
MEASUREMENT LABORATORIES

Annual Activity Report 2013

UNIT: Radiation Protection and Safety

TEAM

Name	Category	R&D (%)
Mário Reis	Auxiliary Researcher	75%
Lídia Silva	Graduated Technician	100%
João Abrantes	Graduated Technician	100%
Marta Santos	Graduated Technician	50%
Gabriel Silva	Technician	100%
Gonçalo Carvalho	Grantee	100%

OBJECTIVES

The main working areas of the Measurement Laboratories Group are related to Research, Education & Training and Services in the area of radioactive analysis. For 2013 the main objectives of the group are:

- To continue and increase the participation in national and international R&D funded Projects;
- To continue and increase the collaboration with other Universities and Research Centres, at national and international level, in order to provide high education and training concerning LM areas of expertise;
- To support the fulfilment of the Portuguese State obligations and EURATOM Treaty regarding the environmental radiological monitoring;
- To further develop the implemented Quality Management System in order to provide high quality services to support industrial and commercial activities;
- To increase the number of radioanalytical techniques accredited, according to the ISO/IEC 17025;
- To increase the dissemination of the group activities through the participation in Conferences and publication of papers.

MAIN ACHIVEMENTS

Research and Development

During 2013, the group has participated in several research projects:

- DYNOZONE – Measurement and analysis of ^7Be (stratospheric tracer) activity in aerosol samples by high resolution gamma-ray spectrometry.
- MetroMetal – Participation in 3 intercomparison exercises in the framework of the Project, aiming the certification of specific reference materials to be used in the metallurgical industry (cast steel, slag and fume dust samples).
- VADOSE – Gamma-ray spectrometry measurements of a set of soil samples previously collected in the framework of the Project.
- MetroNORM – The project addresses mainly the development of measurement systems, methods and technique including in-situ systems which support innovative industrial processing of resources containing naturally occurring radioactive materials, design of traceable measurement procedures for industrial NORM raw material, products, by-products, residues and waste, development and establishment of traceable metrological reference materials and standard sources needed for calibration purposes for NORM and TENORM.

Technical Services

The Measurement Laboratories (LM) provides analytical services in the area of radioactive analysis of low and medium activity samples. The used techniques are high resolution gamma-ray spectrometry, gross alpha/beta counting and beta counting of specific radionuclides using gas flow proportional counters (together with Environmental Radioactivity (GRA) group) and liquid scintillation (also with GRA support). The range of radioactivity measurements includes: analysis of radioisotopes in water to assist in the surveillance of the IST/CTN research reactor, control of foodstuffs, export or import of products and building materials (external clients), and gross alpha/beta and tritium in drinking waters (in collaboration with the GRA). During 2013, a total of about 2000 analysis were carried out, including gamma-ray spectrometry, gross alpha/beta and tritium (together with GRA group), as services for external entities, to support other IST/CTN Groups and in the framework of the national environmental radiological survey.

Quality Management System (NP ISO/IEC 17025)

The group was involved on the process of implementing a Quality Management System related to the accreditation of several radioanalytical techniques according to the ISO/IEC/17025. During 2013, the Group participated, in collaboration with the GRA, in several international inter-comparison exercises and Proficiency Tests with good results.

Education & Training

During 2013, the LM team was involved in education and training activities, namely by hosting two Master Degree students from Coimbra and Porto Universities, by lecturing in training courses and by conducting study visits to groups of students from secondary schools and universities.

RELEVANT PUBLICATIONS

- Pedro Duarte, Lúcia Silva, António Mateus, M. Fátima Araújo, Mário Reis, Romão Trindade, Isabel Paiva, Radiological and geochemical characteristics of an ultramafic massif (NE Portugal) regarding the site aptness to host a near surface repository for low and intermediate level radwaste, *Env. Earth Sci.*, 68 (2), 547-557 (2013), doi:10.1007/s12665-012-1758-0.
- A.C. Carvalho, M. Reis, L. Silva, M.J. Madruga, A decade of ^7Be and ^{210}Pb activity in surface aerosols measured over the Western Iberian Peninsula, *Atmospheric Environment*, 67, 193-202 (2013), doi.org/10.1016/j.atmosenv.2012.10.060.
- J. Abrantes, G. Carvalhal, M. Reis, A new suite of tools for the radioactivity measurements laboratory, *International Conference Advances in Liquid Scintillation Spectrometry* (2013), Oral.
- G. Carvalhal, J. Abrantes, I. Lopes, M.J. Madruga, M. Reis, A couple of methods to calculate the activity of Rn-222 in water samples by means of LSC technique: preliminary comparative studies, *International Conference Advances in Liquid Scintillation Spectrometry* (2013), Oral.

FUNDS

Project/Service	Reference	Timeframe	2013
Radioactivity Analysis (Liquid Scintillation and Gas Flow Proportional Counting with GRA)	Technical Services	2013	20.000 €
Radioactivity Analysis (Gamma-ray Spectrometry)	Technical Services	2013	29.000 €

TEAM RESEARCHERS

NAME: Mário João Capucho dos Reis

CATEGORY: Investigador Auxiliar

ID NUMBER: 04969

ACTIVITIES

Nº	Activities Description	R&D (%)
1	DYNOZONE – Total column and surface ozone variability over the Iberian Peninsula: dynamical and chemical atmospheric factors. (PTDC/CTE-ATM/105507/2008 – FCT funding)	13
2	MetroMetal – Ionizing radiation metrology for metallurgical industry. (JRP IND04 – EMRP funding)	10
3	VADOSE – Spatial variation of dose rate in soils and sediments. (PTDC/AAC-AMB/121375/2010 – FCT funding)	5
4	PREPARE – Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe. (EURATOM 7 th Framework Programme – Grant agreement n° 323287)	10
5	MetroNORM – Metrology for processing materials with high natural radioactivity. (JRP I13 – EMRP funding)	5
6	PETRUS III – Implementing sustainable E & T programmes in the field of radioactive waste disposal. (EURATOM 7 th Framework Programme – Contract n° 605265)	5
7	Analytical Services on Radioactivity Measurements	15
8	CTBTO Contract for the management of the RN53 radionuclide particulate station	7
9	Coordination of the Measurement Laboratories (LM) group	20
10	Radioactivity Monitoring Programme of the IST/ITN <i>campus</i>	10
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	FCT Project DYNOZONE: Total column and surface ozone variability over the Iberian Peninsula: dynamical and chemical atmospheric factors. Participants: UNL (Leading Institution), UA, UFP, IST/ITN A time series analysis of the natural atmospheric ⁷Be (cosmogenic radionuclide) and ²¹⁰Pb (radionuclide of terrestrial origin) was performed, focused mainly on the temporal evolution of ⁷Be due its great potential as natural tracer for tropospheric intrusion of air masses with stratospheric origin. By integrating ⁷Be data, ozone air quality data and reanalysed meteorological fields, several events with high probability of stratospheric intrusions were identified. During 2013, the work regarding the analysis of the stratospheric tracer ⁷Be was continued. Besides the data from Sacavém (based on weekly samples), also data from Oporto (48 hours frequency) and Ponta Delgada (daily samples) was used and correlated with other meteorological parameters and ozone data in order to enable detection of short duration and local scale events and confirm (or not) the contribution of stratospheric intrusions in high level ozone episodes at surface air.
2	EMRP Project MetroMetal: Ionising radiation metrology for the metallurgical industry. Participants: CIEMAT (Spain), BEV/PTP (Austria), CEA (France), CMI (Czech Republic), ENEA (Italy), IFIN-HH (Romania), IJS (Slovenia), JRC (EC), MKEH (Hungary), NCBJ (Poland), PTB (Germany), SMU (Slovakia and STUK (Finland) and IST/ITN (Portugal). During 2013, a characterization of a specific HPGe detector using Monte Carlo simulations

	was carried out. The model was validated by using multi-gamma volume sources on the energy range from 46.5 keV to 1836 keV. Sensitivity studies of the detector efficiency were also performed. For the purpose of certifying reference materials specially prepared to be used in the metallurgical industry (cast steel, slag and fume dust samples), an intercomparison exercise on gamma-ray measurements of several radionuclides of interest (Co-60, Cs-137 and Ra-226) was organized in the framework of the project. A meeting to discuss and present the results of the different Work Packages of the project took place in Madrid, CIEMAT, on the 26 and 27 of November. Participants: C. Oliveira, M. Reis, L. Portugal.
3	FCT Project VADOSE: Spatial variation of dose rate in soils and sediments. Participants: IST/ID (Leading Institution), SUERC, UA This project is coordinated by the Chemical and Radiopharmaceutical Sciences Unit. The main objective of VADOSE is to develop improved methodologies for the simple, rapid and accurate prediction of dose rates at different scales in soils and sediments, through detailed experimental investigation and Monte Carlo modeling. The implications of this understanding and the information gathered for its development will be assessed in the context of methodologies in environmental dosimetry and the significance of radiological and geochemical baselines. During 2013 a set of soil samples were measured by high resolution gamma-ray spectrometry.
4	EURATOM Project PREPARE: Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe. Participants: Consortium of 43 European partners. The project aims to close gaps that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster. It addresses the call Fission-2010-3.3.1: Update of emergency management and rehabilitation strategies and expertise in Europe. The consortium intends to review existing operational procedures in dealing with long lasting releases, address the cross border problematic in monitoring and safety of goods and will further develop still missing functionalities in decision support systems. The 1st meeting of the WP3 (Contaminated Goods), to discuss the National Panels methodology, programme, coherence and follow-up, was held in May 2013 at CIEMAT, Madrid. Participants: M.J. Madruga, M. Reis. According to the WP6 (Information and Participation of the Public) deliverables, a Workshop on Managing Complexity in Nuclear Accidental Situations was organized at the CTN by the IST project team, in November 2013.
5	EMRP Project MetroNORM: Metrology for processing materials with high natural radioactivity. Participants: CEA (France), CIEMAT (Spain), CMI (Czech Republic), ENEA (Italy), IJS (Slovenia), IST/ITN (Portugal), JRC (EC), MKEH (Hungary), NPL (UK), NRPA (Norway), SMU (Slovakia) and STUK (Finland). The project addresses the following scientific and technical objectives: (i) Development of measurement systems, methods and techniques including in-situ systems which support innovative industrial processing of resources containing naturally occurring radioactive material; (ii) design of traceable measurement procedures for industrial NORM raw material, products, by-products, residues and waste; (iii) development and establishment of traceable metrological reference materials and standard sources needed for calibration purposes for NORM and TENORM measurement; (iv) improvements to decay data for selected natural radionuclides of the U-238, U-235 decay chains, and to the rare earth element La-138, focusing on decay chains description and gamma-ray intensities and half-life improvement; (v) testing of developed systems, standards and reference materials in industrial processing situations. The kick-off meeting of the project took place in September 2013, at BEV, in Vienna. Participants: C. Oliveira, M. Reis.
6	EURATOM Project PETRUS III: Implementing sustainable E & T programmes in the field of radioactive waste disposal. Participants: Consortium of 20 European partners. The main goal is the development of a cooperative approach to education and training in the geological disposal, aiming the elaboration and implementation of training modules defined in term of learning outcomes in a “competency-based curriculum”. The objective is to set up accredited and recognized qualification in geological disposal that can be achieved in parallel both through formal and PD training programmes.

7	Analytical Services on Radioactivity Measurements: The Measurement Laboratories (LM) provides analytical services in the area of radioactive analysis of low and medium activity samples. The used techniques are high resolution gamma-ray spectrometry, gross alpha/beta counting and beta counting of specific radionuclides using gas flow proportional counters (together with Environmental Radioactivity (GRA) group) and liquid scintillation (also with GRA support). The range of radioactivity measurements includes: analysis of radioisotopes in water to assist in the surveillance of the CTN/IST research reactor, control of foodstuffs, export or import of products and building materials (external clients), and gross alpha/beta and tritium in drinking waters (in collaboration with the GRA).
8	CTBTO Contract for the management of the RN53 radionuclide particulate station: The radionuclide particulate station RN53, installed at São Miguel island, Azores, belongs to the International Monitoring System (IMS) network for the verification of the Comprehensive nuclear-Test Ban Treaty (CTBT), which was signed and ratified by the Portuguese state. The station was already certified and is managed by the IST/ITN under the Contract n° 2008-0065 “<i>Testing and Evaluation and Post-Certification Activities</i>”. On 2013, CTBTO organized a <i>Technical Training Course for Radionuclide Station Operators using Cinderella Equipment</i>, 5-9 August, Reykjavik, Iceland. RN53 Participant: C. Ramalho (local station operator).
9	Coordination of the Measurement Laboratories (LM) group: Management of the activities of the group. Involvement, as group responsible, on the process of implementing a Quality Management System related to the accreditation of several radioanalytical techniques according to the ISO/IEC/17025.
10	Radioactivity Monitoring Programme of the CTN campus: This environmental monitoring programme is carried out in order to assess the levels of radioactivity in the external environment of the CTN campus, its variability over time, assure that the established discharge limits are respected and allow a for a timely intervention in case of occurrence of unplanned situations. This work is carried out through the cooperation between Environmental Radioactivity, Measurement Laboratories, Radioprotection and Radioactive Waste and Dosimetry and Radiobiology groups.

PUBLICATIONS

- Pedro Duarte, Lúcia Silva, António Mateus, M. Fátima Araújo, Mário Reis, Romão Trindade, Isabel Paiva, Radiological and geochemical characteristics of an ultramafic massif (NE Portugal) regarding the site aptness to host a near surface repository for low and intermediate level radwaste, *Env. Earth Sci.*, 68 (2), 547-557 (2013), doi:10.1007/s12665-012-1758-0.
- A.C. Carvalho, M. Reis, L. Silva, M.J. Madruga, A decade of ^7Be and ^{210}Pb activity in surface aerosols measured over the Western Iberian Peninsula, *Atmospheric Environment*, 67, 193-202 (2013), doi.org/10.1016/j.atmosenv.2012.10.060.
- C. Oliveira, L. Portugal, I. Paiva, M. Reis, C. Cruz, R. Trindade, A metrologia das radiações ionizantes na indústria metalúrgica, *Medições e Ensaios*, 5, 14-18 (2013).
- Madruga M.J., F.P. Carvalho, M. Reis, J. Alves, J.A. Corisco, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, Y. Romanets, A. Libânio, A. Mourato, G. Silva, A. Batista, A.R. Gomes, E. Andrade, G. Carvalhal, J. Melo, M. Pereira (2013). Programas de Monitorização Radiológica Ambiental (Ano 2011). Internal Report LPSR, Série A, nº39/13, ISBN 978-989-96542-7-3, Depósito Legal 194022/03, pp. 137.

COMMUNICATIONS

- *Quality control assurance of strontium-90 in foodstuffs by LSC*, I. Lopes, A. Mourato, J. Abrantes, G. Carvalhal, M.J. Madruga, M. Reis, *International Conference Advances in Liquid Scintillation Spectrometry, LSC2013*, Barcelona, Spain, March 18-22 (2013), Oral.
- *A couple of methods to calculate the activity of Rn-222 in water samples by means of LSC technique: preliminary comparative studies*, G. Carvalhal, J. Abrantes, I. Lopes, M.J. Madruga, M. Reis, *International Conference Advances in Liquid Scintillation Spectrometry, LSC2013*, Barcelona, Spain, March 18-22 (2013), Oral.

- *Aço, Escória, Fumo: Estado da Arte e Progressos da Metrologia Induzidos pelo Projecto*, M. Reis, Workshop MetroMetal, CTN/IST, April 3 (2013), Oral.
- *Problemática do radão (^{222}Rn) e sua monitorização em ambientes atmosféricos interiores*, E. Andrade, M. Reis, M.J. Madruga, *Jornadas Científicas de Saúde Ambiental, 1th Annual Meeting of Coimbra Health School*, April 13 (2013), Oral.
- *Development of a couple of methods for measuring radon exhalation from building materials commonly used in the Iberian Peninsula*, C. Miró, E. Andrade, M. Reis, M.J. Madruga, *7th Conference on Protection against Radon at Home and at Work, Prague, Czech Republic, September 2-6 (2013)*, Oral.
- *Testing and implementation of a new reading technique for LR-115 track detectors*, E. Andrade, M. Reis, *7th Conference on Protection against Radon at Home and at Work, Prague, Czech Republic, September 2-6 (2013)*, Poster.
- *Radioactivity and Environmental Impacts*, M. Reis, *International Workshop: Uranium, Environment and Public Health*, Instituto Politécnico de Castelo Branco, October 25 (2013), Oral.
- *Establishing an E&T platform on NORM related industries*, I. Paiva, M. Reis, L. Portugal and C. Oliveira, *Nuclear Education and Training International Conference, NESTet 2013*, November 17-21, Madrid (2013), Oral
- *Indústria Metalúrgica e Radioactividade sob o Ponto de Vista da Metrologia*, M. Reis, *1st Workshop for Stakeholders, Project EMRP MetroMetal, CTN/IST, December 6 (2013)*, Oral.

EDUCATION

- Supervisor, summer training (22 July- 06 September 2013) on *Técnicas radioanalíticas aplicadas à determinação dos níveis de radioatividade em amostras ambientais* by Daniela Alves in the framework of the Master Degree in Environmental Engineering of Coimbra University.
- Arguing Jury member on a Master Degree Thesis on Environmental Sciences and Tecnology, *Radionuclidos Antropogénicos (^{137}Cs) em sistemas lagunares e estuarinos de Portugal: Implicações Ambientais*, by Joel Costa Esteves, Faculdade de Ciências da Universidade do Porto, September 12 (2013).

PROJECTS

- *Total column and surface ozone variability over the Iberian Peninsula: dynamical and chemical atmospheric factors (DYNOZONE)*, FCT funding, PTDC/CTE-ATM/105507/2008. Leading Institution: Universidade Nova de Lisboa. IST/ITN Coordinator: M. Reis (13%).

CONTRACTS

Contract	Client identification	2013
Gamma spectrometry measurements	Several external clients	29 000 €
Indoor radon measurements	Several external clients	30 000 €
Contract nº. 2008-0065 “ <i>Testing and Evaluation and Post-Certification Activities</i> ” for the RN53 radionuclide particulate station	Comprehensive Nuclear-Test Ban Treaty Organization	30 000 €

CONFERENCES ORGANIZATION / SCIENTIFIC COMMITEES

- Member of the Organizing Committee of the MetroMetal Workshop, on the framework of the EMRP Project IND04 *Ionizing Radiation Metrology for Metallurgical Industry*, CTN/IST, April 3 (2013).
- Member of the Organizing Committee of the Project IND04-MetroMetal Meeting, CTN/IST, April 23-24 (2013).
- Participation in the IV General Assembly of the NERIS Platform (European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery), UPM, Madrid, May 21 (2013).

- Participation in the NERIS Topical Workshop on Management of Contaminated Goods, CIEMAT, Madrid, May 22 (2013).
- Member of the Organizing Committee of the Workshop on Managing Complexity in Nuclear Accidental Situations, on the framework of the PREPARE Project Work Package 6 *Information and Participation of the Public*, CTN/IST, November 28-29 (2013).
- Member of the Organizing Committee of the 1st Workshop for Stakeholders, on the framework of the EMRP Project IND04 *Ionizing Radiation Metrology for Metallurgical Industry*, CTN/IST, December 6 (2013).

COLLABORATIONS

- Conrado Miró Rodriguez, Departamento de Física Aplicada, Universidad de Extremadura, Collaboration regarding radon measurements.
- Iuliu Bobos, Faculdade de Ciências da Universidade do Porto, collaboration regarding radioactivity measurements in Portuguese estuarine and lagoon systems.