# Radiological Protection and Radioactive Waste Management

*Romão Trindade*

The Radiological Protection and Radioactive Waste Management Group (PRGRR) has not only pursued the main actions mentioned in previous Annual Reports but has also increased its range of activities during the last year.

Concerning R&D activities, the PRGRR Group, in collaboration with Portuguese Universities and Associated Laboratories has two research projects successfully approved by FCT: RADCLAYWASTE and KADCLAY. Lately these projects were combined in one bigger Project, KADRWaste (ADFC/FC/UP, FFC/CREMINER/FC/UL,CG/ADFC/FC/UP,FC/UP, UÉvora, ITN/DPRSN/Química). This Project has been approved in 2007 but is due to start in 2008.

Still in terms of R&D, PRGRR/DPRSN and Química/ITN, are involved in the European IP ACSEPT Project ("*Actinide Recycling by Separation and Transmutation*") approved under the Euratom FP7-Fission-2007 Framework Program and due to start in 2008. The Group is still involved in another FP7 Project, *EUROTRANS*, when its collaboration is requested.

Included within the framework of the "Projecto de Plano Nacional de Acção Ambiente e Saúde, PNAAS", supported by Ministério do Ambiente and Ministério da Saúde, the PRGRR Group submitted the project *"Harmonização de Práticas de Gestão de Resíduos Radioactivos em Estabelecimentos Médicos e Industriais*" that has been approved and is waiting for financial contribution.

PRGRR Group has also submitted to Department of Technical Cooperation of IAEA, a Regional Project Concept *"Strengthening and enhancing education and training capabilities in safety and management of Radwaste from medical, industrial and teaching applications"* that has been considered of interest but is still waiting for funding. The Group is involved in a National Project Concept "Strengthening and enhancing the QA/QC system on the nuclear analytical and service providing laboratories of DPRSN/ITN" also submitted to IAEA.

A member of the Group has submitted to Instituto Superior Técnico (IST/ITN) a thesis for a Master Degree in Radiological Protection and Dosimetry. Another member has been continuing to pursue a PhD degree in the field of radioactive waste management in collaboration with Faculdade de Ciências (FCUL/ITN).

Two Post Graduation students in Geology are carrying out Thesis in the field of radioactive waste and geological characterization in collaboration with Faculdade de Ciências (Depart. Geologia/FCUL) and Departamento de Química/ITN. A Final Degree Thesis in Environmental Engineering in the area of scrap metal as radioactive waste is also running in collaboration with Universidade Lusófona de Humanidades e Tecnologias.

Members of PRGRR have also participated as teachers and invited professors in high-level education activities: Master Course on "Biomedical Inorganic Chemistry: Diagnostic and Therapeutical Applications" (FCUL/ITN-Química) Advanced Post-Graduation Studies (DFA) on "Radiological Protection and Dosimetry" (IST/ITN-DPRSN). PRGRR had also participated in a variety of professional courses, in-house and at external request.

Members of the Group were also involved in several committees, working groups and task forces from EU, IAEA, OECD, OSPAR, CTBTO and national groups.

Considering activities that are resulting of legal obligations such as licensing of sealed sources for medical, industrial, teaching and research applications, this Group has received 365 licensing requests for analysis and authorization during 2007. Also during 2007 and still considering legal obligations, about 164 requests for collecting and storing radioactive waste were received and solved.

Included in its verification activities, seven (7) operations were carried out in 2007 to verify compliance with the law and radiological protection principles. Fifteen (15) events related to the detection of radioactive substances in scrap metal were carried out by the Group during 2007.

The Monitoring Programme of the radioactive liquid discharges from public and private nuclear medicine services into the public sewage of Lisbon was continued in 2007, in collaboration with Lisbon Borough City Council (CML).

ITN Monitoring Programme in compliance with Articles 35º and 36º of the Euratom Treaty has been pursued with the setup of Estação de Controlo das Descargas dos Efluentes Líquidos Radioactivos, ECoDELiR, to monitoring all radioactive liquid discharges of ITN *Campus.*,

Still in the framework of the above mentioned Euratom Articles, the *Campus* environmental gamma radiation dose has been assured through the gamma monitoring network, GAMMANET, with detectors located in three strategic points of the Campus operated and maintained by the Group.

## Research Team

**Researchers**
R.TRINDADE, Aux., Group Leader
M. I. PAIVA, Aux.

**Technical Personnel (Graduate)**
L.M. PORTUGAL (1st Class grad. Technician)

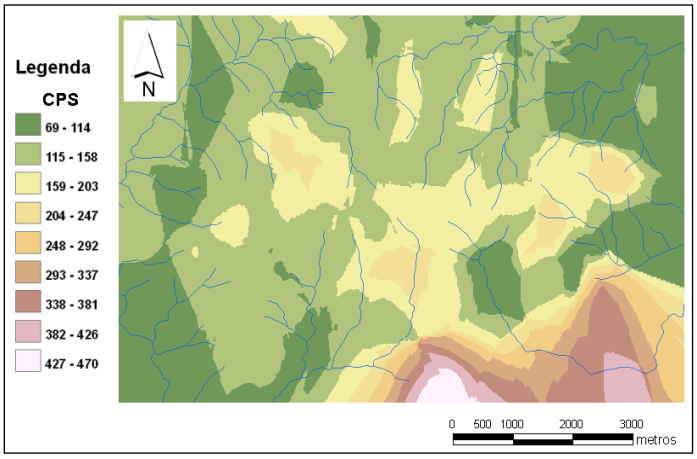
**Technicians**
J. SEBASTIÃO (Senior Technician)
J. VENÂNCIO (Senior Technicians)

**Collaborators**
P. DUARTE (Master in Hydrogeology)
L. BRÁS (Electr.Eng.Stud.,until Aug. 2007)
A. BAPTISTA, ITN Grant (since 1 Mar 2005) (Degree in Physical Engineering)
P. SANTOS (Degree in Geology, Pos-Graduate Student)
F. MAIA (Degree in Geology, Pos-Graduate Student)
C. Betânia (Final Year Environmental Engineering Student)

**Characterization of Suitable Areas for a Long - Term Radioactive Waste Repository Facility in Portugal**
P. Duarte, I. Paiva, A. Mateus[1], R. Trindade

The work in progress is part of a PhD thesis being carried out in collaboration with Department of Geology/FCUL. Following a preliminary study, two specific potential suitable areas to host near-surface repositories (geologicaly composed by peridotites and schists), have been chosen to be characterized in more detail. Radiological mapping of both areas was performed, using a based Geographic Information System and gamma radiation data from 980 measuring points along several profiles. These data was obtained with portable NaI (Tl) gamma detectors. Statistical treatment of the data (interpolation by kriging) obtained from the radiometric profiles pointed out significant and representative sampling locals (Fig.1). In these locals, soils (through vertical profiles in three different depths), rocks, and vegetable covers were collected and were taken to the lab for ongoing analysis by various techniques: Gamma spectrometry for the identification and quantification of natural and artificial gamma emitters (total sample and fraction <63μm); XRD for mineralogical analysis (with emphasis on granulometric fraction <10μm due to the importance of clay minerals in radionuclide retention processes). Organic matter content was also quantified in soil samples and, rock samples mineralogy is in progress.

Studies of the <63μm soil fraction adsorption capacity for radionuclides, mainly $^{137}Cs$, have started (with the involvement of Group of Environmental Radioactivity of DPRSN). ED-XRF analyses 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; FT-IR measurements were performed in the Department of Geology of FCUP.




Two Graduate students are also working in this research Project: "Técnicas Nucleares na Determinação da Concentração de Radionuclidos em Matrizes Naturais" (P. Santos, Co-supervisors: A. Mateus, P.Duarte, I.Paiva, R. Trindade,) and "Estudo dos Factores que Gerem a Adsorção/Desadsorção de Radiocésio em Matrizes Naturais" (F. Serafim, Co-supervisors: A. Mateus, M.J.Madruga, I.Paiva) in Applied Geology

**EUROpean Research Programme for the TRANSmutation of High Level Nuclear Waste in an Accelerator DriveN System (ADS), IP "EUROTRANS", (7th Programme EURATOM- FP7-Fission2007)**
DPRSN/Física/ITN/FEUCP
P. Vaz (Coordinator)[1], I.F. Gonçalves[2], I. Paiva[1]Y.Romanets[4], R. Pires[3], R. Trindade[1]

PRGRR collaborates, when it is requested, in the *EUROTRANS Project* (Contract Number FI6W-CT-2004-516520), which is about transmutation of high-level waste from nuclear power plants using an accelerator driven system (ADS). Partitioning and transmutation if achieved at industrial scale will be able to reduce radiotoxicity of high-level wastes and change the safety assessment concept of final disposal.

[1]DPRSN/ITN, [2]Física/ITN, [3]Fac Eng/UCP, [4]Project fellow

**Radioactive Liquid Discharges from Hospitals in Public Sewage of Lisbon Borough Council (CML)**
P. Duarte, L.Portugal, L.Brás, J.Venâncio, F.Gomes, I. Paiva, R.Trindade

Radioactive liquid discharges from private and state owned nuclear medicines in Lisbon public sewage as well as residual effluents from Lisbon's four Water Treatment Plant (ETARs), have been continued to be monitored by DPRSN/ITN in 2007. Sampling 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, requested by CML, was divided in two different programmes. Programme I involved 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 discharge point of each Lisbon's ETARs.

**Published:**
R. Trindade, P.Duarte, L. Portugal, L.Brás, J. Trincheira, F. Gomes, I. Paiva Programa de Vigilância Radiológica da Rede Pública de Saneamento de Lisboa, Report DPRSN - C nº16/2007

**1. Radioactive waste management**

During 2007 about 164 requests for radioactive waste collection were received, corresponding to 178 sealed sources, 359 $^{99m}$Tc generators, 18 lightning rods, 4632 smoke detectors and other heterogeneous radioactive waste. These radioactive wastes were collected, segregated, transported and conditioned in cement matrix for interim storage at the "Pavilhão de Armazenamento Interino de Resíduos Radioactivos", (PAIRR) located at ITN *Campus.* At this point, the "Pavilhão de Armazenamento Interino de Resíduos Radioactivos", (PAIRR), has reached almost its full capacity and is in urgent need of being updated to be able to store more radwaste in the future. The only technician that is now working at PAIRR is also insufficient to carry out present duties.

**2. Sealed sources licensing**

In order to verify the compliance with Decree-Law nº 38/2007 and Decree-Law nº 165/2002, 365 sealed sources licensing requests were analysed and issued: national territory introduction licences (131), transfer (46), transport (53) and ownership (135).

**3. Gamma Monitoring Network (GAMMANET) of Instituto Tecnológico e Nuclear (ITN)**

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

**4. Radiological safety verification of medical, industrial and research facilities**

The verification of radiological safety conditions and detection of contamination with radioactive substances of public and private medical, industrial and research facilities was pursed in 2007. During the last year seven (7) verifications were requested carried out.

**5. Radioactive liquid discharges from Instituto Tecnológico e Nuclear (ITN)**

Radioactive liquid wastes originated at ITN are analysed and measured at "Estação de Controlo das Descargas dos Efluentes Líquidos Radioactivos" (ECoDELiR) before being discharged into Estação de Águas Residuais. The data are reported to the EU according Articles 35º and 36º of Euratom Treaty and to the Radioactive Substances Committee of OSPAR Convention.

**6. Radioactive liquid discharges from Instituto Portugês de Oncologia (IPO), Coimbra**

In 2007 and as requested by IPO-CROC, EPE, Coimbra, the radiological survey of radioactive liquid waste from the IPO's Medicine Nuclear Retention Tanks, was carried out by the Group before discharge into the public sewage.

**7. Nuclear vessels radiological monitoring**

In 2007, four nuclear vessels (3 submarines and 1 sea-plane carrier) stayed at Portinho da Costa harbour and estuary of Rio Tejo. Environmental radioactivity survey programmes consisting on continuous monitoring of radioactive aerosols and airborne radioiodine, sampling of water, sediments and biological species for gamma spectrometry analysis were carried out. 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 2007, and as result of radiological surveys requested by the smelting industry, fifteen (15) events related to the detection of radioactive materials in scrap metal at smelting factories have been reported. The material collected has been stored at Pavilhão de Armazenamento Interino de Resíduos Radioactivos, (PAIRR) as radioactive waste. Reports were sent to the smelting company.

**9. Dismantling of "Sala dos Cofres e dos Moldes" at Instituto Portugês de Oncologia (IPO FG), Lisboa**

Dismantling of "*Sala dos Cofres e Sala dos Moldes*" of IPOFG/Lisbon was carried out in 2007. These rooms were the core of a very old laboratory where radioactive substances were manipulated in the past, namely $^{226}$Ra solutions and needles. The laboratory was decontaminated and the resulting radwaste was packed and transported to "*Pavilhão de Armazenamento Interino de Resíduos Radioactivos*", (PAIRR)