive Liquid Discharge Control Plant, RLDCP) was submitted to the ITN Directive Board for appreciation and decision.

The *Campus* environmental dose gamma radiation is assured through the gamma monitoring network, GAMMANET, operated and maintained by PRGRR Group and data are reported to the EU according to articles 35° and 36° of the Euratom Treaty.

The involvement of Group members in EU, IAEA, OECD committees, projects, working groups and task forces has increased in 2006 with the involvement in the Ad Hoc Working Party on Nuclear Safety (WPNS), EU.

While a member of the Group is carrying out a PhD in the field of radioactive waste management in collaboration with Faculdade de Ciências (FCUL/ITN), other is finishing a Master Degree in Radiological Protection and Dosimetry with Instituto Superior Técnico (IST/ITN). A Post Graduation Thesis in the area of health and safety of workers dealing with ionizing radiation in collaboration with Nova Etapa was also developed and finalized.

The Group has been involved in several training courses to provide professionals in the field of medical and industrial applications of ionizing radiation with knowledge on Radiological Protection. Still concerning education and training, members of PRGRR have also participated in the teaching activities of post-graduation activities: Master Course on “Biomedical Inorganic Chemistry: Diagnostic and Therapeutical Applications” (FCUL/ITN-Química) Master Course on “Radiological Protection and Dosimetry” (IST/ITN-DPRSN) and in a Post-Graduation Course, “Curso Pós Graduado em Protecção Civil-Riscos Naturais e Tecnológicos” (FCL/ISEL/ITN-DPRSN).

Concerning research activities, the PRGRR Group, in collaboration with Portuguese universities and Associated Laboratories, has submitted six projects to the FCT funding.

Included within the framework of the “Projecto de Plano Nacional de Acção Ambiente e Saúde, PNAAS”, PRGRR Group has submitted one project concerning the harmonization of radioactive waste management practices, in collaboration with Direcção Geral de Saúde and Instituto do Ambiente

Research Team

Researchers

R. TRINDADE, Aux. Researcher, Group Leader
M. I. PAIVA, Aux. Researcher

Technical Personnel (Graduate)

L.M. PORTUGAL

Grants

P. DUARTE
L. BRÁS
A. BAPTISTA, ITN Grant (since 1 Mar 2005)

Technicians

J. SEBASTIÃO
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Characterization of Suitable Areas for a Long-Term Radioactive Waste Repository Facility in Portugal

P. Duarte, I. Paiva, R. Trindade, A. Mateus¹

This project makes part of a Ph.D thesis whose main objectives are: to identify and select the most suitable area(s) to host near-surface repositories for low and intermediate radioactive wastes; to characterize the reference situation in geological and hydrogeological terms; to identify the radionuclide migration pathways in the selected areas and to apply and validate objective criteria to monitor the environmental impacts related to the disposal facility. This work project is expected to contribute to the development and implementation of future actions in the field of the radioactive waste management at national level.

In the pursuit of the above mentioned objectives, an *in locu* appreciation of the most suitable areas accordingly to a set of defined criteria (resulting from the first evaluation ITN Annual Progress Report 2005) was carried out during 2006. Rocks and soils' samples from those areas were collected and analyzed by different techniques: ED-XRF for the chemical analysis of the fraction <63µm; Gamma Spectrometry for the identification and quantification of gamma emitters also in the fraction <63µm and DRX for mineralogical analysis of total sample and fraction <10µm, in special for the identification and characterization of the clay minerals. ED-XRF studies were carried out with the collaboration of the Environmental Analytical Chemistry Group of the ITN's Chemistry Department; Gamma Spectrometry studies were developed in collaboration with the Measurement Unit of ITN's DPRSN and the ED-XRF studies were supervised by the Department of Geology of FCUP.

¹ Dept. of Geology, FCUL

Analysis Of The Activity Distribution Of A Radioactive Source Trapped Inside A Cylindrical Volume, Using The Mcnpx Code

L. Portugal, C. Oliveira, R. Trindade, I. Paiva

It is our goal to distinguish different radius of spherical source geometries trapped inside the cylinder. For this we propose a methodology, using the Monte Carlo simulation and again the MCNPX Code, based on the ratio of the counts of two regions of the gamma spectrum. From a spectrum obtained with a sodium iodide detector, it is possible to calculate the ratio of the counts in the region of the characteristic photons of the source (for cobalt, between 1100 and 1400 keV) and the counts of a selected region in the lower energies. These calculated ratios allow us to determine a function $r = aR^2 + bR + c$, where R is the ratio between the counts of the two regions of the gamma spectrum and r is the radius of the source. To apply this methodology in a real scenario, it is necessary to acquire a spectrum of a cylinder containing the source. Based on the spectrum, the ratio between the counts of the two regions of the gamma spectrum is calculated. With the ratio and the function $r=f(R)$, previously determined, we are able to estimate the source radius.

Radioactive Liquid Discharges from Hospitals in Public Sewage of Lisbon Borough Council (CML)

R. Trindade, L. Portugal, L. Brás, J. Venâncio, F. Gomes, P. Duarte, I. Paiva

A monitoring programme of radioactive liquid discharges from hospitals in the public sewage and Residual Water Treatment Plant (ETAR) of Lisbon was carried out in order to identify the radionuclides present and their activities. About 115 samples of liquid effluents were collected and analysed by quantitative and qualitative gamma spectrometry. This monitoring programme was requested by CML. The monitoring programme was divided in two different programmes. In Programme I was involved the sequential collection of 4 discrete samples in 5 sampling points from nuclear medicine facilities. In Programme II, 4 discrete samples were taken at one single point of each Lisbon's ETAR.

1. Radioactive waste management

Radioactive wastes from the national producers were collected, segregated, transported and conditioned in cement matrix for interim storage at the Radioactive Waste Interim Storage Facility (RWISF) located at ITN *Campus*

During 2006 about 135 requests for radioactive waste collection were received, corresponding to 148 sealed sources, 347 ^{99m}Tc generators, 22 lightning rods, 12201 smoke detectors and other heterogeneous radioactive waste.

2. Sealed sources licensing

In order to verify the compliance with Decree-Law n° 153/96, Ministry for Environment, and Decree-Law n° 165/2002, Ministry for Health, 263 sealed sources licensing requests were analysed and issued: 92 national territory entrance licences, 56 of transfer, 41 of transport and 74 of possession.

3. Gamma network of Nuclear and Technological Institute (ITN)

The environmental dose gamma radiation at ITN *Campus* is measured continuously by the gamma network, GAMMANET. The data are collected, analysed and reported to the EU, according articles 35° and 36° of the Euratom Treaty.

4. Radiological safety verification at medical, industrial and research facilities

The verification of radiological safety conditions and detection of contamination with radioactive substances at public and private medical, industrial and research facilities was pursued in 2006. During the last year 17 verifications were carried out.

5. Radioactive liquid discharges from Nuclear and Technological Institute (ITN)

The total activity of radioactive liquid discharges, from ITN to the Residual Water Treatment Plant, is reported to the EU according article 35° of Euratom Treaty and the Radioactive Substances Committee of OSPAR Convention.

In 2006 a project proposal involving a complete technical revision and auditing the existent facility “Estação de Controlo das Descargas dos Efluentes Líquidos Radioactivos” (ECoDELiR) including a new control system, has been submitted to the ITN Directive Board for appreciation and decision.

6. Radioactive liquid discharges from Oncology Portuguese Institute (IPO), Coimbra

In 2006 and as requested by IPOFG-CROC, EPE, Coimbra, the radiological survey of radioactive liquid waste from the Medicine Nuclear Retention Tanks, was carried out by the Group before discharge into the public sewage.

7. Nuclear vessels radiological monitoring

In 2006, three nuclear vessels (2 submarines and 1 sea-plane carrier) stayed at Portinho da Costa harbour and estuary of Rio Tejo. An environmental radioactivity survey is carried out each time a nuclear vessel stayed at national harbours.

The programme consisted on continuous monitoring of radioactive aerosols and airborne radioiodine, sampling of water, sediments and biological species for gamma spectrometry analysis. Sampling was done before, during and after the stay of the vessel. Reports were sent to Ministry of Defence.

8. Radioactivity in scrap metal

In 2006, and as result of radiological surveys requested by the smelting industry, eight (8) events related to the detection of radioactive materials in scrap metal at smelting factories have been reported. The material collected has been stored at ITN as radioactive waste. Reports were sent to the smelting company.