Unit of Radiological Protection and Safety

MISSION AND OBJECTIVES

The activities of the UPSR aim at i) the deployment of unique scientific and technical expertise, skills and competence in radiological protection in Portugal, ii) keeping abreast of the state-of-art in scientific and technical topics and in international regulations and safety standards in modern radiological protection and radiation safety, iii) the fulfilment of the Portuguese State duties and obligations in radiological protection and radiation safety and iv) the provision of scientific and technical advice and support to the Portuguese Government, to the competent authorities and to other entities and stakeholders in the execution of policies in radiological protection and in areas involving applications of ionizing radiations and radioisotopes. These activities encompass:

- Research and Development, with participation in FCT and European Union Framework Programmes EURATOM, SECURITY and EURAMET funded projects and in European Technology Platforms;
- Services of high added value in radiological protection and safety, radioactivity measurements, dosimetry and metrology of ionizing radiation, provided to stakeholders in the medical, industrial, research and military sectors;
- Fulfilment of legal obligations assigned to IST;
- Education and Training in radiological protection and safety, including teaching activities in undergraduate, post-graduation and Doctoral programmes and short-duration training courses;
- National & international representation, in Committees and Working Groups of the European Union, the IAEA, the OECD Nuclear Energy Agency, BIPM, OSPAR;
- Preparedness of response to radiological and nuclear accidents/emergencies, with the deployment of adequate scientific and technical expertise, techniques and equipment.

The main topical areas of expertise activities of the UPSR are associated to:

- Radioactive waste management
- Monitoring and assessment of environmental radioactivity
- Dosimetry and radiobiology
- Metrology of ionizing radiation
- Radioactivity measurements using different radioanalytical techniques
- Occupational radiation protection
- Radiological emergency response and intervention

ACHIEVEMENTS

R&D Activities

Research activities in radiological protection, dosimetry, metrology, environmental radioactivity were undertaken in the framework of:

- The participation in several R&D projects funded by the EU FP7 programmes, executed by international consortia;
- The participation in R&D projects funded by the FCT, in collaboration with Portuguese academia, research centres and hospitals;

- The cooperation with CERN, EURADOS (European Radiation Dosimetry Group) and EURAMET (European Association of National Metrology Institutes) in the fields of radiological protection and safety, dosimetry and metrology of ionizing radiation;
- New research activities with Portuguese hospitals and industrial companies;
- New R&D links with major laboratories, research centres and universities in European countries;
- The participation in the EU Technological Platforms MELODI (low dose radiation research), IGD-TP (Geological Disposal of radioactive waste) and NERIS (Preparedness for Nuclear and Radiological Emergency Response and Recovery).

Services, Quality Management System and Accreditation of Techniques

High added value services were provided, including:

- The assessment of the safe use of ionizing radiation in 14 medical (radiotherapy and nuclear medicine) and industrial facilities;
- The individual monitoring of the exposure of workers to ionizing radiation (approximately 3000 workers were monitored on a monthly or quarterly basis);
- Analyses of the radioactivity contents of environmental (waters, foodstuffs, building materials, soils, aerosols, etc.) and biological samples. Several hundreds of samples were measured throughout the year using techniques such as gamma and alpha spectrometry, liquid scintillation and proportional counters;
- The assessment of indoor radon concentrations (about 400 measurements of radon concentration were performed during the year);
- The collection, segregation and interim disposal of radioactive waste from the medical, industrial and research uses of ionizing radiation (165 interventions were performed during the year to collect and segregate radioactive sources);
- The authorization and licensing of radioactive sealed sources (495 authorizations were issued);
- The calibration and metrological verification of radiation monitors and detectors (approximately 130 monitors and detectors were calibrated);
- The radiological protection and safety monitoring actions of 21 medical and industrial facilities, including 14 detections of radioactive materials in scrap metal at smelting factories;
- The environmental radiological monitoring during the visit of 4 nuclear propulsion vessels at Portinho da Costa harbour in the estuary of Rio Tejo.

New competences in Quality Assurance and Quality Control were developed.

The implementation and consolidation of the Quality Management System of the UPSR was pursued. Eight radioanalytical and dosimetric techniques received the accreditation from the IPAC (Portuguese Institute for Accreditation) and other 2 techniques should be accredited soon.

Fulfilment of Legal Obligations

IST is responsible for conducting yearly, under Article 35 of the EURATOM Treaty, the environmental radiological monitoring of the Portuguese territory. Three monitoring programmes were devised: one nationwide, another consisting of the monitoring of the CTN and another in the region around the former uranium mines. These programmes are very resource intensive and involved field missions throughout the year, with the main objective of measuring artificial and natural radionuclides in environmental compartments (atmospheric, aquatic and terrestrial environments). Samples of aerosols, rainwater, surface water, sediments, fish, drinking water, mixed diet, complete meals, milk and soils were analysed. The results are published yearly and made available to the European Commission.

IST holds, through the Laboratory of Metrology of Ionizing Radiation of the UPSR the specific responsibility of maintaining the national standards for ionizing radiation.

The DoseDataMed 2 project, aiming at determining the most frequently performed medical examinations in radiodiagnostic and nuclear medicine was successfully conducted for the first time in Portugal.

Several databases (on the exposure of workers to ionizing radiation and the corresponding doses received, on radon concentration, on environmental radioactivity measurements) were maintained and updated.

Education and Training in Radiological Protection and Dosimetry

The UPSR staff participated in education and training activities in:

- Master´s and Doctoral programmes in several universities and higher education establishments
- Short-duration training courses offered to several institutions and companies

Furthermore, supervision of several Master's thesis and Doctoral programmes was pursued by the UPSR staff. Three Ph.D. theses and several Master's theses were accomplished, under the supervision of UPSR staff.

National & International Representation

UPSR staff acted as Portuguese representatives or delegates in Committees and Working Groups of the European Union, the IAEA, the OECD Nuclear Energy Agency, BIPM, OSPAR, among others.

Representation in national Commissions and Working Groups was also assured, providing technical and scientific advice.

Preparedness of Response to Radiological and Nuclear Accidents/Emergencies

In the event of a radiological and nuclear accident (such as the one in Fukushima) the UPSR together with the other national competent authorities should play a key role in the response to the resulting emergency situation. In this respect, scientific and technical expertise, techniques and equipment must be available to be deployed.
The competences in the existing biodosimetry techniques were further consolidated and new techniques started to be implemented, in the framework of the UPSR participation in European networks and projects, aiming at increasing the preparedness of response to radiological and nuclear emergencies.
The operation of the Whole Body Counter, unique equipment in Portugal, to assess the internal contamination of individuals due to the incorporation of radionuclides, was maintained.

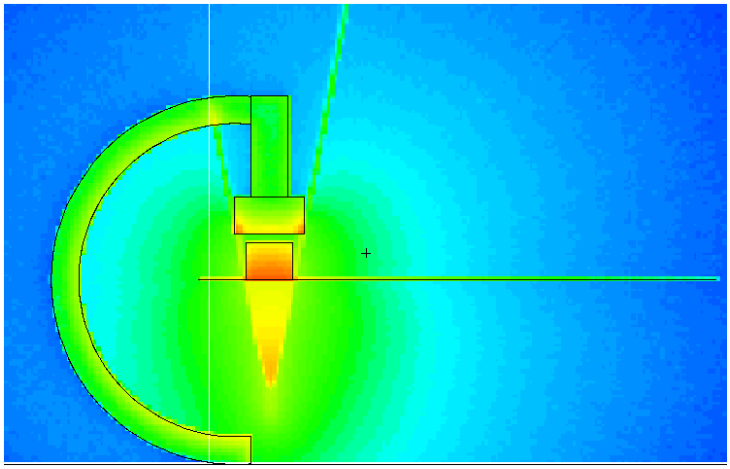


Fig.1: Dosimetry of the medical applications of ionizing radiation: computational dose assessment of an interventional cardiology room in a Portuguese hospital.

Fig. 2: Dosimetry of the medical applications of ionizing radiation: CT-fluoroscopy: hand phantom (left) and model (right, the red dots correspond to dosimeters).

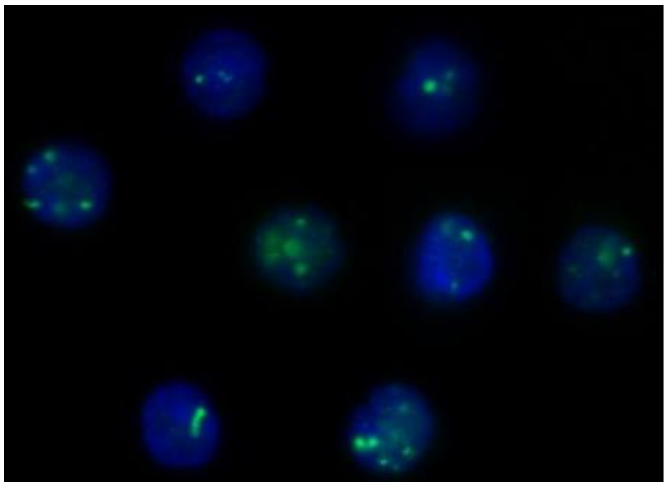


Fig. 3: Study of the biological damage induced by ionizing radiation using the γ-H2AX assay.

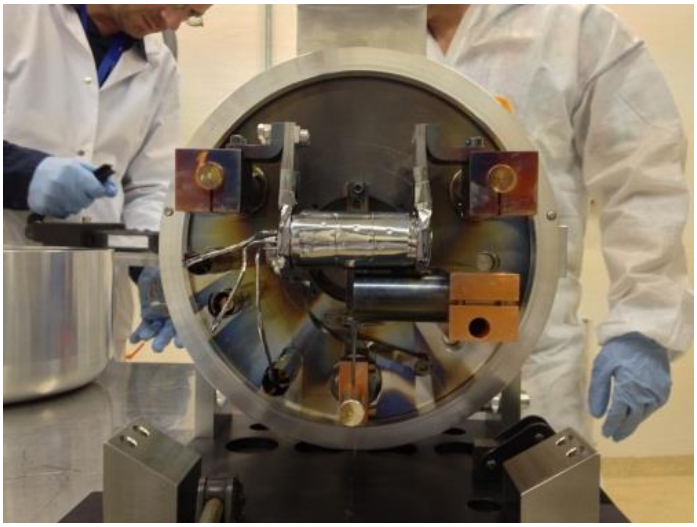


Fig. 4: Cooperation with CERN in the development of target prototypes for ISOLDE.

Fig. 5: Infrastructures at the UPSR: Cobalt-60 irradiator (left) and HPGe detectors for gamma spectrometry (right).

Fig. 6: Radiological monitoring during the visit of nuclear propulsion vessels (left) and radiation surveys of facilities (right).

Groups – R&D Activities

Dosimetry and Radiobiology Group

TEAM

Name	Category	R&D
Pedro Vaz	Principal Researcher with habilitation	50%[1]
João Alves	Auxiliary Researcher	100%
Octávia Gil	Auxiliary Researcher	100%
Augusto Oliveira	Auxiliary Researcher	100%
Pedro Teles	Auxiliary Researcher (*Ciência 2008*)	100%
Maria Neves	Principal Researcher (retired)	Collaborator
Yuriy Romanets	Technician (Ph.D. finished in 2012)	100%
Tiago Antunes	Technician	100%
Lubélia Machado	Technician	100%
Sandra Rangel	Technical Assistant	100%
Manuela Saraiva	Technical Assistant	100%
Salvatore di Maria	Post-Doc Fellow	100%
Catarina Figueira	Fellow (FCT)	100%
Vanda Martins	Fellow (FCT+IST)	100%
Ana C. Antunes	Fellow (FCT)	100%
Joana Bento	Fellow (FCT)	100%[2]
Miguel Pereira	Fellow (IST)	100%
Filipa Costa	Fellow (IST)	100%
Mónica Mendes	Fellow (IST)	100%
Mariana Baptista	Project Fellow (FP7-Security)	100%
Joana Pereira	Project Fellow (FCT since Nov 2012)	100%
Mário Oliveira	Project Fellow (FCT)	100%
Carlos Carrapiço	Ph.D. Fellow (FCT, Ph.D. finished in 2012)	50%
Raul Sarmento	Ph.D. Fellow (FCT, Ph.D. finished in 2012)	50%
Ana Belchior	Ph.D. Fellow (FCT)	100%
Raul Luís	Ph.D. Fellow (FCT)	100%
Sílvia Barros	Ph.D. Fellow (FCT)	100%
Cecília Borges	Ph.D. Fellow	30%

OBJECTIVES

To undertake the following activities:

- Research and development
- Technical services
- Fulfilment of legal obligations
- Education and training
- Representation in national and international Committees and Working Groups
- Response to radiological and nuclear emergencies

in Computational Dosimetry, Individual Dosimetry, Internal Dosimetry, Biological Dosimetry and Radiobiology. As follows:

- Research and development:
    - Participation in R&D projects funded by the:

[1] Accumulate with Coordination functions of the Unit.
[2] Until June 2012.

  - European Union EURATOM 7th Framework Programme
  - EMRP ("European Metrology Research Programme") of EURAMET ("European Association of National Metrology Institutes")
  - Foundation for Science and Technology (FCT)
- Cooperation with:
  - EURADOS ("European Radiation Dosimetry Group")
  - CERN (European Laboratory for Particle Physics)
  - Institutes and research centres such as PTB (Germany), SCK/CEN (Belgium), IRSN (France) and CIEMAT (Spain), amongst others.

- Services and fulfilment of legal obligations:
  - Individual monitoring of workers exposed to ionizing radiation
  - Radiological safety assessment of medical installations (external radiotherapy, brachytherapy, nuclear medicine) and industrial facilities (particle accelerators, etc.)
  - Maintenance and update of the Central Dose Registry containing the dosimetric data of workers exposed to ionizing radiation
  - Establishment of opinions ("pareceres") for the licensing of service provider companies in the areas of radiological protection, dosimetry and education and training.
- Representation in Committees and Working Groups of the European Union, IAEA and OECD/NEA.
- Operation of equipment, laboratories and infrastructures in the aforementioned areas.
- Participation in education and training activities teaching Radiological Protection, Dosimetry and Radiobiology disciplines in academia as well as for workers in the medical and industrial sectors.

Last but not least, the implementation of a Quality Management System and the accreditation of the individual monitoring techniques.

MAIN ACHIEVEMENTS

R&D Projects

- On-going projects: staff and fellows from the Dosimetry and Radiobiology Group (GDR) participated in research activities in the framework of:
  - Projects executed by international consortia of institutions in the framework of:
    - The EU 7th FWP EURATOM and SECURITY, namely, ENETRAP-II, FREYA, RENEB, REWARD and TRASNUSAFE.
    - The EMRP of EURAMET, namely the project "BioQuaRT".
  - Projects in collaboration with CERN:
    - "*Cooperation with CERN - Optimization studies of the ISOLDE targets and design of HIE-ISOLDE*" (funded by FCT).
    - "*Participation of ITN in the n-TOF-Ph2 experiments at CERN*" (funded by FCT).
  - National projects funded by the FCT:
    - "*Tecnologias digitais em mamografia: optimização utilizando métodos de simulação de Monte Carlo*".
    - "*Distribuição de doses e simulações Monte Carlo em fluoroscopia CT*".

- The project "*Dose Datamed 2 – Portugal - Assessment of the exposure of the Portuguese population to ionizing radiation due to medical practices*"
- EURADOS Working Groups (in individual monitoring, internal dosimetry, computational dosimetry, dosimetry in the medical applications of radiation and retrospective dosimetry).

- Projects submitted: staff from GDR participated in the submission of the following projects:
  - PREPARE (7th FWP EURATOM, approved for funding)
  - MARISA and ENETRAP-III (7th FWP EURATOM, currently under evaluation)
  - "*Melhoria da qualidade de imagem e redução de dose em tomossíntese para mamografia, com recurso a algoritmos estatísticos de reconstrução de imagem*" (approved for funding by FCT)

Other R&D activities

- **Computational Dosimetry**
  - Monte Carlo simulations were applied in Radiation Protection and Safety, Dosimetry and Shielding studies of:
    i) Radiological and nuclear installations
    ii) Medical radiological equipment
  - Radiation detection systems
  - The competences in the manipulation of voxel phantoms were consolidated.
- **Medical applications of ionizing radiation**
  - Cooperation links with hospitals were fostered aiming at the measurement or assessment of doses in mammography, Computer Tomography and Fluoro-CT
  - Research activities and studies in Nuclear Medicine, radiotherapy and brachytherapy were undertaken in the framework of Ph.D. and Master theses supervised by GDR researchers
  - Compilation of dosimetric data concerning the exposure of the Portuguese population in the framework of the medical applications of ionizing radiation ("*DoseDataMed II – Portugal*" project.
- **Internal Dosimetry**
  - The skills in the manipulation of biokinetic models were consolidated and strengthened
  - The operation of the Whole Body Counter (unique equipment in Portugal) and associated phantoms (BOMAB, RMC-II, etc.) was consolidated.
- **Biological Dosimetry and Radiobiology**

  The competences and skills were strengthened and expanded through studies in the Portuguese population, relative to the determination of the dose-response curves for exposure to gamma radiation. These studies used biodosimetry techniques and assays such as the assessment of dicentrics, micronuclei and γ-H2AX.
- **Effects of exposure to low dose radiation**

  The GDR followed the activities of the MELODI ("*Multidisciplinary European LOw Dose Initiative"*) platform, namely in the definition of a strategic research agenda for low dose radiation research in Europe.

Several articles were published in international peer reviewed journals and several contributions were presented at International Conferences and Workshops.

Technical services and fulfilment of legal obligations

- The activities of radiological safety assessment of medical installations, namely of external radiotherapy (8), brachytherapy (1) and nuclear medicine (4) as well as of industrial installations (1) continued at a sustained pace.
- The whole body individual dosimetry and monitoring services were operated at a good rhythm and an increase was observed in the number of monitored workers and of controlled installations.
- Environmental monitoring activities for the national environmental radiological monitoring programme were pursued.
- The Central Dose Registry was updated with dosimetric information from the 7 services and companies currently operating in Portugal offering individual monitoring services.

Accreditation of dosimetry techniques

Two individual monitoring techniques formally received the accreditation from IPAC (Portuguese Institute for Accreditation).

Education and Training activities

Several GDR researchers and technical personnel:

- Taught disciplines of Radiological Protection and Dosimetry, in Universities and Higher Education establishments.
- Supervised Ph.D. theses (3 concluded in 2012 and 5 others on-going) and Master theses.
- Participated in short duration training courses in radiological protection and dosimetry.

Representation in international and national Committees and Working Groups

GDR staff acted as national or institutional representatives in international Committees and Working Groups of the European Union, the Nuclear Energy Agency (NEA) of the OECD as well as in national Commissions.

RELEVANT PAPERS

- "Monte Carlo modelling and simulations of the High Definition (HD120) micro MLC and validation against measurements for a 6 MV beam", C. Borges *et al.*, Med. Phys, 37(1), 415-423 (2012).
- "Monte Carlo simulation of the movement and detection efficiency of a Whole Body Counting System using a BOMAB Phantom", J. Bento *et al.*, Radiat. Prot. Dosim. 148(4), 403-413 (2012).
- "Estimation of the Collective Dose in the Portuguese Population Due to Medical Procedures in 2010", P. Teles et al., *Radiat. Prot. Dosim. (2012), doi:10.1093/rpd/ncs258.*
- "Dose and time dependence of targeted and untargeted effects after very low doses of α-particle irradiation of human lung cancer cells", *A. Belchior et al., Dose Response (2012) (accepted for publication).*
- "Assessment of Pediatric CT Exposure in a Portuguese Hospital", A. Neves et al., *Radiat. Prot. Dosim, (2012), doi:10.1093/rpd/ncs037.*
- "Polymorphisms in base excision repair genes and thyroid cancer risk", *L.S. Santos et al., Oncology Reports, 28(5), 1859-1868 (2012), doi: 10.3892/or.2012.1975.*
- "Implementation of a dose-response curve for γ-radiation in the Portuguese population by use of the chromosomal aberration assay", *V. Martins et al., Mutation Research - Genetic Toxicology and Environmental Mutagenesis, Epub 2012 Oct 5 (2012), doi: 10.1016/j.mrgentox.2012.09.009.*

FUNDS

Project/Service	Reference	Timeframe	2012
Projects			
ENETRAP-II	FP-7 EURATOM	2009-2012	0,00 €
TRASNUSAFE	FP-7 EURATOM	2010-2014	0,00 €
CDT	FP-7 EURATOM	2010-2012	0,00 €
FREYA	FP7-EURATOM	2011-2015	0,00 €
REWARD	FP7-EURATOM	2011-2014	133.760,00 €
RENEB	FP7-EURATOM	2012-2016	7.232,34 €
BioQuaRT	EMRP/EURAMET	2012-2014	60.344,64 €
Cooperation with CERN - Optimization studies of the ISOLDE targets and design of HIE-ISOLDE (CERN/FP/123598/2011)	FCT funded	2012-2014	2.250,00 €
Tecnologias digitais em mamografia: optimização utilizando métodos de simulação de Monte Carlo (PTDC/SAU-BEB/100745/2008)	FCT funded	2009-2012	0,00 €
Distribuição de doses e simulações Monte Carlo em fluoroscopia CT (PTDC/SAU-ENB/115792/2009)	FCT funded	2011-2014	0,00 €
Services			
Radiological Safety Assessment of installation	Service	2012	119.499,27 €
Individual dosimetry and monitoring	Service	2012	120.000,00 € (estimation)
		Total	**443.086,25 €**

Environmental Radioactivity Group

TEAM

Name	Category	R&D
Maria José Madruga	Principal Researcher	100%
Fernando P. Carvalho	Principal Researcher	100%
José Alberto G. Corisco	Auxiliary Researcher	100%
Mário Capucho dos Reis	Auxiliary Researcher	25%
João Maria Oliveira	Graduated Technician	100%
Maria Irene Lopes	Graduated Technician	100%
Maria Margarida Malta	Graduated Technician	100%
Anabela Figueiredo Mourato	Technician	100%
Maria Albertina Libânio	Technician	100%
Ana Rita Dias Gomes	Grantee GCT (FCT)	100%
Eva Andrade	Grantee GCT (FCT)	100%
João Oliveira de Melo	Grantee GCT (FCT)	100% (until August 2012)

OBJECTIVES

The objectives of the Environmental Radioactivity Group (GRA) are:

- The development of research activities in the study of the biogeochemical cycles of natural and artificial radionuclides in the atmosphere (aerosols) aquatic and terrestrial environments under projects funded by FCT, FP-7, QREN/IAPMEI;
- The implementation of the annual environmental radiological monitoring programmes (at National Level, the Source Related programme for the CTN *Campus* and the Specific programme for the Regions around Old Uranium Mining Sites) to fulfil the State´s obligations (Decree-Law 138/2005, 17th August) and the EURATOM Treaty Article 35/36 requirements;
- The concession of accreditation by the Portuguese Accreditation Body (IPAC) of five radioanalytical techniques and maintaining the requirements of the Quality Management System (NP ISO/IEC 17025) implemented at the GRA laboratories. The participation in international laboratory inter-comparison exercises in order to prove the quality of the results issued.
- The development and improvement of radioanalytical techniques;
- Provide technical services to private and public entities to fulfil State's obligations in the determinations of radioactivity levels in waters, foodstuff, indoor radon, etc.
- To maintain operational the radionuclide particulate station RN53, installed at São Miguel island, Azores, belonging to the International Monitoring System (IMS) network for the verification of the Comprehensive nuclear-Test Ban Treaty (CTBT)
- Participation in national and international technical and scientific committees (IAEA, IAEA-ALMERA, EC, CTBT, etc) to fulfil legal obligations or as advisors;
- Provide high education and training in environmental radioactivity and radiological protection;
- Disseminate of the GRA activities with the preparation of papers for presentation in conferences, workshops, etc., for publication in peer-reviewed international scientific journals and elaboration of internal reports;

MAIN ACHIEVEMENTS

Research & Development Activities

DYNOZONE – Analysis on the temporal evolution of ^{7}Be (series of 10 years with weekly frequency) in aerosol particulate samples. Installation of a HVS equipment at the *Campus* of University Fernando Pessoa (Porto) and measurement of the ^{7}Be activity at the aerosol samples by high resolution gamma-ray spectrometry.

ENGENUR – Analyses of samples from biota exposed to uranium mine waste and search of correlation of toxic effects and exposure. Preparation of an experimental set up in the field to be fully implemented in 2013.

PREPARE – This project approved in 2012 will start in February 2013 and aims to close gap that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster.

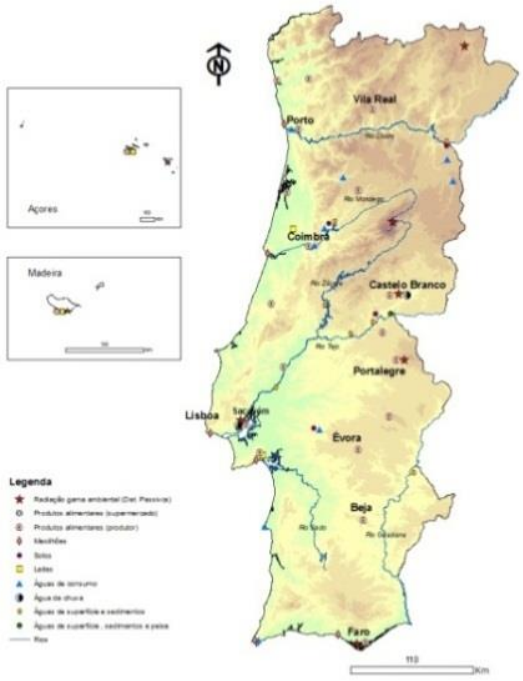
KADRWaste (follow up) – The ^{137}Cs adsorption/desorption in *raña* (continental detrital sediments, constituted mainly by clay minerals) was investigated as a function of Cs, K and Mg concentrations. Two different experimental systems (static and dynamic) were tested and compared, simulating *in situ* conditions for ^{137}Cs desorption in case of an incident/accident scenario in a radioactive waste disposal facility.

ROBOSAMPLER – Preliminary results show that the silt/clay fraction (<63 μm) of surface sediments collected from the southern bank of the estuary bay at the Samouco mudflats, has a lesser diversity of natural radionuclides than far upstream in river sediments. Concentration ratios higher than 1 for some radionuclides in the Japanese clams from Samouco might be explained as result of bioaccumulation from ingested organic particles retained in the fine sediment fraction.

CAPTAR – Participation in the education web based project CAPTAR (Web site: captar.web.ua.pt) in the field of environmental sciences.

Legal obligations activities

The Radiological Environmental Monitoring Programmes were performed in collaboration with the Measurement Laboratories (LM). The radiological environmental survey has as main objectives to quantify the artificial and natural radionuclide levels in the environment (aquatic, terrestrial and atmospheric) considered as direct pathways of contamination to man and to evaluate the external radiation levels in order to assess the potential exposure of the Portuguese population.
During 2012, about 530 samples (aerosols, rainwater, surface water, drinking water, sediments, fish, mixed diet, complete meals, milk, soils, etc.) were collected and a total of about 1700 analyses were performed for the determination of artificial and natural radionuclides, using gamma and alpha spectrometry, alpha/beta measurements and liquid scintillation technique. The results show that Portuguese population was not exposed to radioactive contamination levels higher than the radioactive background. Consequently, there is no need to adopt any measures for radiological protection of the population. All the data are published in Internal Reports available on the IST/ITN website (http://www.itn.pt) and entered on the European Radioactivity Environmental Monitoring Database (REM) located at the EU Joint Research Centre, ISPRA (Italy). The implementation of these programmes required a proportion of time spent by the GRA human resources of about 75% and a financial cost of around 300k€.



Quality Management System according to NP ISO/IEC 17025

The accreditation of three radioanalytical techniques (gross alpha and gross beta in waters by Liquid Scintillation Counting (LSC) and tritium determination in waters by LSC) by the Portuguese Accreditation Body (IPAC) was achieved in July 2012. In September 2012, an internal audit was carried out by an independent auditor having highlighted the good quality of the work developed, the experience, technical training and the spirit of openness to improvement of the staff involved. A continuous effort was devoted during the year by the personnel involved to maintain and improve the quality system implemented at the GRA laboratories. The Group participated in collaboration with the Measurement Laboratories in international inter-comparison exercises for the

radioanalytical techniques. The results published in 2012 were in good agreement/compatible with the reference values. In order to increase the Environmental Radioactivity Group and the Measurements Laboratories capabilities a new technique for the determination of ^{228}Ra, ^{226}Ra in waters by LSC have been tested. The technique for the determination of ^{222}Rn in waters by LSC was also improved.

Technical Services

During 2012, a total of about 150 analyses were performed for the determination of gross alpha, gross beta, tritium and Total Indicative Dose in drinking waters (Decree-Law 306/2007), ^{222}Rn in waters and ^{90}Sr in foodstuff samples.
Following the National System of Building Energetic Certification for the Indoor Air Quality (Decree-Law 78/2006, NT-SCE-02) measurements of indoor radon were requested. Besides, since November 2003 a collaborative Protocol was established between UPSR-ITN and DECO to answer the associate's indoor radon requests. In 2012, about 470 measurements were carried out.

Other Technical/Scientific Activities

GRA members were involved in scientific conference organizations, in international technical and scientific committees and working groups from IAEA, EC, ISO and CTBT and in high education and training activities in environmental radioactivity and radiological protection.

RELEVANT PAPERS

- C. Miró, A. Baeza, M.J. Madruga, R. Periañez. Caesium-137 and strontium-90 temporal series in the Tagus River: experimental results and a modelling study. *Journal of Environmental Radioactivity*, 113, 21-31 (2012), doi:10.1016/j.jenvrad.2012.04.012.
- D. D. Nhan, F.P. Carvalho, N. Ha, N. Quang Long, D. D. Thuan, H. Fonseca. Radon (222Rn) concentration in indoor air near the coal mining area of Nui Beo, North of Vietnam. *Journal of Environmental Radioactivity* 110, 98-103 (2012).
- F. P. Carvalho, J. M. Oliveira, M. Malta. Forest fires and resuspension of radionuclides into the atmosphere. American *Journal of Environmental Sciences* 8 (1): 1-4 (2012), doi: 10.3844/ajessp.2012.1.4.
- F. P. Carvalho, M.C. Reis, J. M. Oliveira, M. Malta, L. Silva. Radioactivity from Fukushima nuclear accident detected in Lisbon, Portugal. *Journal of Environmental Radioactivity* 114: 152-156 (2012), doi:10.1016/j.jenvrad.2012.03.005.
- M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio. Characterization of geomaterials from NE Portugal using k_o-based instrumental neutron activation analysis (k_o-INAA) and gamma spectrometry methods, *J. Radioanal Nucl Chem*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.

FUNDS

Project/Service	Reference	Timeframe	2012
DYNOZONE- *Total column and surface ozone variability over the Iberian Peninsula: Dynamical and chemical atmospheric factors*	FCT PTDC/CTE-ATM/105507/2008	2011-2013	5.359,00 €
ENGENUR- *Definition of new ENdpoints to assess GENtoxic effects resulting from environmental exposures to URanium, Uranium daughters and ionizing radiation in bioindicator species*	FCT PTDC/AAC-AMB/114057/2009	2010-2013	11.450,00 €
ROBOSAMPLER- *Development of a Terrestrial Robotic System as a Tool for Radiological and Heavy Metal Monitoring in Estuarine Environments* funding by QREN/IAPMEI (PORLisboa)	Lisboa-01-0202-FEDER-24961	2013-2014	0,00 €
Comprehensive Nuclear-Test Ban Treaty	Contract nº. 2008-0065	2012	30.000,00 €

Organization *"Testing and Evaluation and Post-Certification Activities"* for the RN53 radionuclide particulate station			
Analyses of radioactivity in waters (in collaboration with LM)	Technical Services	2012	16.000,00 €
Analyses of radioactivity in foodstuff (in collaboration with LM)	Technical Services	2012	500,00 €
Indoor radon measurements	Technical Services	2012	25.000,00 €
		Total	**83.390,00 €**

INTERNATIONALIZATION

- **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 nº 2008-0065 *"Testing and Evaluation and Post-Certification Activities"*. On June 2012, CTBTO organized the first training course for radionuclide stations managers, with stations operating under PCA contracts: *Training Course on Operation and Maintenance for IMS Radionuclide Station Managers*, 18-22 June, Vienna, Austria. RN53 Participant: M. Reis.

Metrology Laboratory of Ionizing Radiation Group

TEAM

Name	Category	R&D
Carlos Oliveira	Principal Researcher with habilitation	100%
João Cardoso	Graduated Technician	100%
Luis Santos	Technician	100%
Margarida Caldeira	PhD student, FCT grant	

OBJECTIVES

The activities of Metrology Laboratory of Ionizing Radiation (LMRI) include the scientific, applied and legal metrology and occur under a protocol with the IPQ (Portuguese Institute for Quality), the body responsible for coordinating the SPQ, dated from 1989, revised and updated in 2009.

Participation in European projects of the EMRP.

Participation in activities of EURADOS related to computational dosimetry.

Development of a robust system of primary standards. Ongoing construction of two types of standards: cavity chamber and free air chamber.

To ensure high quality academic theses through the presentation of several scientific themes and close follow-up of the students.

As National Laboratory of Ionizing Radiation, LMRI should ensure the maintenance of national standards of dosimetric and radiological protection quantities, realize the characterization of radiation fields and perform the dosimetry of radiation fields.

LMRI also performs calibration and metrological verification of dosimeters and radiation protection equipment. Irradiation of personal dosimeters for Dosimetry and Radiobiology Group of UPSR and collaboration with RPI-URSN to realize the metrological verification of the radiation protection equipment is also one of the inter-group activities to be carried out by LMRI.

To continuously improve the effectiveness of the Quality Management System is a fundamental task of LMRI. Prepare an audit plan for 2012 and prepare a plan of the corrective actions according to the findings of previews audits; collaborate with the reviewer team of 43 CMCs available at LMRI and, currently, under revision. These CMC's are recognized by CIPM and EURAMET and are published at BIPM site.

Review of general, administrative and technical procedures and writing of new ones. Fulfil the plan of calibrations of ionizing chambers (secondary standards) and other devices.

Ensure representation on international committees and working groups related to the metrology of the ionizing radiation and radiation protection.

MAIN ACHIEVEMENTS

EMRP IND 04- MetroMetal "Ionising radiation metrology for the metallurgical industry". Start date 01/12/2011. End date 12/01/2014.

This project has 14 European partners. During the year 2012 the priority of the project has been the definition of the optimized methods for the measurement of radioactivity in scrap loads and to collect information about the traceability for measurements of radioactivity in cast steel products. Taking into account the goals to be reached, a questionnaire had been prepared concerning the current gate monitor systems operated in steel companies and various alternatives to the measurement systems currently used at steel factories for the determination of radioactive contamination in cast steel and slag samples. The Portuguese team involved in the project invested some effort in the dialogue with the steel making factories and managed their collaboration. On other hand, our participation on reports produced was realized with suggestions and comments.

EMRP JRP-i13 MetroNORM "Metrology for processing materials with high natural radioactivity", submitted and approved in 2012. Start date 05/01/2013 end date 01/05/2016. This project has 12 European partners. Due to the efforts of all 12 partners during 2012, the project has been approved.

The design and construction of a new model of graphite cavity chamber has been realized, in the framework of a PhD thesis. This new model has a higher volume (~6 cm3) and spherical ends. An automated system was programmed with Labview and implemented in order to control the data acquisition equipment and to log the measured values for current/charge, temperature, humidity and pressure.

Participation in EURADOS Intercomparison on Monte Carlo modelling for the in-vivo monitoring of 241Am in Skull phantom (in progress).

In the framework of a MSc. thesis, a first characterization of the radiation field of the mammography unit (GE Senographe 600T Senix) allowed to know that the radiation field produced by the unit did not fulfill the necessary conditions for the realization of dosimetry. After some changes in the geometry of the system, namely the X-ray tube inclination, a radiation field with the adequate characteristics was obtained. The HVL values were determined in order to characterize the radiation qualities according to the international standard IEC 61267, and the dosimetry for the RQR-M radiation qualities was performed.

A one-day Workshop entitled "METROLOGIA DAS RADIAÇÕES IONIZANTES E APLICAÇÕES CLINICAS" was co-organized with the Centro Hospitalar Lisboa Norte, Hospital de Santa Maria with two sessions: Radiotherapy and Radiodiagnostic. The goal of this workshop was to strength the link between the Metrology Laboratory and the stakeholders and final users. The Workshop had 40 participants and the support of the Divisão de Física Médica of Sociedade Portuguesa de Física.

In 2011, LMRI participated in a comparison of therapy level ionizing chamber calibration coefficients promoted by the AIEA. The results were known during 2012: For the comparison of the air kerma, value was 0.998 and for the comparison of absorbed dose to water, value was 0.995. These results are inside the range of values which does not need any corrective action. LMRI also participated in the TLD audit to the absorbed dose to water for ^{60}Co promoted by the AIEA. The results obtained for the exercise of 2012 showed a relative deviation of -0.5%. Agreement within +/-3.5 % is considered satisfactory by the AIEA.

To monitor the Quality Management System two internal audits and two external audits in the framework of the EURAMET and IPAC accreditation, have been carried out. The Euramet audit, a peer review audit, has occurred in the framework of the project 1123 entitle "On site peer review". Three institutes, INRIM (Italy), CEM (Spain) and IPQ participated on this Project. LMRI participated in the project realizing audits to CIEMAT-LMRI and INRIM-ENEA.

LMRI provides the community, mainly hospitals, industry, universities, armed forces and IST/ITN Units with calibration and metrological control services. During 2012, 120 dosimeters were calibrated and controlled, 2 medical dosimeters were also calibrated and 1100 TLD's were irradiated.

The LMRI has a representative in the Technical Committee of the Radiological EURAMET, and participates as an observer in the CCRI (I) (Consultative Committee for Ionizing Radiation) of the CIPM (International Committee for Weights and Measures) and is part of the IAEA/WHO SSDL (Secondary Standards Dosimetry Laboratories. Participate also in the Group of Experts of art. 31. (Radiation Protection) of UE.

RELEVANT PAPERS

- Silva Ribeiro, A., Oliveira, C., Cox, M. G., Alves e Sousa, J., Lages Martins, L., Cardoso, J., Limede, P., Modelling and uncertainty evaluation for the radiation quality parameters used in metrological management of diagnostic radiology dosimeters, Advanced Mathematical and Computational Tools in Metrology and Testing, vol. 9, pg. 377-384 (editors: F. Pavese, M. Bar, J-R Filtz, AB Forbes, L. Pendrill, H. Shirono). Series on Advances in Mathematics for Applied Sciences, vol. 84. World Scientific. Singapura, (2012).
- Plagnard J, Oliveira C, Cutarella D, Gouriou J, Aubineau-Lanièce I, Rodrigues M, Portugal L, Cardoso J, , Full characterization of the 125I IBt Bebig I25.S16 brachytherapy source and sensitivity study of the absorbed dose to water due to the seed dimensional variations, *Metrologia*, vol. 49, nº 5, S223-S227. (2012).

- Oliveira, C. Cardoso, J. Santos, L., Limede, P., Góis, D., Oliveira, M. A dosimetria em radiodiagnóstico. *Medições e Ensaios* (SPMet), Vol 1, nº 3. September 2012.
- D. Broggio,J. Bento, M. Caldeira, E. Cardenas-Mendez, J. Farah, T. Fonseca, C. Konvalinka, L. Liu, B. Perez, K. Capello, P. Cowan, J.-A. Cruzate, L. Freire, J.-M. Gómez-Ros, S. Gossio, B. Heide, J. Huikari, J. Hunt, S. Kinase, G.H. Kramer, O. Kurihara, A. Kyrieleis, A.-L. Lebacq, D. Leone, C. Li, J. Li, L.-C. Mihailescu, M. Moraleda, J.-F. Navarro, C. Oliveira, N. Puerta, U. Reichelt, C. Simões, D. Sommer, M. Takahashi, P. Teles, F. Vanhavere, T. Vrba, D. Franck, G. Gualdrini, M.-A. Lopez. Monte Carlo modelling for the in vivo lung monitoring of enriched uranium: Results of an international comparison. Radiation Measurements. Vol. 47, 7, 492-500. (2012).
- Diana D. Duarte, João Cardoso, Luís Santos, Carlos Oliveira, Lina Vieira, Estudo da eficiência de deteção de um monitor portátil de contaminação de superfícies em função da distância e do débito de emissão da fonte. Saúde & Tecnologia. Nº. 8. November 2012.

FUNDS

Project/Service	Reference	Timeframe	2012
EMRP IND 04 - MetroMetal		01/12/2011-12/01/2014	49.620,10 €
iMERA Brachytherapy		01/06/2008-31/05/2011	2.915,20 €
Services		01/01/2012-31/12/2012	47.576,50 €
		Total	**100.111,80 €**

Radiation Protection and Radioactive Waste Group

TEAM

Name	Category	R&D
Isabel Paiva	Auxiliary Researcher	100%
Luis Portugal	Graduated Technician	100%
Pedro Pereira	Graduated Technician	100%
José Venâncio	Technician	100%
Alfredo Baptista	Grantee	60%

OBJECTIVES

Main working areas of GRRR are research and development, training and education, expertise and legal support to regulators and competent authorities, representation in national and international organizations and services to the Community.

- To pursue and increase the participation in national and international R&D funded by EURATOM/FP-Fission, EURAMET, FCT and QREN/IAPMEI;
- To pursue the involvement of GRRR in the EU Technological Platforms (IGD-TP, NERIS-TP) as a way to further increase the participation of the Group in the new research Agendas (Lisbon Strategy and Horizon 2020);
- To increase the collaboration with other Universities and training centers (at national and international level and within the collaboration with the IAEA and with the PALOP's);
- To collaborate in the fulfilment of university post-graduate degrees (Ph.D. and Master's) and to increase dissemination and visibility of GRRR' research and technical activities through participation in workshops and conferences, papers published and fulfilment services request;
- To ensure support to the national regulators and competent authorities (DGS, APA, MNE, MES and MEE, ANPC, CNTMP, CNER, REPER Brussels, Permanent Mission in the IAEA/Vienna) in matters of national strategies concerning GRRR areas of expertise;
- To ensure participation in international bodies (Euratom Treaty , Art. 37º, IAEA Committees, EU Committees, Joint Convention of the IAEA, OSPAR Convention) as national experts in the areas of GRRR activities;
- To pursue development of services: Radioactive waste management; Licensing of radioactive sources; Transport of radioactive materials; Intervention in case of radiological emergencies; Detection of radioactive materials in scrap metal; Radiological monitoring of radioactive liquid discharges from medical establishments in Lisbon Borough sewer system; Radiological surveillance during the visit of nuclear vessels in Portuguese harbours; Radiological verification of medical, industrial, research and teaching facilities;
- To pursue the management of the following facilities: Radioactive Waste Laboratory; Active Samples Gamma-Spectrometry Laboratory; Radioactive Liquid Waste Discharge Treatment Station of CTN (ECoDELiR); CTN gamma monitoring network – Gammanet; Radioactive Waste Interim Storage Facility (PAIRR).

MAIN ACHIEVEMENTS

Research and Development

ACSEPT – IST/ITN (UCQR/QIO, GRRR). Work was mainly developed in the domain "Design, Synthesis and Assessment of Novel Ligands". Electrospray ionization quadrupole ion trap mass spectrometry (ESI-QIT/MS) was used to investigate several aspects of the coordination chemistry of lanthanides and actinides.

PETRUS II – Towards an European Training Market and Professional Qualification in Geological Disposal. Post-Graduation development of the PD and Pilot PD programmes.

PREPARE – The project aims to close gaps that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster.

MetroMETAL – Data collected from a questionnaire was processed and separate reports summarizing the systems and methods currently used for monitoring scrap loads, cast steel, slags and fume dusts were prepared with the support of the two Portuguese steel making companies. A Monte Carlo model of the spectrometric device for measuring the activity of cast steel and slag samples has been studied by the Portuguese team.

MetroNORM – The project addresses the development of measurement systems, methods and techniques including in-situ systems which support design of traceable measurement procedures for industrial NORM and TENORM raw material, products, by-products, residues and waste, development.

KADRWaste Follow-up – Development of a methodology to assess adequate sites to host a radioactive waste disposal facility for LILW has been pursued with research on Cs-137 adsorption/desorption mechanisms with mineral surfaces of continental detrital sediments known as *raña*, have been studied in order to act as liner/backfill/buffers for LILW repositories.

CMET Project/ IGD-TP – Transference of the state of the art analysis and needs in GD, development of quality assurance procedures and criteria for the voluntary accreditation of T&E in geological disposal using the ECVET approach.

IGD-TP – Technological platform dedicated to initiate and carry out European strategic initiatives to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level waste and other long-lived radioactive waste, addressing other scientific, technological and social challenges, and support the radwaste management programs in the EU.

ARIAS – Development of training and education programs in radiological protection, radwaste, etc., written material/presentations and implementation of the training courses, analysis of the inputs in terms of adequacy to the proposed objectives of ARIAS project.

ROBOTSAMPLER – Development of an autonomous terrestrial robotic system for radiological and heavy metal monitoring in estuarine environments. Development of technical specifications for sample collection and measurement by gamma spectrometry and instrumental neutron activation analysis.

TECHNICAL ACTIVITIES

- Radioactive waste management - **165** requests;
- Licensing of radioactive sources - **495** sealed sources licensing were issued: national territory introduction licences (**104**), transfer licences (**89**), transport licences (**116**) and ownership licences (**186**);
- Radioactive liquid discharges from CTN - **191** samples were analysed and measured before being discharged;
- Nuclear vessels radiological monitoring - **4** nuclear vessels stayed at Portinho da Costa harbour and estuary of Rio Tejo;
- Detection of radioactive materials in scrap metal at smelting factories - **14** events related have been reported;
- Gamma spectrometry analysis - **426** gamma spectrometry analysis were performed on samples from medical, industrial and environmental origin;
- Radiological protection and safety verifications - **21** verifications and monitoring actions concerning radiological protection and safety of medical and industrial facilities.

RELEVANT PAPERS

- Characterization of geomaterials from NE Portugal using k_o-based instrumental neutron activation analysis (k_o-INAA) and gamma spectrometry methods, M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio, *J. Radioanal Nucl Chem*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.
- 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, Pedro Duarte, Lídia Silva, António

Mateus, M. Fátima Araújo, Mário Reis, Romão Trindade, Isabel Paiva, Environ., Earth Sci. doi:I 10.1007/s12665-012-1758-0

- Effect of competitive ions on radiocaesium retention in clay mineral phases from raña deposits (NE Portugal). M.J. Madruga; M.J. Madruga; I. Paiva; E. Andrade; M. A. Gonçalves; A. Mateus Full paper submitted to Applied Geochemistry, November, 2012.
- Effect of competitive ions on radiocaesium retention in clay mineral phases from raña deposits (NE Portugal), M.J. Madruga, I. Paiva, E. Andrade, M.A. Gonçalves, A. Mateus, 9th International Symposium on Environmental Geochemistry, Aveiro, Portugal, July 15-21 (2012), Invited talk.

FUNDS

Project/Service	Reference	Timeframe	2012
ACSEPT	EURATOM/FP7-Fission	End October 2012. Final report has been delivered.	
PETRUS II	EURATOM/FP7-Fission	End September 2012. Final report has been delivered.	
IND04 MetroMETAL	EURAMET EMRP	Started December 2012. First report has been delivered February 2013	
IND04 MetroNORM	EURAMET EMRP	Approved in 2012. First Meeting due March/April 2013	
PREPARE	EURATOM/FP7-Fission	Kick-off meeting February 2013	
CMET/IGD-TP	IGD-TP	Started November 2012. First Meeting due 8th April 2013	
ARIAS	FCT 2012	Approved 2012. Started January 2013	
ROBOTSAMPLER	QREN/IAPMEI	Approved 2012. Started January 2013	
Sealed Sources Licensing	(4142 – OF12)	2012	19.000,00€
Radiological Control	(4134 – OF12)	2012	45.000,00€
Radioactive Waste	(4066 – OF12)	2012	42.000,00€
		Total	**106.000,00 €**

PROTOCOLS

- The Monitoring Programmes of the radioactive liquid discharges from public and private nuclear medicine facilities into the public sewage of Lisbon as well as the monitoring of the four ETAR'S (Lisbon City waste water treatment facilities), in collaboration with Lisboa Council Borough.
- Collaboration with AT- Taxes and Customs Authority in the framework of the Megaports Initiative of the Second Line of Defense of the USA. Support to the decision and intervention in the radiological monitoring activities of containers in the Port of Lisboa.

Measurement Laboratories Group

TEAM

Name	Category	R&D
Mário Capucho dos Reis	Auxiliary Researcher	75%
Lídia Silva	Graduated Technician	100%
João Abrantes	Graduated Technician	100%
Marta Santos	Graduated Technician	50%
Gabriel Silva	Technician	100%
Gonçalo Carvalhal	FCT 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 2012 the main objectives of the group were:
    - 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 obtain the accreditation of several radioanalytical techniques, according to the ISO/IEC 17025;
    - To increase the dissemination of the group activities through the participation in Conferences and publication of papers.

MAIN ACHIEVEMENTS

Research and Development

During 2012, the group has participated in several research projects:

DYNOZONE – Measurement and analysis of stratospheric tracers (cosmogenic ^{7}Be) activity in aerosol samples by high resolution gamma-ray spectrometry.

MetroMetal – Compilation of data summarizing the systems and methods currently used for monitoring scrap loads, cast steel, slags and fume dusts. Comparison of different Monte Carlo simulation codes for the computation of coincidence summing correction factors.

VADOSE – 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. During 2012, a group element was integrated in the field campaign to carried out in-situ gamma spectrometry measurements.

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/ITN 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 2012, a total of about 1500 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/ITN Units 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. Some of the techniques were accredited by the Portuguese Accreditation Body (IPAC) on July 2012. The Group participated, in collaboration with the GRA, in several international inter-comparison exercises and Proficiency Tests with good results.

Education & Training

During 2012, the LM team was involved in education and training activities, namely by providing advanced training to an IAEA fellow under the framework of a Technical Cooperation Project, by lecturing in training courses and by conducting study visits to groups of students from secondary schools and universities.

RELEVANT PAPERS

- M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio, Characterization of geomaterials from NE Portugal using k_0-based instrumental neutron activation analysis (k_0-INAA) and gamma spectrometry methods, *J. Radioanal. Nucl. Chem.*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.
- M.-C. Lépy, T. Altzitzoglou, M.J. Anagnostakis, M. Capogni, A. Ceccatelli, P. DeFelice, M. Djurasevic, P. Dryak, A. Fazio, L. Ferreux, A. Giampaoli, J.B. Han, S. Hurtado, A. Kandic, G. Kanisch, K.L. Karfopoulos, S. Klemola, P. Kovar, M. Laubenstein, J.H. Lee, J.M. Lee, K.B. Lee, S. Pierre, G. Carvalhal, O. Sima, Chau Van Tao, Tran Thien Thanh, T. Vidmar, I. Vukanac, M.J. Yang, Intercomparison of methods for coincidence summing corrections in gamma-ray spectrometry - part II (volume sources), *Applied Radiation and Isotopes*, 70, 2112-2118 (2012), doi:10.1016/j.apradiso.2012.02.079.
- Pedro Duarte, Lídia 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.*, doi:10.1007/s12665-012-1758-0.

FUNDS

Project/Service	Reference	Timeframe	2012
Analysis of Radioactivity (Liquid Scintillation Counting in collaboration with GRA)	Technical Services	2012	16.500,00 €
Analysis of Radioactivity (gamma-ray spectrometry)	Technical Services	2012	29.000,00 €
		Total	**45.500,00 €**

Researchers – Scientific Activities

(ordered by category and name)

NAME: Carlos Manuel Azevedo de Sousa Oliveira

CATEGORY: Principal Researcher with habilitation
ID NUMBER: 14514

R&D ACTIVITIES

Nº	Activity Description	%
1	IND04 MetroMetal: Ionising radiation metrology for the metallurgical industry.	25
2	JRP–i13 MetroNORM : Metrology for processing materials with high natural radioactivity.	5
3	Head of LMRI (Metrology Laboratory of Ionising Radiation)	50
4	Services	5
5	Education, Training, Conference Organization	10
6	International representations	5
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	**EMRP Project**: IND04 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). The project started in December 2011 and a kick-off meeting was held at CIEMAT in January 2012. Since then a questionnaire for determining currently used devices/systems for measuring the activity of radionuclides in metallurgy was prepared and sent to steel factories in 14 European Countries. Data collected were processed and separate reports summarising the systems and methods currently used for monitoring scrap loads, cast steel, slags and fume dusts were prepared. As coordinator of the Portuguese team I have got the support of the two portuguese steel making companies. The Portuguese team has contributed for the writing of the questionnaire and for the reports realized based on the answers to the questionnaire. A Monte Carlo model of the spectrometric device for measuring the activity of cast steel and slag samples, the adequate shielding and the sample chamber was studied by the Portuguese team and will be proposed for all the partners.
2	**EMRP Project**: JRP- i13 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). As responsible of the Portuguese team I have coordinate the efforts to contribute for the finalization of the project and contacted some Portuguese industries to support the project. The project has been approved and will start in June 2013 with duration of 3 years. The project addresses the following scientific and technical objectives: (i) Development of measurement systems, methods and technique 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.

3	**Management** Head of LMRI (Metrology Laboratory of Ionising Radiation) The LMRI is the laboratory recognized by IPQ as the national laboratory for ionizing radiation. LMRI has its Calibration and Measurements Capabilities (CMC's) recognized by CIPM (International Committee for Weights and Measures) and published in the BIPM site and ensures international traceability of national standards for dosimetric quantities upon compliance with the requirements of the MRA (Mutual Recognition Arrangement). Recently the LMRI extended its capabilities to the radiodiagnostic area. An annual audit is done to the LMRI and the results are presented on the Quality Technical Committee of EURAMET. This year the annual audit is part of the EURAMET Project nº. 1123 "On site peer review" with participants from Spain, Italy and Portugal. As results of the audit, it was recognized that Quality System of the institute is adequate and its implementation demonstrates the conformity with the requirements of CIPM-MRA". Concerning the legal metrology, LMRI is also been recognised by IPQ as the Metrological Verification Body - OVM. Due to limited human resources the management and supervision of the work realized in the LMRI is very demanding. A deep collaboration with IPQ has occurred in drafting a new ordinance for metrological control.
4	**Services** LMRI provides the community, mainly hospitals, industry, universities, armed forces and ITN Units with calibration and metrological control services. This metrological control of instruments is being carried out under a contract with Portuguese Institute of Quality and is the enforcement of Portaria nº. 1106/2009 dated of 24 of September. During 2012 were calibrated and controlled 120 dosimeters. About 1100 TLD dosimeters have been irradiated for the Dosimetry and Radiobiology Group of UPSR. The LMRI also performs, every year, the metrological control of installed detectors and associated instrumentation of the RPI (URSN) radiological protection system. Also for Radioprotection and Radioactive Waste Group, LMRI realizes calibration of several equipment. This year the total amount due to the services done to the exterior has been of 47.5 k€. The costs of the internal calibrations are estimated around 10.7 k€**.**
5	**Supervision of theses** M.SC. thesis "Caracterização de um mamógrafo Senographe 600T Senix da GE com ânodo de Mo. Dosimetria das qualidades de radiação." Ana Filipa Soares Cartaxo, Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa (2011-2012). PhD thesis "Design, construction, calibration and inter-laboratorial comparison of an air-kerma cavity standard" Margarida Isabel Camacho Caldeira. IST. Co-supervisors: Jean Marc Bordy (LNHB, CEA) and Lidia Ferreira. (2009-….). **Jury membership** PhD thesis of Miriam Zarza Moreno, "Monte Carlo simulations for dosimetric verification in photon and electron beam radotherapy", Universidade Nova de Lisboa. 2012. M.Sc. Thesis of Maria José Pereira Rodrigues, "Avaliação de Métodos de Cálculo de Barreiras de Proteção Radiológica em Instalações de Radioterapia Externa e Braquiterapia", Faculdade de Ciências da Universidade de Lisboa. 2012. M.Sc. Thesis of Ana Filipa Soares Cartaxo, "Caracterização de um mamógrafo Senographe 600T Senix da GE com ânodo de Mo. Dosimetria das qualidades de radiação", Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa. 2012. **Workshop** "METROLOGIA DAS RADIAÇÕES IONIZANTES E APLICAÇÕES CLINICAS". IST/ITN. Co-

	organizer: Hospital de Santa Maria. Local: IST/ITN CTN. 16 Nov. 2012.
6	**National representations** Member of the Group of Experts referred to in Article 31 of Euratom Treaty (Radiation Protection). Corresponding Member of the Working Party on Implications on Health and Safety Standards established under Article 31. Official Observer of the Consultative Committee for Ionizing Radiation Section I (X and γ-Rays, charged particles) of International Committee for Weights and Measures (CIPM). Contact person of the EURAMET- European Association of National Metrology Institutes. Participation on Working Group activities of EURADOS-European Radiation Dosimetry Group.

PAPERS

- Silva Ribeiro, A., Oliveira, C., Cox, M. G., Alves e Sousa, J., Lages Martins, L., Cardoso, J., Limede, P., Modelling and uncertainty evaluation for the radiation quality parameters used in metrological management of diagnostic radiology dosimeters, Advanced Mathematical and Computational Tools in Metrology and Testing, vol. 9, pg. 377-384 (editors: F. Pavese, M. Bar, J-R Filtz, AB Forbes, L. Pendrill, H. Shirono). Series on Advances in Mathematics for Applied Sciences, vol. 84. World Scientific. Singapura, (2012).
- D. Broggio,J. Bento, M. Caldeira, E. Cardenas-Mendez, J. Farah, T. Fonseca, C. Konvalinka, L. Liu, B. Perez, K. Capello, P. Cowan, J.-A. Cruzate, L. Freire, J.-M. Gómez-Ros, S. Gossio, B. Heide, J. Huikari, J. Hunt, S. Kinase, G.H. Kramer, O. Kurihara, A. Kyrieleis, A.-L. Lebacq, D. Leone, C. Li, J. Li, L.-C. Mihailescu, M. Moraleda, J.-F. Navarro, C. Oliveira, N. Puerta, U. Reichelt, C. Simões, D. Sommer, M. Takahashi, P. Teles, F. Vanhavere, T. Vrba, D. Franck, G. Gualdrini, M.-A. Lopez. Monte Carlo modelling for the in vivo lung monitoring of enriched uranium: Results of an international comparison. *Radiation Measurements.* Vol. 47, 7, 492-500. (2012).
- Plagnard J, Oliveira C, Cutarella D, Gouriou J, Aubineau-Lanièce I, Rodrigues M, Portugal L, Cardoso J, , Full characterization of the 125I IBt Bebig I25.S16 brachytherapy source and sensitivity study of the absorbed dose to water due to the seed dimensional variations, *Metrologia*, vol. 49, nº 5, S223-S227. (2012).
- Oliveira, C. Cardoso, J. Santos, L., A metrologia das radiações ionizantes. *Medições e Ensaios* (SPMet), Vol 1, nº 2, May 2012.
- Oliveira, C. Cardoso, J. Santos, L., Limede, P., Góis, D., Oliveira, M. A dosimetria em radiodiagnóstico. *Medições e Ensaios* (SPMet), Vol 1, nº 3. September 2012.
- Diana D. Duarte, João Cardoso, Luís Santos, Carlos Oliveira, Lina Vieira, Estudo da resposta de um dosímetro eletrónico individual. Saúde & Tecnologia. Nº. 7. May 2012.
- Diana D. Duarte, João Cardoso, Luís Santos, Carlos Oliveira, Lina Vieira, Estudo da eficiência de deteção de um monitor portátil de contaminação de superfícies em função da distância e do débito de emissão da fonte. Saúde & Tecnologia. Nº. 8. November 2012.

COMMUNICATIONS

- *A Metrologia e o papel do LMRI, C. Oliveira, Workshop Metrologia das radiações ionizantes a aplicações clinicas,* Sacavém,16 Nov. (2012)(oral).
- *O LMRI e o radiodiagnóstico. Qualidades de radiação e o HVL*, C. Oliveira, *Workshop Metrologia das radiações ionizantes a aplicações clinicas,* Sacavém,16 Nov. (2012) (oral).
- *Unidades Fisiológicas do SI*. Olivier Pellegrino, Isabel Godinho e Carlos Oliveira, *1º. Encontro Nacional dos Utilizadores da Radiação de Sincrotrão*, 16 January 2012. FCT-UNL (poster).

- *Development of Cavity Chambers for the measurement of Air Kerma in the Metrology Laboratory of Ionizing Radiation*. Caldeira, M., Oliveira C., *Eurisol Topical Meeting*, Lisbon, 15-19 October 2012 (poster).
- *Unidades Fisiológicas do SI – Medições para a Segurança* Pellegrino, O., Godinho I., Oliveira, C., Filipe E., *5º Encontro da Sociedade Portuguesa de Metrologia*, November 2012 (poster).

EDUCATION / THESES SUPERVISION

- Supervisor, M. Sc. Thesis, *Caracterização de um mamógrafo Senographe 600T Senix da GE com ânodo de Mo. Dosimetria das qualidades de radiação*, by Ana Filipa Soares Cartaxo, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 14th December 2012.
- Supervisor, PhD Thesis, *Design, construction, calibration and inter-laboratorial comparison of an air-kerma cavity standard*, by Margarida Isabel Camacho Caldeira, Instituto Superior Técnico. Universidade de Lisboa. (running).

Jury membership

- PhD Thesis, "Monte Carlo simulations for dosimetric verification in photon and electron beam radotherapy" by Miriam Zarza Moreno, Universidade Nova de Lisboa. 9th March 2012.
- M. Sc. Thesis "Avaliação de Métodos de Cálculo de Barreiras de Proteção Radiológica em Instalações de Radioterapia Externa e Braquiterapia" by Maria José Pereira Rodrigues, Faculdade de Ciências da Universidade de Lisboa. 27th September 2012.
- M. Sc. Thesis *Caracterização de um mamógrafo Senographe 600T Senix da GE com ânodo de Mo. Dosimetria das qualidades de radiação*, by Ana Filipa Soares Cartaxo, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 14th December 2012.

PROJECTS

- IND04 MetroMetal: Ionising radiation metrology for the metallurgical industry. *EMRP Project* Leading Institution: Ciemat, Spain. Coordinator of Portuguese team: C. Oliveira. From December 2011 to December 2014.
- JRP- i13 MetroNORM: Metrology for processing materials with high natural radioactivity. EMRP Project Leading Institution: BEV, Austria. Coordinator of Portuguese team: C. Oliveira. From June 2013 to May 2016.

NAME: José Pedro Miragaia Trancoso Vaz

CATEGORY: Principal Researcher with habilitation
ID NUMBER: 2286

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Coordination and management (approx. 50 staff members and fellows)	65%
2	Research activities (projects)	20%
3	Teaching, education and training – including supervision of Master´s degree and Ph.D. students	10%
4	Representation in international Committees and Working Groups	5%
Total		100%

WORK SUMMARY

Nº	Summary of Work and Main Achievements
1	Coordination and harmonization of the research activities and technical services in the multiple areas of Radiological Protection and Safety: radioactive waste management, environmental radioactivity, dosimetry, radiobiology, metrology of ionizing radiation, determination of radioactivity in samples.

	Planning and definition of the activities of the UPSR Programme of Work. Administrative and financial management of the activities in the aforementioned topical areas and the associated budget. Identification of the main lines of development of new activities, new projects and new programmes. Coordination and management of the Dosimetry and Radiobiology Group (20 people). Organization of working meetings with the responsibles for the UPSR groups. Organization of meetings with the members of the Working Groups (on Accreditation, Dosimetry, Radiobiology, Radiological Safety Assessment, amongst others). Drafting and preparation of working documents to answer the solicitations from the Installation Commission, management bodies of IST, several national and international organizations and institutions.
2	Participation in national and international R&D projects, namely: • FCT funded projects (related to experiments at the ISOLDE and n-TOF facilities at CERN) • FP7-EURATOM funded projects (ENETRAP-II, TRASNUSAFE, CDT, FREYA, RENEB) • FP7-SECURITY funded project (REWARD) Undertaking of activities involving cooperation with national or international teams in the framework of the aforementioned projects in hospitals, in laboratories and research centres in Portugal or in foreign countries, etc. Fostering of NEW research activities, in cooperation with national or international teams in the framework of the aforementioned projects, in hospitals, in laboratories and research centres in Portugal or in foreign countries, etc. Drafting and submission of scientific articles to international peer reviewed journals. Participation in project meetings, in Portugal and abroad. Participation in national and international Conferences and Workshops. Participation in the drafting of R&D projects, to be submitted in the framework of FCT or the EU FP7/EURATOM Calls and Programmes. Reviewing and refereeing of scientific articles submitted to international journals.
3	Teaching of disciplines in the framework of Master´s degree courses in Radiation Protection and Dosimetry in several Higher Education establishments, namely: ESTeSC - Escola Superior de Tecnologias de Saúde de Coimbra ESTeSL – Escola Superior de Tecnologias de Saúde de Lisboa. Co-supervision of 8 Ph.D. theses (3 finished during 2012, other 3 to be concluded during 2013). Supervision of 2 Master´s degree theses. Participation in the jury of a Ph.D. thesis and in the jury of a Master´s degree thesis.
4	Participation in meetings of national and international Committees and Working Groups, as representative of IST/ITN or as national delegate, namely: • **CRPPH** ("Committee on Radiation Protection and Public Health" of the Nuclear Energy Agency of the OECD) – 1 annual meeting • **Group of Experts** (GoE) **under Article 31 of the EURATOM Treaty** – 2 meetings per year • **WPMED** ("Working Party on Medical Exposures", in the framework of the GoE previously mentioned) – 2 meetings per year • **CCE-FISSION** ("Consultative Committee for Energy – Fission" of the European Union) – 2 meetings per year

	• **CNER** – Comissão Nacional para as Emergências Radiológicas Comments on scientific and technical reports in the framework of the activities of the aforementioned Committees and Working Groups. Replies to questionnaires and surveys launched by international organizations and institutions.

PUBLICATIONS

In international peer reviewed journals

[1] "Monte Carlo modelling and simulations of the High Definition (HD120) micro MLC and validation against measurements for a 6 MV beam", C. Borges et al., *Med. Phys*., 39 (1), 415-423 (2012).

[2] "Monte Carlo simulation of the movement and detection efficiency of a Whole Body Counting System using a BOMAB Phantom", J. Bento et al., *Radiat. Prot. Dosim.* 148(4), 403-413 (2012).

[3] "Measurement and resonance analysis of the ^{237}Np neutron capture cross section", C. Guerrero et al., accepted for publication in *Physical Review C* (2012).

[4] "Assessment of Pediatric CT Exposure in a Portuguese Hospital", A. Neves et al., accepted for publication in *Radiat. Prot. Dosim.* (2012), 10.1093/rpd/ncs037.

[5] "Performance Assessment and Uncertainty Evaluation of a Portable NaI Based Detection System for Thyroid Monitoring", J. Bento et al., accepted for publication in *Radiat. Prot. Dosim*. (2012).

[6] "Realising the European Network of Biodosimetry (RENEB)", U. Kulka et al., *Radiat. Prot. Dosim.* 151 (4) 621–625 (2012), doi: 10.1093/rpd/ncs157.

[7] "Optimization Studies of the CERN-ISOLDE Neutron Converter and Fission Target System", R. F. Luís et al., *European Physical Journal A* 48:90 (2012).

[8] "Simultaneous measurement of neutron-induced capture and fission reactions at CERN", C. Guerrero et al., *European Physical Journal A* 48 (3), 29 (2012).

[9] "Neutron-induced fission cross-section of 245Cm: New results from data taken at the time-of-flight facility n_TOF", M. Calviani et al., *Phys. Rev. C* 85, 034616 (2012).

[10] "Resonance neutron-capture cross sections of stable magnesium isotopes and their astrophysical implications", C. Massimi et al., *Phys. Rev. C* 85, 044615 (2012).

[11] "Measurement of resolved resonances of ^{232}Th(n, γ) at the n_TOF facility at CERN", F. Gunsing et al., *Phys. Rev. C* 85, 064601 (2012).

[12] "Estimation of the Collective Dose in the Portuguese Population Due to Medical Procedures in 2010", P. Teles et al., accepted for publication in *Radiat. Prot. Dosim.* (2012), doi:10.1093/rpd/ncs258.

[13] "Dosimetric assessment and characterization of the neutron field around a Howitzer container using a Bonner Sphere Spectrometer, Monte Carlo simulations and the NSDann and NSDUAZ unfolding codes", S. Barros et al., accepted for publication in *Radiat. Prot. Dosim.* (2012), doi:10.1093/rpd/ncs246.

[14] "Radiation protection and radiation shielding assessment of HIE-ISOLDE", Y. Romanets et al., accepted for publication in *Radiat. Prot. Dosim.* (2012).

[15] "Neutron induced capture and fission discrimination using calorimetric shape decomposition", C. Carrapiço et al., *Nuclear Inst. and Methods in Physics Research A* (2013), 704, 60-67.

[16] "Dose and time dependence of targeted and untargeted effects after very low doses of α-particle irradiation of human lung cancer cells", A. Belchior et al., accepted for publication in *Dose Response* (2012).

[17] "Neutron-induced fission cross section measurement of 233U, 241Am and 243Am in the energy range 0.5 MeV ≤ En ≤ 20 MeV at n_TOF at CERN", F Belloni et al., *Physica Scripta*, 2012, T150, (2012), doi:10.1088/0031-8949/2012/T150/014005.

[18] "Neutronic assessment and criticality analysis of the in-vessel fuel storage facilities in the CDT project" S. Di Maria et al., *Fusion Science and Technology*, 61(1T) 298-301, (2012).

[19] "Measurement of the neutron induced fission cross section of ^{241}Am at the time-of-flight facility n TOF", F. Belloni et al., accepted for publication in the *European Physical Journal A* (2012).

[20] "Efficiency correction factors of an Accuscan Whole-Body Counter due to the biodistribution of ^{134}CS, ^{137}CS and ^{60}CO", J. Bento, S. Barros, P. Teles, P. Vaz, M. Zankl, *Radiat. Prot. Dosim.* (2012), doi:2012 doi:10.1093/rpd/ncs308.

In international conference proceedings

[1] "Assessing different conformal radiotherapy techniques for breast cancer treatments using Monte Carlo simulations", C. Borges et al., submitted to "Monte Carlo Treatment Planning 2012 (MCTP 2012)", Seville, Spain, 15-18 May 2012.

[2] "Optimization Studies of the CERN-ISOLDE Neutron Converter and Fission Target System", R. Luís et al., in Proceedings of the ICANS XX Conference, Bariloche, Río Negro, Argentina, 4-9 March 2012.

[3] "Radiation Exposure of Medical Staff: Application of Hand Phantoms in Experiments and Simulations", F. Becker et al., submitted to the "First International Conference on Radiation and Dosimetry in Various Fields of Research (RAD 2012)", Poland, May 2012.

[4] "Monte Carlo simulations on clinical applications using the new HDMLC BEAMnrc component module", C. Borges et al., submitted to the "51^{e} Journées Scientifiques de Physique Médicale", Strasburg, France, 12-15 June 2012.

[5] "Neutron spectra and dosimetric assessment around a neutron Howitzer container", S. Barros et al., in Proceedings of the International Conference on Radiation Shielding (ICRS-12)", accepted for publication in Progress in Nuclear Science and Technology (2012).

[6] "RENEB – Realizing the European Network in Biological Dosimetry", U. Kulka et al., in Proceedings of the International Radiation Protection Association (IRPA-13) Conference, Glasgow, Scotland, May 2012.

[7] "RENEB - Realizing the European Network of Biological Dosimetry", U. Kulka et al., 4th International MELODI Workshop, Helsinki, Finland, 12-14 September 2012.

[8] "RENEB – Realizing the European Network in Biological Dosimetry", P. Voisin et al., in Proceedings of the NATO HFM-223 Symposium On Biological Effects of Ionizing Radiation Exposure and Countermeasures: Current Status and Future Perspectives, Ljubljana, Slovenia 8-10 October 2012.

Ph.D. theses concluded in 2012 under my co-supervision

- Yuriy Romanets (Ph.D. in Physics by IST), thesis entitled "Nuclear Technology, Dosimetry and Radiological Protection Aspects of Accelerator Driven Systems (ADS) and Radioactive Ion Beam Facilities", 28 September 2012. Classification "Aprovado com muito bom", and also "Muito bom com distinção".
- Carlos Alberto de Almeida Carrapiço (Ph.D. in Physics by IST), thesis entitled "Measurement of the 233U neutron capture cross section at the n TOF facility at CERN", 12 December 2012. Classification "Aprovado com muito bom" and also "Muito bom com distinção".
- Raul Cambraia Sarmento (Ph.D. in Physics by IST), thesis entitled "Measurement of fission cross sections of actinides and of neutron capture cross sections of Fe and Ni isotopes using the TOF spectrometer at CERN", 18 December 2012. Classification "Aprovado com muito bom", and also "Muito bom com distinção".

Technical reports ("deliverables") in the framework of the EU FP7 project REWARD

- "Best and Common Practices - Summary" (Deliverable D1.1)
- "Characterization of the reference scenarios v1" (Deliverable D1.3)

INVITED PRESENTATIONS

- *"The Impact of Radiological Protection and Radiation Safety Requirements in the Next Generation, Emerging and Innovative Nuclear Technology Facilities",* P. Vaz, EURISOL Town Meeting, IST, Lisbon, 17-18 October 2012.
- "*Protecção e Segurança Radiológica - Das aplicações médicas aos acidentes nucleares*", P. Vaz, Universidade do Minho, 30 May 2012.
- *"Applications of ionising radiations in Health",* P. Vaz, 6º Congresso do Comité Português da URSI, Fundação Portuguesa das Comunicações, Lisbon, 16 November 2012.

EDUCATION / THESES SUPERVISION

Supervision of Ph.D. theses

- Yuriy Romanets (Ph.D. in Physics by IST), thesis entitled "*Nuclear Technology, Dosimetry and Radiological Protection Aspects of Accelerator Driven Systems (ADS) and Radioactive Ion Beam Facilities*", 28 September 2012. Classification "*Aprovado com muito bom*" and also "*Muito bom com distinção*".
- Carlos Alberto de Almeida Carrapiço (Ph.D. in Physics by IST), thesis entitled "*Measurement of the 233U neutron capture cross section at the n TOF facility at CERN",* 12 December 2012. Classification "*Aprovado com muito bom*" and also "*Muito bom com distinção*".
- Raul Cambraia Sarmento (Ph.D. in Physics by IST), thesis entitled "*Measurement of fission cross sections of actinides and of neutron capture cross sections of Fe and Ni isotopes using the TOF spectrometer at CERN",* 18 December 2012. Classification "*Aprovado com muito bom*" and also "*Muito bom com distinção*".
- MSc. Cecília Borges (Doutoramento em Física Biomédica, Faculdade de Ciências Médicas da Universidade Nova de Lisboa), thesis entitled "*Estudo da influência das diversas técnicas de irradiação da mama na dose na mama contralateral*", ongoing, conclusion in 2013.
- MSc. Raul Fernandes Luís (Doutoramento em Física e Tecnologia Nucleares da Faculdade de Ciências da Universidade de Lisboa), thesis entitled "*Radiological Protection and Nuclear Engineering Studies in multi-MW Target Systems"*, ongoing, conclusion in 2013.
- MSc. Ana Lúcia Vital Belchior (Doutoramento em Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa), thesis entitled, "*Contribution to Fundamental Aspects of Biophysics, Radiobiology and Modelling of Cellular Response to Low Radiation*", ongoing, conclusion in 2013.
- MSc. Silvia Frias Barros (Doutoramento em Física pelo IST), thesis entitled "*Neutron Dosimetry and Neutron Spectrometry studies for Radiation Protection, using the n-TOF facility at CERN*", ongoing, conclusion in 2015.
- MSc. Maria João Furtado Raminhas Carapinha (Doutoramento em Sáude Pública e Ambiental, Escola Nacional de Saúde Pública), thesis entitled "*Avaliação da Exposição Ambiental a Radiações Ionizantes em Medicina Nuclear*", ongoing, conclusion in 2014.

Member of the jury (PhD theses examiner) of other Ph.D. theses

- Jury member (examiner) of the Ph.D. thesis in Biomedical Engineering entitled "*Monte Carlo simulations for dosimetric verification on photon and electron beam radiotherapy*", by the "Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa", of Miriam Zarza Moreno, March 2012.

Supervision of Master's degree theses

- "*Neutronic Performance and elements of radiological protection and safety of CERN's HIE-ISOLDE Radioactive Ion Beam production facility*", Ricardo Manuel dos Santos Augusto, ("Mestrado em Engenharia Física Tecnológica of Instituto Superior Técnico", 19th October 2012).

- *"Dosimetria e Análise de Incertezas em Braquiterapia Ginecológica"*, Técnica Márcia Sofia Alves Coelho (Mestrado em Radiações Aplicadas às Tecnologias de Saúde, Escola Superior de Tecnologia de Saúde de Lisboa, conclusion in March 2013).

Member of the jury (examiner) of other master's theses

- Jury member (examiner) of the Master´s degree thesis in Biomedical Engineering of Marco Gilles Rodrigues Costa, by "Faculdade de Ciências e Tecnologia da Universidade de Coimbra", October 2012.

Disciplines taught at Higher Education establishments

- Professor responsible for the discipline "Dosimetria Computacional e Aplicações" ("Mestrado em Ciências Nucleares Aplicadas à Saúde da Escola Superior de Tecnologia de Saúde de Coimbra (ESTeSC))
- Teacher of the disciplines "Protecção Contra Radiações" and "Produção e Dosimetria das Radiações" (Mestrado em Radiações Aplicadas às Tecnologias da Saúde (RATES) da Escola Superior de Tecnologia de Saúde de Lisboa (ESTeSC))

PROJECTS

Funded in the framework of the European Union´s 7th Framework Programme EURATOM

- **CDT** *("Central Design Team"), concluded in March 2012* - P.I. of the Portuguese team.
- **ENETRAP-II** *("European Network on Education and Training in RAdiation Protection – part II") – concluded in December 2012* - P.I. of the Portuguese team.
- **FREYA** *("Fast Reactor Experiments for hYbrid Applications"), on-going* - P.I. of the Portuguese team.
- **TRASNUSAFE** *("TRAining Schemes on NUclear SAFEty Culture"), on-going* - P.I. of the Portuguese team.

Funded in the framework of the European Union´s 7th Framework Programme SECURITY

- **REWARD** *("Real Time Wide Area Radiation Surveillance System") - P.I. of the Portuguese team.*

Submitted in 2012, in the framework of the European Union´s 7th Framework Programme EURATOM

- **PREPARE** *("Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe") - approved for funding in 2012, starting in 2013.*
- **ENETRAP-III** *("European Network on Education and Training in RAdiation Protection – part III") - pending approval.*
- **MARISA (***"MYRRHA Research Infrastructure Support Action) – pending approval.*

Funded by the FCT (P.I. of the IST/ITN team)

- "**Cooperation with CERN - Optimization studies of the ISOLDE targets and design of HIE-ISOLDE**", project CERN/FP/123598/2011, ongoing.
- *"***Melhoria da qualidade de imagem e redução de dose em tomossíntese para mamografia, com recurso a algoritmos estatísticos de reconstrução de imagem***",* project PTDC/BBB-IMG/3310/2012 – approved in 2012.

CONFERENCE ORGANIZATION / COMMITTES

Co-Chair of the Scientific Programme Committee of the Conferences

- **ICRS-12** (12th International Conference on Radiation Shielding) jointly organized with **RPSD-2012** (17th Topical Meeting of the Radiation Protection and Shielding Division of the American Nuclear Society), in Nara, Japan, September 2012. It was one of the major International Conferences worldwide in the field of Radiation Shielding, Radiation Dosimetry and Radiation Protection,

organized by the JAEA (Japanese Atomic Energy Agency) and co-sponsored by several Japanese institutions, the American Nuclear Society and several international organizations and institutions.

Member of the Scientific Committee of the Conferences

- **PHYSOR 2012** ("International Conference on the Physics of Reactors - Advances in Reactor Physics")**,** in Knoxville, Tennessee, USA, from 15-20 April 2012.
- **SNA + MC2013** ("Joint conference on Supercomputing in Nuclear Applications & Monte Carlo), in Paris, from 27-31 October 2013.
- **ICENES 2013** ("16th International Conference on Emerging Nuclear Energy Systems"), in Madrid, Spain, from 26-30 May 2013.

NAME: Fernando da Piedade Carvalho

CATEGORY: Principal Researcher
ID NUMBER: 25347

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Environmental radioactivity survey of old uranium mine regions (IST/ITN; Art 35 Euratom)	50%
2	Research project «ENGENUR» funded by FCT, on environmental toxicology in uranium mining areas.	30%
3	Training of fellows (from Spain and IAEA). Invited lectures for post-graduation courses and dissemination of IST/ITN activities. Member of Doctoral Thesis panel and co supervisor of a PhD Thesis. Participation in scientific committees of several international conferences.	5%
4	Scientific/technical missions for the IAEA and preparation of contracts with industrial partners	5%
5	Participation in international working groups for preparation of two reference publications (IAEA Technical Report Series, one on radium and other on polonium)	5%
6	Supervision and coordination of radiochemistry laboratories and alpha spectrometry.	5%
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Annual activity to fulfil the State's obligations entrusted to IST / ITN, particularly under the Euratom Treaty Article 35 and the Annual Radiological Environmental Monitoring Report. Conducting field missions in the regions of former uranium mines to determine external radiation and radon in the environment, sampling water, soil, aerosols, and agricultural and livestock products for determination of radionuclides, whose results are part of the Annual Report on radiological surveillance. Preparation of articles for publication in peer-reviewed international scientific journals and conferences.
2	Implementation (2nd year of the «ENGENUR» research project in collaboration with the University of Aveiro. Analyses of samples from biota exposed to uranium mine waste and search of correlation of toxic effects and exposure. Preparation of an experimental set up in the field to be fully implemented in 2013.
3	Training of students and visitors in analytical methods and environmental radioactivity. Invited lectures on environmental radioactivity, uranium mining residues and radioactivity in water for post-graduation courses in FCT-Universidade Nova. Panel member for one Doctoral Thesis (Univ. Aveiro). Co supervision of a PhD Thesis (Univ Cadiz). Lecture and guided visit, in collaboration with EDM, to old uranium mines for visiting scientists attending the 9th Geochemistry Conference in Aveiro.

	Lectures on environmental radioactivity and monitoring of uranium regions, at Universities and Ministries in countries visited in IAEA missions (Mozambique, Tanzania, and Niger). Member of scientific and advisory committees to International Conferences. Member of Evaluation Panel for EU FP 7.
4	At invitation by the IAEA, implementation of training courses and advisory missions to implement and enhance radiation protection infrastructures and environmental radioactivity monitoring programmes of Member States in Africa (Mozambique, Tanzania, Niger). Meetings and discussions for contracts with industry in Niger (uranium) and Portugal (phosphate).
5	Participation at invitation by the IAEA in two working groups to write two IAEA publications in the Technical Report Series (Environmental Behaviour of Radium; Environmental Behaviour of Polonium).
6	Supervision and coordination of analytical work in radiochemical analyses and alpha spectrometry for research projects, environmental monitoring and services, including quality assurance for alpha spectrometry.

PAPERS

- Carvalho, F.P. (2011). Environmental Radioactive Impact Associated to Uranium Production. American Journal of Environmental Sciences 7(6): 547-553 (DOI: 10.3844/ajessp.2011.547.553, Publication Date: January 14, 2012)
- Carvalho F.P., Oliveira J. M. and Malta, M. (2012). Forest Fires and Resuspension of Radionuclides into the Atmosphere. American Journal of Environmental Sciences 8 (1): 1-4. (DOI: 10.3844/ajessp.2012.1.4).
- Carvalho F.P., Reis M.C., Oliveira J.M., Malta M., Silva L. (2012). Radioactivity from Fukushima nuclear accident detected in Lisbon, Portugal. Journal of Environmental Radioactivity 114: 152-156 (doi:10.1016/j.jenvrad.2012.03.005).
- Nhan D.D., Carvalho F.P. Ha N., Quang Long N., Thuan D.D., Fonseca H. (2012). Radon (222Rn) concentration in indoor air near the coal mining area of Nui Beo, North of Vietnam. Journal of Environmental Radioactivity 110 (2012) 98-103.
- M. Felizardo, T.A. Girard, T. Morlat, A. C. Fernandes, A. R. Ramos, J. G. Marques, A. Kling, J. Puibasset, M. Auguste, D. Boyer, A. Cavaillou, J. Poupeney, C. Sudre, H. S. Miley, R. F. Payne, F. P. Carvalho, M.I. Prudencio, A. Gouveia, and R. Marques (2012). Final Analysis and Results of the Phase II SIMPLE Dark Matter Search. PHYSICAL REVIEW LETTERS 108, 201302:1-5.
- Lourenço J., Pereira R., Silva A., Carvalho F., Oliveira J., Malta M., Paiva A., Gonçalves F., Mendo S. (2012) Evaluation of the sensitivity of genotoxicity and cytotoxicity endpoints in earthworms exposed in situ to uranium mining wastes. Ecotoxicology and Environmental Safety 75: 46–54.

COMMUNICATIONS

- Carvalho, F. P.; Oliveira, J. M.; Malta, M. (2012). *Exposure to forest fires, radioactivity and health risk. In: Occupational Safety and Hygiene - SHO2012*. Arezes, P., Baptista, J.S., Barroso, M.P., Carneiro, P., Cordeiro, P., Costa, N., Melo, R., Miguel, A.S., Perestrelo, G.P.(Editors), pp 126-130. Portuguese Society of Occupational Safety and Hygiene (SPOSHO). (ISBN 978-972-99504-9-0).
- Carvalho, F. P.(2012).*Occupational exposure to ionizing radiation in non-nuclear industries and the European radiation protection basic safety standards. In: Occupational Safety and Hygiene - SHO2012*. Arezes, P., Baptista, J.S., Barroso, M.P., Carneiro, P., Cordeiro, P., Costa, N., Melo, R., Miguel, A.S., Perestrelo, G.P. (Editors), pp 131-134. Portuguese Society of Occupational Safety and Hygiene (SPOSHO), (ISBN 978-972-99504-9-0).
- Carvalho, F.P. (2012). *Radionuclides in the NE Atlantic Ocean and sediment accumulation*. In: *Proceedings of VII Symposium on the Atlantic Iberian Margin*. M.C. Freitas, R. Taborda, M. Ribeiro, et al., (Ed.), held in Lisbon, FCUL, 16-20 December 2012, p.78 (ISBN 978-989-20-3447-8).

- Carvalho F. P. (2012). *Environmental health impact of uranium mining legacy in Portugal*. INVITED LECTURE to the *9th International Symposium on Environmental Geochemistry*, Aveiro, 15th– 21th July 2012. Book of Abstracts (ISBN 978-972-789-365-2), pp xxviii-xxix.
- F. P. Carvalho (2012). *Biogeochemical Cycling of Uranium Series Radionuclides in the NE Atlantic Ocean.* Oral communication to the *9th International Symposium on Environmental Geochemistry*, Aveiro, 15th– 21th July 2012. Book of Abstracts (ISBN 978-972-789-365-2), pp 130-131.
- Caetano, A.L., Gavina, C., Carvalho, F.P., Sousa J.P., Gonçalves, F.Ferreira da Silva, E. Pereira, R. (2012). *Derivation of Soil Screening Levels (SSLs) for Uranium*. Communication to *the 9th International Symposium on Environmental Geochemistry*, Aveiro, 15th– 21th July 2012. Book of Abstracts (ISBN 978-972-789-365-2), pp. 260-261.
- F. P. Carvalho, J. M. Oliveira, M. Malta (2012). *Environmental distribution and cycling of radionuclides from legacy uranium mine wastes in the Sortelha valley, near Sabugal, Portugal*. *9th International Symposium on Environmental Geochemistry*, Aveiro, 15th– 21th July 2012. Book of Abstracts (ISBN 978-972-789-365-2), pp.304-305.
- Pereira, R., Barbosa, S. and Carvalho F. P. (2012). *Uranium mining in Portugal: the environmental legacies of the greatest explorations*. 9th International *Symposium on Environmental Geochemistry*, Aveiro, 15th– 21th July 2012. Field Trip Guidebook, 9th ISEG Conference (ISBN 978-972-789-366-9) 24 pp.
- Carvalho F. P. (2012). *The Fukushima Nuclear Accident and Environmental And Human Health Impacts*. INVITED LECTURE presented to the *International Congress of Environmental Health 2012 (ICEH2012),* Lisboa, Escola Superior de Tecnologias da Saúde, May 29- June 1, 2012. E-Book of Abstracts.
- F. P. Carvalho, J. M. Oliveira, M. Malta (2012). *Water quality in old uranium mining regions and public health*. Poster presented to the *International Congress of Environmental Health 2012 (ICEH2012),* Escola Superior de Tecnologias da Saúde, Lisboa, May 29- June 1, 2012. E-Book of Abstracts.
- Carvalho F.P., Fajgelj, A. (2012).*Environmental Radioactivity Monitoring and Reference Materials in Emergency Response*. Oral communication presented to the *13th International Symposium on Biological and Environmental Reference Materials (BERM13),* held at the International Atomic Energy Agency, Vienna, Austria, 25-29 June 2012. Book of Synopsis pp. 291-292.
- Carvalho F. P., Edge, R. (2012). *The Need For Reference Materials In Radiological Surveillance Programmes Of Uranium Mining And Milling Areas*. Oral communication presented to the *13th International Symposium on Biological and Environmental Reference Materials (BERM13),* held at the International Atomic Energy Agency, Vienna, Austria, 25-29 June 2012. Book of Synopsis pp. 78-80.
- Malta, M., Oliveira J.M., Carvalho F.P. (2012). *Estimativa da Dose de Radiação Anual por Ingestão de Produtos Hortícolas nas Zonas das Antigas Minas de Urânio em Portugal*. Oral communication presented to the *Second Portuguese Congress of Radiation Protection*. SPPCR/SBPR, Lisboa 20-23 November 2012. Book of Abstracts.

EDUCATION / THESES SUPERVISION

- Training in ITN (April-May 2012) and co-supervision of PhD Thesis of student Juan Francisco Rodrigo Oliva, University of Cadiz, Spain, in analytical methods and environmental radioactivity.
- Invited lectures on environmental radioactivity, uranium mining residues and radioactivity in water for post-graduation courses in FCT-Universidade Nova, Monte da Caparica.
- Panel member for Doctoral Thesis of Joana do Vale Lourenço, entitled «Genotoxicity in humans and indicator species exposed to uranium waste», University of Aveiro, defended on June 8, 2012.
- Lecture and guided visit, in collaboration with EDM, to old uranium mines and remediation work carried out in Urgeiriça e Cunha-Baixa for visiting scientists attending the 9th Geochemistry Conference in Aveiro.

- Lectures on environmental radioactivity and monitoring of uranium regions, at Universities and Ministries in countries visited in IAEA missions (Mozambique, Tanzania, and Niger).

PROJECTS

- Definition of new ENdpoints to assess GENtoxic effects resulting from environmental exposures to URanium, Uranium daughters and ionizing radiation in bioindicator species-ENGENUR. Contract FCT PTDC/AAC-AMB/114057/2009. Total buget: 172,945.00€ (years 2009-2012). ITN budget: 57,252 €. ITN Coordinator F.P. Carvalho.
- Participation in the education web based project CAPTAR (Web site: captar.web.ua.pt) in the field of environmental sciences. Project coordinated by the University of Aveiro, funded by the Gulbenkian Foundation. ITN Coordinator F.P. Carvalho.

CONFERENCE ORGANIZATUION / COMMITTEES

- Carvalho F.P. (2012), EU project Evaluator for the 7th Framework Programme for Research- DG Research and Innovation-Directorate E.
- Carvalho F.P. (2012), Member of the International Atomic Energy Agency Consultant Group to draft an IAEA Technical Report Series monograph on Radium in the Environment.
- Carvalho F.P. (2012), Member of the International Atomic Energy Agency Consultant Group to draft an IAEA Technical Report Series monograph on Polonium in the Environment.
- Carvalho F.P. (2012), Member of International Scientific and Advisory Committees for conferences such as: International Congress on Environmental Health 2012, International Symposium on Environmental Geochemistry 2012, Environmental Health Risk 2013; International Conference on Polonium and Lead Radioisotopes 2013; International Conference on Environmental Rehabilitation 2013. .
- Carvalho F.P. (2012), Sent in IAEA Missions as expert to Mozambique (March 19-23), Tanzania (September 3-7), and Niger (August 5-12) to assist with the development of Radiological Protection Infrastructures and to lecture in regional training courses.
- Carvalho F.P. (2012), National Contact Point of the ALARA European Network.

COLLABORATIONS

- Prof. Juan Pedro Bolivar e Antonio Padilla Ollero, Universidad de Huelva, Departamento Física Aplicada, Huelva, Spain. Work visit to IST/ITN on 12-14 May 2012.

NAME: Maria José Bação Madruga

CATEGORY: Principal Researcher
ID NUMBER: 5350

R&D ACTIVITY

Nº	Activity Description	R&D
1	Research activity: *Radiocaesium adsorption/desorption on geomaterials from "Raña" deposits originated from the NE Portugal Mainland,* following the *KADRWaste* – PTDC/CTE-GEX/82678/2006.	20%
2	DYNOZONE- *Total column and surface ozone variability over the Iberian Peninsula: Dynamical and chemical atmospheric factors*. Contract PTDC/CTE - ATM/105507/2008.	5%
3	PREPARE- *Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe* (FP7-Fission 2012-3.3.1).	2%
4	Responsible by the Radiological Environmental Monitoring Programme at National Level	15%

5	Head of the Environmental Radioactivity Group (GRA)	48%
6	Supervisor of two FCT fellows in Management of Science and Technology in the framework of the EURATOM programme	5%
7	Technical/scientific activities	5%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	One of the requirements for the assessment of adequate sites to host a radioactive waste disposal facility is a clear understanding of radionuclide adsorption/desorption mechanisms, mainly the interactions between radionuclides and the mineral surfaces. Continental detrital sediments known as *raña* (constituted mainly by clay minerals, smectite 15 Å, kaolinite, and illite) originated from the NE Portugal mainland have been studied in order to act as liner/backfill/buffers at low and intermediate radioactive level wastes (LILW) repositories. The ^{137}Cs adsorption/desorption in *raña* was investigated as a function of the initial Cs concentration (10^{-4} M to $5x10^{-3}$M) in presence of K^+ (poorly hydrated ion) and Mg^{2+} (strongly hydrated ion) competitive ions using a batch method. Two different experimental systems (static and dynamic) were tested and compared, simulating *in situ* conditions for ^{137}Cs desorption in case of an incident/accident scenario. The sorption data were fitted to Freundlich and Langmuir isotherms and the ^{137}Cs adsorption/desorption distribution coefficients (Kd), as well as the ^{137}Cs adsorbed/desorbed fractions, were evaluated.
2	In relation to surface measurements and analysis of stratospheric tracers, a time series analysis of the natural atmospheric ^{7}Be (cosmogenic radionuclide) and ^{210}Pb (radionuclide of terrestrial origin) was performed. The analysis was mainly focused on the temporal evolution of ^{7}Be (series of 10 years with weekly frequency) given its great potential as natural tracer for tropospheric intrusion of air masses with stratospheric origin. Correlations with meteorological parameters were also attempted. Installation and operation of the equipment purchased using project funding (high volume particulate sampler with portability features) was done. The equipment was installed at the *Campus* of University Fernando Pessoa (Porto) to sample aerosol particles with a 48 hours frequency, enabling the detection of short duration events. The ^{7}Be activity of the aerosol samples is being measured by high resolution gamma-ray spectrometry.
3	This project approved in 2012 aims to close gaps that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster. Existing operational procedures dealing with long lasting releases and addressing the cross border problematic in monitoring and safety of goods will be reviewed and further develop still missing functionalities in decision support system ranging from improved source term estimation and dispersion modelling to the inclusion of hydrological pathways for European water bodies. This will be achieved through a collaboration of industry, research and governmental organizations in Europe taking into account the networking activities carried out under the NERIS Platform which will be actively involved in the project development.
4	The Radiological Environmental Monitoring Programme at a National Level which execution was legally attributed to IST/ITN was established by law in 2005 (Decree-Law 138/2005, 17th August) and performed yearly according to the EURATOM Treaty (Article 35) recommendations. The objective of the programme is to determine the radioactivity levels in environmental and foodstuff samples, collected along the country, considered as direct pathways of contamination to man and to assess the potential exposure of the Portuguese population. During 2012 about 250 samples (aerosols, rainwater, surface water, drinking water, sediments, fish, mixed diet, complete meals, milk, soils, etc.) were collected accordingly to international sampling procedures and a total of about 750 analyses were performed for the determination of artificial and natural radionuclides, using gamma and alpha spectrometry, alpha/beta measurements and liquid scintillation technique. The results show that the Portuguese population was not exposed to radioactive contamination levels higher than the radioactive background. Therefore, there is no need to adopt any measures for

	radiological protection of the population. All the data are published in Internal Reports made available in the IST/ITN website (http://www.itn.pt) and included in the European Radioactivity Environmental Monitoring Database (REM) located at the EU Joint Research Centre, ISPRA (Italy).
5	Management of the GRA activities, including human resources (3 researchers, 5 technicians, 3 collaborators), goods, services and infrastructures. Coordination of: the Quality Assurance System activities applied to the radioanalytical techniques implemented at the GRA in compliance with ISO/IEC 17025; the development of new radioanalytical techniques; the technical services provided by the GRA under contract with private entities or governmental organizations; the international inter-comparison exercises organized by the IAEA, EC, CSN. Participation in: coordination and accreditation group meetings conveyed by the UPSR coordinator; elaboration of internal documents issued by the UPSR coordinator; internal and external audits performed to the GRA accredited radioanalytical techniques.
6	Supervision of two fellow's activities related to the improvement of radioanalytical techniques for the determination of the radionuclides levels in water samples and the implementation of the Quality Control System in these techniques.
7	Provide advices in environmental radioactivity and on the development of new techniques applied to the water quality to the following international groups: - Portugal representative of the Group of Experts *under Articles 35 and 36 of the EURATOM Treaty (EC)* - Portugal representative of the Group of Experts *ISO/TC 147/SC3 Water quality-Radiological methods* Provide advices in environmental radioactivity and radiological protection to national entity (Comissão de Coordenação e Desenvolvimento Regional do Centro, MAMAOT); Participation at the CPEAMB (*Comissão de Planeamento de Emergência do Ambiente*) meetings, whenever requested. Preparation of responses to a questionnaire elaborated by the Network of Excellence in Radioecology (STAR-ALLIANCE) concerning the future of the European research in radioecology and participation in a workshop organized by the STAR-ALLIANCE for preparing the inclusion of the IST/ITN in this network. Reviewer of papers for: *Applied Radiation and Isotopes* and *Journal of Environmental Radioactivity*.

PAPERS

- M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio, Characterization of geomaterials from NE Portugal using k_o-based instrumental neutron activation analysis (k_o-INAA) and gamma spectrometry methods, *J. Radioanal Nucl Chem*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.
- C. Miró, A. Baeza, M.J. Madruga, R. Periañez, Caesium-137 and strontium-90 temporal series in the Tagus River: experimental results and a modelling study, *Journal of Environmental Radioactivity*, 113, 21-31 (2012), doi:10.1016/j.jenvrad.2012.04.012.

COMMUNICATIONS

- *Effect of competitive ions on radiocaesium retention in clay mineral phases from raña deposits (NE Portugal*, M.J. Madruga, I. Paiva, E. Andrade, M.A. Gonçalves, A. Mateus, *9th International Symposium on Environmental Geochemistry, Aveiro, Portugal, July 15-21 (2012)*, Oral.
- *Radioactive fallout in Portugal following the Fukushima nuclear accident*, M. Reis, L. Silva, E. Andrade, M.J. Madruga, *9th International Symposium on Environmental Geochemistry, Aveiro, Portugal, July 15-21 (2012)*, Oral.

- *Exposição ao gás radão no ar interior*, M. Reis, E. Andrade, M.J. Madruga, *2º Encontro Riscos, Ambiente e Qualidade do Ar, Fundação Calouste Gulbenkian, Lisbon, Portugal, November 8 (2012)*, Oral.
- *Assessment of natural radioactivity levels and radiation hazards due to building materials*, M.J. Madruga, M. Reis, L. Silva, *III Congresso de Proteção Contra Radiações dos Países de Língua Portuguesa, Lisbon, Portugal, November 20-23 (2012)*, Oral.

PROJECTS

- *Control, Modelización Y Prevencion de las Alteraciones Radiologicas en Cauces Fluviales Transfronterizos Utilizados en la Refrigeracion de Reactores Nucleares, Rio Tajo,* SUDOE Interreg IVB (2012-2014). Leading Institution: University of Extremadura, Cáceres, Spain. IST/ITN Coordinator: M.J. Madruga (10%). (submitted)

CONTRACTS

Contract Description	Client identification	2012
Analyses of radioactivity in waters	Private and public entities	16.000,00 €
Analyses of radioactivity in foodstuffs	Private and public entities	500,00 €
	Total	**16.500,00 €**

NAME: Augusto Manuel Dias de Oliveira

CATEGORY: Auxiliary Researcher
ID NUMBER: 04851

R&D ACTIVITY

Nº	Activity Description	R&D
1	FCT research project: "Dose distribution mapping and Monte Carlo simulations in CT-fluoroscopy" Ref.: PTDC/SAU-ENB/115792	20 %
2	Radiation safety assessment of facilities and activities	30%
3	Responsibility and management of radiation safety assessments of facilities and activities	38%
4	Applied research in radiation safety assessment and dosimetry	10%
5	Training courses	2%
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	**Dose distribution mapping and Monte Carlo simulations in CT-fluoroscopy.** The aim of this project is to perform an in-depth study on CT-fluoro guided procedures in order to fully characterize the practice in terms of dose assessments for staff and patient. The assessments will include direct measurements during clinical and phantom-simulated procedures, as well as Monte Carlo simulation studies. The proposed approach is to obtain a detailed mapping of the dose distribution through the use of numerical tools (Monte Carlo simulations), properly validated by in situ measurements. The validated model will be used to optimize the monitoring methodology and safety measures. Three research teams (IPOP, IST/ITN and INESC), with complementary skills and know-how, will be involved in this work. Deliverables of the project will be to gain a thorough insight on CT-fluoro guided procedures in clinical practice, respective dose distributions (range, average and quartiles), and a collection of reliable dose values that will allow the proposal of guidelines on individual monitoring and radiological protection of workers.

2	**Radiation safety assessment of facilities and activities** Radiological safety assessment is carried out for the following facilities and activities: radiotherapy, brachytherapy, nuclear medicine, cyclotrons and industrial application of linear accelerators. All the mentioned facilities and activities of the country needs to present to the Directorate General of Health (DGS) a set of radiological assessment reports performed by the UPSR/CTN/IST. The radiological safety assessments are carried out on three fundamental issues: shielding, dose measurements and safety culture. In general, they are produced three reports: shielding calculation report, dose measurements report and the DCS report (Document for radiological Safety Culture) where one can find, for example, several checklist of assessment of the safety culture and, as a conclusion of this report, some specific safety recommendations, in accordance with the recommendations of international bodies such as the IAEA, the ICRP, etc. This activity provided an approximate income of 119 000.00 euros, corresponding to 1.2 evaluations per month and a total of 33 reports, approximately 2.75 reports per month. The activity is performed by a group of 5 persons with an average percentage of workload of approximately 50%, which means more or less 2.5 persons full time. This allows to conclude that the productivity of this task group is of the order of 119000/2.5≅47 500 euros per full time worker.
3	**Responsibility and management of radiation safety assessments** Responsibility and management of the radiological safety assessment performed by the IST of the facilities and activities described in the previous point 2 of this report. Definition of the formats and the technical and scientific contents of the reports produced. One of the main technical and scientific goals is the implementation of international recommendations (IAEA, ICRP, NCRP, etc.). It also includes the supervision of he reports produced in shielding calculations, dose measurements and radiological safety culture (DCS).
4	**Applied research in radiation safety assessment and dosimetry** • Models of computational dosimetry using compartments for human body incorporation of radionuclides. Application of a previously developed software BiokinModels in a task group of the Portuguese Society of Physics, Section of Medical Physics in nuclear medicine: Determination of the period of internment and release of a patient submitted to radiation exposure due to diagnostic and treatments in nuclear medicine. Resulted in some unpublished papers because it is an ongoing work. • Study of some issues concerned with shielding in nuclear medicine in collaboration with the Hospital Garcia de Orta, resulted in a poster in an international meeting. • Dose calculations of the radiation scatter in water phantoms for application in dose measurements in radiation safety assessment with direct implications in the radiation safety assessment projects. • Characterization of radiation beams used in medicine resulted in a paper that will be submitted for publication soon. • Participation in the annual meeting of nuclear medicine of the IPOLFG (“Instituto Português de Oncologia de Lisboa Francisco Gentil”) with an oral presentation in a round table concerned with “radiation protection and the organization of nuclear medicine services”. • Development of studies in health and medical physics which will be incorporated in the radiation protection and safety assessments projects.
5	**Training courses.** Centro Hospitalar de Trás-os-Montes e Alto Douro E.P.E., at the Hospital of Vila Real. Two short training courses on "Radiological Protection for workers exposed to ionizing radiation in their professional practice Course of a total of 12 hours, 8 hours of lectures and 4 hours practices. Part I: physics and radiation dosimetry in the operation of X-ray equipment, the evolution of the radiation detectors for medical

	radiology as well as the magnitudes of dose in radiology, complemented with fundamentals of biological effects of radiation. Part II: fundamentals of occupational radiation protection, the public and the patients. The outline of a radiation protection program, including the principles of detection and measurement of ionizing radiation, the intervention in situations of accident and incident and a short presentation of national legislation in the field of radiation protection. Emphasis was on quality control in radiology as a tool for the assurance of good performance of services, optimization practices and reduction of doses for patients, professionals and the public. In the practice sessions were used portable monitors and radiation dose measurements were made in selected facilities (CT and conventional radiology) of the hospital, with the aim of demonstrating monitoring procedures.

COMMUNICATIONS

- *Procedimento para a avaliação da dose de radiação recebida pelo médico radiologista em fluoro-CT*, M.F. Pereira, J.G. Alves, A.D. Oliveira, M. Saraiva, S. Rangel, J.V. Cardoso, L.M. Santos, S. Sarmento, J.A.M. Santos, M.J. Sousa, M. Gouvêa, *18th National Conference of Physics, SPPF, Aveiro, Sep. 6-8 (2012) (poster)*
- *Massive cement bricks as cost-efficient radiation shielding in a Nuclear Medicine facility*, J.G. Santos, G. Cardoso, M. Melo, A. Baptista, A.D. Oliveira, A.I. Santos, *25th annual congress of the European Association of Nuclear Medicine, Milan, Italy, Oct. 27-31 (2012) (poster)*
- *Licenciamento de unidades de medicina nuclear – legislação e novas culturas*, A.D. Oliveira, *XII curso de divulgação de medicina nuclear Instituto Português de Oncologia de Lisboa, radioprotecção e organização dos serviços de medicina nuclear, Lisbon, Nov. 23-24 (2012) (oral)*
- *Assessment of the dose to the interventional radiologist in Fluoro-CT guided procedures*, J.G. Alves, M.F. Pereira, J.C. Pereira, A.D. Oliveira, L.M. Santos, J.V. Cardoso, S. Sarmento, J.A.M. Santos, M.J. Sousa, M. Gouvêa, *8th International Workshop on individual Monitoring of Ionizing Radiation, Oarai, Japan, Dec. 1-2 (2012) (oral)*

EDUCATION / THESES SUPERVISION

- Centro Hospitalar de Trás-os-Montes e Alto Douro E.P.E., at the Hospital of Vila Real. Short training course on "*Radiological Protection for workers exposed to ionizing radiation in their professional practice*" (6 hours in a total of 12 hours), Oct. 12-13 (2012)
- Centro Hospitalar de Trás-os-Montes e Alto Douro E.P.E., at the Hospital of Vila Real. Short training course on *"Radiological Protection for workers exposed to ionizing radiation in their professional practice"* (6 hours in a total of 12 hours), Oct. 19-20 (2012)

CONTRACTS

This activity provided an approximate income of 119 000.00 euros, corresponding to 1.2 assessments per month and a total of 33 reports, approximately 2.75 reports per month.

- Radiological safety assessment of a radiotherapy facility and activity with a linear accelerator, Instituto Português de Oncologia de Lisboa Francisco Gentil (IPOLFG). Concluded in 06-03-2012, value: 13879.30 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator, Clínica Quadrantes, Santarém. Concluded in 17-04-2012, value: 13879.30 euros.
- Radiological safety assessment of a brachytherapy facility and activity with a sealed source, Lenicare in Hospital de Évora. Concluded in 03-05-2012, value: 3050.40 euros.
- Radiological safety assessment of a radiotherapy facility and activity of with linear accelerator (1), Lenicare in Hospital de Évora. Concluded in 03-05-2012, value: 13879.30 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator (2), Lenicare in Hospital de Évora. Concluded in 03-05-2012, value: 13879.30 euros.

- Radiological safety assessment of a nuclear medicine facility and activity with open sources, Clínica Dr. Campos Costa no Hospital de Braga. Concluded in 25-05-2012, value: 1525.20 euros.
- Radiological safety assessment of a nuclear medicine facility and activity with open sources, Hospital Beatriz Ângelo, Loures, Concluded in 11-06-2012, value: 1525.20 euros.
- Radiological safety assessment of an industrial facility and activity with linear accelerator, COFICAB, Guarda.Concluded in 11-06-2012, value: 6253.32 euros.
- Radiological safety assessment of a nuclear medicine facility and activity with open sources, Fundação Champalimaud. Concluded in 10-07-2012, value: 1525.20 euros.
- Radiological safety assessment of a nuclear medicine facility and activity with open sources, CHLO, Hospital de Santa Cruz. Concluded in 07-09-2012, value: 1525.20 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator, Hospital de Santa Maria. Concluded in 15-10-2012, value: 6253.32 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator (DHX), Instituto Português de Oncologia de Lisboa Francisco Gentil (IPOLFG). Concluded in 31-10-2012, value: 13879.30 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator (Silhouette), Instituto Português de Oncologia de Lisboa Francisco Gentil (IPOLFG). Concluded in 31-10-2012, value: 13879.30 euros.
- Radiological safety assessment of a radiotherapy facility and activity with linear accelerator, Fundação Champalimaud. Concluded in 12-11-2012, value: 13879.30 euros.

COLLABORATIONS

- Participation in a technical task group in nuclear medicine of the medical physics division of the Portuguese Society of Physics.

NAME: Maria Isabel Flausino de Paiva

CATEGORY: Auxiliary Researcher
ID NUMBER: 14513

R&D ACTIVITIES

Nº	Activity Description	R&D
1	EURATOM/FP7-Fission: *ACSEPT* - Actinide reCycling by SEParation and Transmutation (FP7-CP-2007-211 267). Integrated Project. Prime contractor: CEA. Participants: 27 European Institutions, USA, Japan, South Korea, Russia, private companies and the IAEA. IST/ITN participants: UCQR/QIO, UPSR. ACSEPT Governing Council member: I Paiva (IST/ITN). IST/ITN Coordinator: J. Marçalo & I. Paiva	
2	EURATOM/ FP7- Fission: *PETRUS II* – Towards a European Training Market and Professional Qualification in Geological Disposal (Project No: 232665). Concerted Action. Prime Contractor: INPL. Participants: 20 European institutions, OCDE, IAEA. IST/ITN Coordinator: I. Paiva (IST/ITN)	
3	EURATOM/FP7-Fission-2012– NERIS-TP: *PREPARE* - Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe. Collaborative project. Participants: 45 European Institutions. IST/ITN Coordinator: P. Vaz (IST/ITN).	
4	EMRP Project: *IND04 MetroMETAL* - Ionising radiation metrology for the metallurgical industry. Prime Contract: CIEMAT Participants: 14 European institutions.	

	IST/ITN Coordinator: C. Oliveira (IST/ITN)	
5	EMRP Project: *JRP- i13 MetroNORM_-* Metrology for processing materials with high natural radioactivity. Prime Contractor: Participants: 12 European institutions. IST/ITN Coordinator: C. Oliveira (IST/ITN).	
6	FCT-2012 Research Project: *ARIAS* - Application of Ionizing Radiation for a Sustainable Environment, RECI/AAG-TEC/O400/2012. Institution: IST/ITN, Campus de Loures. IST/ITN Coordinator: M. Luisa Botelho, M. Fernanda Margaça (IST/ITN).	
7	IST/ITN internal research project- Radiocaesium Adsorption/Desorption on Geomaterials from "Raña" Deposits Originated from the NE Portugal Mainland. Follow-up of the former FCT project KADRWaste (PTDC/CTEGEX/ 82678/2006. IST/ITN Coordinator: I. Paiva). Participants: IST/ITN, FCUL, FCUP. Coordinators: I.Paiva, M.J.Madruga (IST/ITN).	
8	CMET Project – IGD-TP. Implementing Geological Disposal of Radioactive Waste Technology Platform Competence Maintenance, Education and Training Working Group. Participants: 16 European institutions, including IST/ITN (I.Paiva). Coordinator: M. Palmu (POSIVA)	
9	IGD-TP. Implementing Geological Disposal of Radioactive Waste Technology Platform: Research platform supported by EU to act as research project launch framework for FP7 and future research actions. National Representative at IGD-TP: I.Paiva (IST/ITN).	
10	Working Party on Atomic Questions (WPAQ). Technical/Scientific Committee of the European Union, national expert: I. Paiva (IST/ITN).	
11	Group of Experts referred to Article 37th of Euratom Treaty. Technical/Scientific Committee of the European Union, national expert: I. Paiva (IST/ITN).	
12	Oslo and Paris Convention, OSPAR: Radioactive Substances Committee (RSC). Technical/Scientific Committee. National representative: I. Paiva (IST/ITN).	
13	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, IAEA: National Contact Point: I. Paiva (IST/ITN).	
14	UPSR/GRRR Management Activities: Co-Coordination of the Radioprotection and Radioactive Waste Management Group (GRRR), under *Despacho CD/ITN Nº9.*	
	Research	75%
	Training & Education	10%
	Technical & Scientific Committees	10%
	Management Activities	5%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	**ACSEPT** - IST/ITN last Progress report (HYBAR n°9), (1/03/12-30/09/12) in Domain 1, WP 1.2. Deliverable 1.2.1 (Design, Synthesis and Assessment of Novel Ligands) was presented. Electrospray ionization quadrupole ion trap mass spectrometry (ESI-QIT/MS) was used to investigate several aspects of the coordination chemistry of lanthanides and actinides. Comparative studies of the gas-phase affinities of different N-and O-donor bases, as models of ligands in use, to Ln(III) and An(III) ions (An = Am and Cm; Ln = several from La to Lu except Pm) and the formation of cluster species in the gas phase, were performed by ESI-QIT/MS and FTICR/MS at UCQR/QIO. Studies on the relative affinities of bidentate N- and monodentate O-donor bases towards An (III)X_2^+ (An = Th to Cm) and Ln (III)X_2^+ (Ln = La to Lu except Pm) were developed. Two missions to CEA-Marcoule were carried out by UCQR/QIO post-graduate students, under ACSEPT and ACTINET-I3, to develop experimental work at ATALANTE Facility. 2 talks, 9 progress reports and 3 posters were presented. The 2nd Annual progress meeting and the First International Workshop Russia-EU/FP7 on radwaste and new fuel cycles were organized by IST/ITN. IST/ITN was not present at the final meeting in 2012 due to financial constraints. ACSEPT final report is waiting EC approval.

2	**PETRUS II**—Towards an European Training Market and Professional Qualification in Geological Disposal. Project meetings were organized according to the project work plan: Clausthal (Germany), Lisbon (Portugal), Rauma (Finland), Prague (C.R.), Cordoba (Spain) and Nancy (France). A workshop was also organized in Baden (Switzerland). Main dissemination activities: Paper presented in the FISA 2009 Conference organised by the EC in Prague on June 2009. Participation to the Post-Fisa workshop organized by ENEN with two presentations: Expectations of the (future) employers from the ETFS projects: A Perspective from a Waste Management Organization. Waste Management Training Experience: Interaction with End-Users. Paper presented in the 4th International Conference on Education and Training in Radiological Protection ETRAP 2009 in Lisbon on November 2009. Presentation of the Petrus II project in the IAEA Network of Centres of Excellence's Technical meeting in Vienna March 2010.Presentation to the IGD-TP's SRA working group. A press release was submitted to the local newspapers in Rauma about the 4th project meeting. A link was established with ENEN III and ENETRP II projects. Final report presented 16 April 2012 and waiting final evaluation. IST/ITN presented oral talks, participated in the dissemination activities, reports, questionnaires, meetings and was presented in the Users Council.
3	**PREPARE -** This proposal made in the call Fission-2012-3.3.1(Update of emergency management and rehabilitation strategies and expertise in Europe) aims to close gaps that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster. Main goal is the update of emergency management and rehabilitation strategies and expertise in Europe. The consortium intends to review existing operational procedures in dealing with l ong lasting releases, address the cross border problematic in monitoring and safety of goods and will further develop still missing functionalities in decision support system ranging from improved source term estimation and dispersion modelling to the inclusion of hydrological pathways for European water bodies. As the management of the Fukushima event in Europe was far from being optimal, it is propose to develop means on a scientific and operational basis to improve information collection, information exchange and the evaluation for such types of accidents. This will be achieved through a collaboration of industry, research and governmental organizations in Europe taking into account the networking activities carried out under the NERIS-TP project. Furthermore, the NERIS Platform member organizations (so far 43 partners) will be actively involved in the development.
4	**MetroMetal** - The project started in December 2011 and a kick-off meeting was held at CIEMAT in January 2012. Since then a questionnaire for determining currently used devices/systems for measuring the activity of radionuclides in metallurgy was prepared and sent to steel factories in 14 European Countries. Data collected were processed and separate reports summarizing the systems and methods currently used for monitoring scrap loads, cast steel, slags and fume dusts were prepared with the support of the two Portuguese steel making companies. The Portuguese team has contributed for the writing of the questionnaire and for the reports realized based on the answers to the questionnaire. A Monte Carlo model of the spectrometric device for measuring the activity of cast steel and slag samples, the adequate shielding and the sample chamber was studied by the Portuguese team and will be purposed for all the partners. A poster was presented at the National Conference on Physics, 2012.
5	**MetroNORM** - The project has been approved and will start in March 2013 with duration of 3 years. The project addresses the following scientific and technical objectives: (i) Development of measurement systems, methods and technique 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.
6	**ARIAS** - Consolidation of the competences and resources developed in previous projects with existent or in development, radiation processing systems (LINAC, the Co-60 experimental chamber,

	LETAL and LM3 laboratories) will focus on the development of: Pulse Radiolysis technique, wastewater treatment and recycling, decontamination of food for immune-deficient patients, materials - catalytic membranes and biopolymers derived from renewable feedstock. Upgrading and maintenance of the facilities is considered. Development of a high level of competency in radiation protection knowledge to account for a real safety culture will be carried out through the implementation of training and education programs focusing on providing an adequate level of knowledge in radiation physics and on occupational radiation protection, acknowledgment of different monitoring equipment's and the ability to produce specific protocols for their correct application, basic skills on radiological emergency response and intervention, National and EU legislative aspects, procedures for the licensing of equipment's and/or activities, import and transport of sources and the management of radioactive wastes. Deliverables will be the syllabus of the main course framework, written material/presentations and implementation of the training courses and the analysis of the inputs in terms of adequacy to the proposed objectives measured by the degree of easiness and/or difficulty showed during the project activities.
7	**IST/ITN internal research project** Radiocaesium Adsorption/Desorption on Geomaterials from "Raña" Deposits Originated from the NE Portugal Mainland. Follow-up of the former FCT project KADRWaste. One of the requirements for the assessment of adequate sites to host a radioactive waste disposal facility is a clear understanding of radionuclide adsorption/desorption mechanisms, mainly the interactions between radionuclides and the mineral surfaces. Continental detrital sediments known as *raña* (constituted mainly by clay minerals, smectite 15 Å, kaolinite, and illite) originated from the NE Portugal mainland have been studied in order to act as liner/backfill/buffers at low and intermediate radioactive level wastes (LILW) repositories. The ^{137}Cs adsorption/desorption in *raña* was investigated as a function of the initial Cs concentration (10^{-4} M to $5x10^{-3}$M) in presence of K^+ (poorly hydrated ion) and Mg^{2+} (strongly hydrated ion) competitive ions using a batch method. Two different experimental systems (static and dynamic) were tested and compared, simulating *in situ* conditions for ^{137}Cs desorption in case of an incident/accident scenario. The sorption data were fitted to Freundlich and Langmuir isotherms and the ^{137}Cs adsorption/desorption distribution coefficients (Kd), as well as the ^{137}Cs adsorbed/desorbed fractions, were evaluated. Work has been published, submitted for publication and presented at a conference (2012).
8	**CMET Project – IGD-TP**- The goals are transference of the state of the art (objectives of "Vision 2025"), analysis and needs in GD, developing quality assurance procedures and criteria for the voluntary accreditation of training (and education) in geological disposal, developing the content of learning outcomes or more traditionally the content of training or a "Curricula" for professionals in geological disposal for the development of joint training, ensuring indirectly that providers for CMET exist i.e. ensure the sustainability of providers and infrastructures/facilities for competence maintenance and development and new personnel, address the accreditation of training concepts using the ECVET approach, interact with other related groups and initiatives like EHRO-N, EETI, PETRUS, ENEN, ENTRAP and CINCH.
9	**IGD-TP** - Is a technology platform dedicated to initiate and carry out European strategic initiatives to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level waste and other long-lived radioactive waste. It will address the remaining scientific, technological and social challenges, and support the waste management programs in the Member States (implementation of Council Directive 2011/70/Euratom). The IGD-TP was launched in November 2009 Its initiators are the European Commission and organizations who contributed to and endorsed the Vision Report of the IGD-TP. The platform includes many European stakeholders such as industry, research, academia, research centres, technical safety organizations, non-governmental organizations, associations, SMEs, etc., endorsing the IGD-TP vision and goals such as establishing and implementing the Strategic Research Agenda (SRA) and the accompanying Deployment Strategy steered by the common vision. IST/ITN has joined IGD-TP in February 2012. IST/ITN (I. Paiva) attended the 3rd IGD-TP's Exchange Forum that was organized in November 29, Paris. Participants: 90 persons from more than 50 organizations, including the DG RTD (Research and Innovation), Unit K4 – Nuclear Fission.

10	**Working Party on Atomic Questions (WPAQ).** Technical/Scientific Committee of the European Union Active collaboration in the production of Council Directive 2011/70/EURATOM of 19 July 2011, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste and comments on BSS of the Euratom.
11	**Group of Experts referred to Article 37th of Euratom Treaty**. Technical/Scientific Committee of the European Union. Analysis of reports sent by the Art. 37º coordinator about decommissioning, dismantling and remediation of nuclear and radiological facilities.
12	**OSPAR/RSC** - The function of the Radioactive Substances Committee (RSC) is to facilitate the implementation of the OSPAR Strategy with regard to Radioactive Substances by the OSPAR Commission. RSC shall develop and periodically review environmental quality criteria for the protection of the marine environment from adverse effects of radioactive substances and apply these and other relevant criteria to identify and prioritize radioactive substances and/or human activities which give rise for concern about their radiological impact; preparation of Quality Status Reports for the maritime area or for regions or sub-regions thereof and review the results; initiate technical studies, where appropriate, and keep under review progress of scientific and technical knowledge; preparation of the national report according to PARCOM recommendation 91/4 on radioactive discharges; inform and advise the OSPAR Commission on specific questions; prepare draft recommendations, decisions or other programs and guidelines, including descriptions of BAT and BEP, aiming at a progressive and substantial reduction of discharges, emissions and losses of radioactive substances. OSPAR annual report analysis and fulfilment of questionnaire concerning PT quality assurance monitoring of radioactive substances in different matrices, was carried out in 2012.
13	**Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. International Atomic Energy Agency, IAEA -** Fourth Review Meeting of the Contracting Parties, 14 to 23 May 2012. Outputs:1st National Report of Portugal under the Joint Convention; Answers to the questionnaire made by other counterparts; Questions to other contracting parties; Presentation of the national report during the 4rd Review Meeting, in Vienna; Participation in the discussions of Group 5. Work preparation was in collaboration with CIPRSN and IST/ITN.
14	**GRRR Management Activities:** Co-Coordination of the Radioprotection and Radioactive Waste Management Group (GRRR), under *Despacho CD/ITN Nº9*, for the coordination of the research, training and education activities, responsibility for international organizations in the radioactive waste field, follow-up of the legal aspects related to radioprotection and radioactive waste management as well as feedback if required.

PAPERS

- Characterization of geomaterials from NE Portugal using k_o-based instrumental neutron activation analysis (k_o-INAA) and gamma spectrometry methods, M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio, *J. Radioanal Nucl Chem*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.
- 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, Pedro Duarte, Lídia Silva, António Mateus, M. Fátima Araújo, Mário Reis, Romão Trindade, Isabel Paiva, *Environ. Earth Sci.*, doi:I 10.1007/s12665-012-1758-0
- Effect of competitive ions on radiocaesium retention in clay mineral phases from raña deposits (NE Portugal). M.J. Madruga; M.J. Madruga; I. Paiva; E. Andrade; M. A. Gonçalves; A. Mateus Full paper submitted to *Applied Geochemistry*, November, 2012.

COMMUNICATIONS

- *Effect of competitive ions on radiocaesium retention in clay mineral phases from raña deposits (NE Portugal),* M.J. Madruga, I. Paiva, E. Andrade, M.A. Gonçalves, A. Mateus, 9th International Symposium on Environmental Geochemistry, Aveiro, Portugal, July 15-21 (2012), Invited talk.

- *The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management-Introduction,* IAEA J9-TM-42916/12ME13118, Regional Meeting on the Joint Convention, Cape Town, South Africa, 16-18 October 2012, I. Paiva (IST/ITN), Invited lecture.
- *The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management-Development of the Peer Review System,* IAEA J9-TM-42916/12ME13118, Regional Meeting on the Joint Convention, Cape Town, South Africa, 16-18 October 2012, I. Paiva (IST/ITN), Invited lecture.
- *Status Report on RWM in Portugal,* Regional Meeting on the Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, IAEA J9-TM-42916/12ME13118, Regional Meeting on the Joint Convention, Cape Town, South Africa, 16-18 October 2012, I. Paiva (IST/ITN), Invited lecture.
- *Lessons learnt in the Area of Stakeholder Dialogue to Strengthen National Competences for Radioactive Waste Disposal*. IAEA TC RER 9-103-014, General Directorate for Environmental Protection and Institute of Nuclear Chemistry and Technology, Warsaw, Poland, 18-24 November, 2012. Participation in working group and seminar.
- *Policy Formulation and Strategy Options for Radioactive Waste Management*, IAEA Regional Workshop RER9107 9001 01, Vienna, Austria, 20-24 February, 2012. Participation in the WG and presentation.

EDUCATION / THESES SUPERVISION

- IST/ITN Supervisor (I.Paiva), ongoing Ph.D. Thesis, by Pedro Duarte, Faculdade de Ciências, Universidade de Lisboa,
- IST/ITN Supervisor (I.Paiva, R. Trindade), ongoing Ms.C. Thesis, Gestão de Resíduos Radioactivos em meio hospitalar. Caso particular das descargas de efluentes líquidos radioactivos da Medicina Nuclear, by Cátia Rua (Escola Superior de Tecnologia da Saúde de Lisboa, ESTeSL), Mestrado em Radiações Aplicadas às Tecnologias da Saúde, Especialização em Protecção Contra Radiações.
- *Radiological protection, manipulation of radioactive materials, decontamination procedures, emergencies and radioactive waste management in medical/bioscience laboratories (microbiology, RIA, nuclear medicine),* Post-Graduation Course on Introduction to lab research with radioisotopes, safety and good practices, Department of Immunology, FCM/UNL, 21st October, 2012. Annual invited lecture.

PROJECTS

- *PETRUS III* - Euratom Seventh Framework Programme for Nuclear Research and Training. Follow-up of PETRUS II. Submission in 2012 and short list to be evaluated during 2013. Leading Institution: INPL, France. IST/ITN Coordinator: I. Paiva.

CONFERENCE ORGANIZATION / COMMITTEES

- IAEA Regional training course on identifying and managing uncertainty for post-closure safety assessment in support of repository development programmes. C7-RER—9.103-013. Lisboa, Portugal, 18-22 June 2012. Organization and Course director: I. Paiva (IST/ITN).

NAME: João Henrique Garcia Alves

CATEGORY: Auxiliary Researcher
ID NUMBER: 5363

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Individual monitoring service for external radiation exposure	30%
2	Environmental monitoring with passive dosimeters for the National Radiological Environmental Monitoring programme	5%
3	Dose assessment for staff and patients (research projects): Mammography, ref. PTDC/SAU-BEB/100745/2008 Fluoro-CT, ref. PTDC/SAU-ENB/115792/2009 Interventional radiology procedures other than Fluoro-CT	 15% 20% 5%
4	Chairman of the EURADOS WG02 on Harmonization of Individual Monitoring	15%
5	EURADOS Council membership	5%
6	Technical expert: reports, audits and referee of papers	5%
7	Supervision of Fellows	Included above
Total		**100**

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	*J.G. Alves, M.F. Pereira, S. Rangel, M. Saraiva* Head of the individual monitoring service for external exposure. The service is based on a TLD system consisting of two 6600 Harshaw readers, whole body dosimeters type Harshaw 8814 TL card and holder with two LiF:Mg,Ti (TLD-100) elements, for the evaluation of $H_p(10)$ and $H_p(0.07)$. Since 2012 the service is Accredited in conformity with the EN ISO/IEC 17025 standard, awarded by the Portuguese Board for Accreditation (*Instituto Português de Acreditação*). IST/ITN is presently taking part in the Eurados 2012 Intercomparison exercise for whole body dosimeters in photon fields that will soon be completed. The service is gradually increasing the number of customers and its activity as extremity and area dosimeters are being prepared for routine operation within 2013. In 2012, approximately 3000 workers from 500 facilities were monitored, 2000 on a monthly basis and 1000 quarterly.
2	*J.G. Alves, M.F. Pereira, S. Rangel, M. Saraiva* The individual monitoring service also performs environmental monitoring at IST/ITN *campus* and in the country for the National Radiological Environmental Monitoring (NREM) programme. Environmental monitoring with passive dosemeters is performed with LiF:Mg,Ti (TLD-100) dosemeters inserted in the Harshaw 8855 holder for the assessment of the ambient dose equivalent $H^*(10)$. The measurements are performed at four sites at IST/ITN and nine sites all over the country on a quarterly basis and the results are published in the annual report of the NREM programme. In 2012 IST/ITN took part in an Intercomparison exercise organized by the Spanish Ministry of Defense in collaboration with CIEMAT.
3	*J.G. Alves[1], M.F. Pereira[1,2], M.F. Oliveira[1,2], J.C. Pereira[1,2], A.D. Oliveira[1], J.V. Cardoso[1], L.M. Santos[1], C. Reis[3,4], A. Pascoal[4,5], S. Sarmento[6], J.A.M. Santos[6], R. Alves[7], S. Tecelão[7]* *Digital technologies for mammography: optimization using Monte Carlo simulation techniques* (ref. PTDC/SAU-BEB/100745/2008) is a research project funded by *Fundação para a Ciência e a Tecnologia* (FCT) in collaboration with *Universidade Católica Portuguesa* as the leading institution. The project aims at the characterization of digital mammography in Portugal and will end in 2013.

	Dose distribution mapping and Monte Carlo simulations in CT-fluoroscopy is also a research project PTDC/SAU-ENB/115792/2009 funded by FCT. The work is performed in collaboration with *Instituto Português de Oncologia do Porto* as the leading institution and *Faculdade de Engenharia da Universidade do Porto*. In the case of interventional procedures in angiography (neuroradiology) and in fluoro-CT guided procedures for lung biopsy collection, the team at the surgery room is likely to receive higher dose levels, particularly to the hands, the upper and lower limbs. The dose assessment methodology is based on the measurements of several dosimeter types. Ten whole-body dosimeters were distributed over the radiologist's body and a special glove was designed to hold 11 extremity dosimeters inserted in casings. Per-procedure dose distributions were obtained using this method. This work is also of interest for the EURADOS WG12 on the European Medical Alara Network. [1]IST/ITN staff, [2]Grant holder; [3]PhD student, ESTS-Lisboa; [4]Universidade Católica Portuguesa, Faculdade de Engenharia; [5]King's College Hospital, London (UK); [6]IPO-Porto, grupo de Física Médica; [7]Universidade Atlântica.
4	*J.G. Alves, P. Ambrosi[1], D. Bartlett[2], C. Cherestes[3], M.A. Chevalier[4], J.W. van Dijk[5], E. Fantuzzi[6], M. Figel[7], P. Gilvin[8], T. Grimbergen[9], E. Carinou[10], M. Lehtinen[11], A. McWhan[12], R. Kopec[13], A. Romero[14], F. Rossi[15], H. Stadtmann[16], B. Vekic[17]* The title and objective of Eurados WG02 is Harmonization of Individual Monitoring in Europe and is chaired by J.G. Alves (IST/ITN). Four subgroups were operational in 2012: a) Organization of the Intercomparison exercise (IC) for whole body dosimeters for photon fields, coordinated by A. McWhan (Babcock) and expected to be completed in 2013; b) Organization of the IC for neutron fields, coordinated by E. Fantuzzi (ENEA) and expected to be completed in June 2013; c) A survey on QA/QC practices in Europe coordinated by P. Gilvin (HPA); d) Organization of a training course (TC) on the implementation of the European technical recommendations for monitoring individuals occupationally exposed to external radiation (RP 160). The TC took place last November in Krakow, Poland, with 40 attendants. Both IC exercises and the TC were planned as self-sustained activities. [1]PTB, Germany; 2 UK; [3]Dozimed, Romania; [4]IRSN, France; [5]Netherlands; [6]ENEA, Italy; [7]Helmholtz-Zentrum, Germany; [8]HPA, UK; [9]NRG, Netherlands; [10]GAEC, Greece; [11]STUK, Finland; [12]Babcock Intl, UK; [13]IFJ, Poland; [14]CIEMAT, Spain; [15]AOUC-Firenze, Italy; [16]Seibersdorf Lab, Austria; [17]RBI, Croatia.
5	Member of the EURADOS (European Radiation Dosimetry Group) Council and Treasurer.
6	Upon request of the Directorate-General for Health (*Direcção-Geral da Saúde*), the technical appraisal of companies that apply for approval as service providers on radiation protection in compliance with Decree-Law n. 167/2002, was performed. Collaboration with the Portuguese Board for Accreditation (*Instituto Português para a Acreditação*) as technical expert performing accreditation audits in conformity with ISO/IEC 17025 of an individual monitoring laboratory.
7	Miguel Pereira, grant holder supported by the *Individual montoring of external radiation* activity, also performs research work on TLD dose assessment to staff and patients in fluro-CT guided procedures (PhD preparation work). Cláudia Reis, preparation of PhD Thesis on *Impact of Digital Mammography in Portugal*, carried out within the project *Digital Technologies in mammography: optimization using Monte Carlo simulation methods*, PTDC/SAU-BEB/100745/2008. Thesis will be presented in 2013 to the Universidade Católica Portuguesa. Mário Oliveira, grant holder on the project *Digital Technologies in mammography: optimization using Monte Carlo simulation methods*, PTDC/SAU-BEB/100745/2008, from January until December 2012. Joana Pereira, grant holder on the project *Dose distribution and Monte Carlo simulations in CT-fluoroscopy*, PTDC/SAU-ENB/115792/2009, since November 2012.

	Rute Alves, undergraduate of Radiology from Universidade Atlântica (Barcarena). Collaboration with S. Tecelão on the supervision of graduation research project performed at Hospital de São José. From May till July 2012. Jerry R. Pereira dos Santos, trainee from the Regulatory Body for Atomic Energy of the Republic of Angola, trainee ANG/10016 in the framework of the IAEA's technical cooperation program for Africa (Angola – ANG9003). 13th February until 12th April 2012.

PAPERS

- C. Reis, M. Oliveira, J.G. Alves, J.C. Marques, A. Pascoal. Caracterização tecnológica da mamografia digital em Portugal : progresso de um projeto em implementação. *SAÚDE & TECNOLOGIA ed. online. Temático (Cancro da mama)*, 13–23 (2012).

COMMUNICATIONS

- *Dosimetry in mammography*, M. Oliveira, C. Reis, J.G. Alves, A. Pascoal, Fisica 2012, 18ª Conferência Nacional de Física, Aveiro, Portugal, September 05-08, 2012 (oral).
- *Avaliação da dose de radiação gama ambiental em Portugal com detectores TLD*, M.F. Pereira, M. Oliveira, M. Saraiva, S. Rangel, J.G. Alves, Fisica 2012, 18ª Conferência Nacional de Física, Aveiro, Portugal, September 05-08, 2012 (poster).
- *Procedimento para a avaliação da dose recebida pelo médico radiologista em fluoro-CT*, M.F. Pereira, J.G. Alves, M. Saraiva, S. Rangel, S. Sarmento, J.A.M. Santos, M.J. Sousa, M. Gouvêa, Fisica 2012, 18ª Conferência Nacional de Física, Aveiro, Portugal, September 05-08, 2012 (poster).
- *Assessment of ionizing radiation exposure in mammography on 36 healthcare institutions in Portugal and accordance analyses with European recommendations*, C. Reis, M. Oliveira, J.G. Alves, A. Pascoal, III Congresso Nacional de Saúde Pública, Coimbra, Portugal, October 25-26, 2012 (oral).
- *Radiation dose in digital mammography for 36 equipment installed in Portugal*, C. Reis, M. Oliveira, J.G. Alves, A. Pascoal, II International Congress of Radiology, Coimbra, Portugal, November 2012 (oral).
- *Dose glandular média em exames de mamografia digital em Portugal*, C. Reis, M. Oliveira, J.G. Alves, A. Pascoal, Congresso Nacional de Senologia, Porto, Portugal, November 17-19, 2012 (poster).
- *Mamografia digital – caracterização das práticas adotadas em 65 unidades de saúde em Portugal*, C. Reis, M. Oliveira, J.G. Alves, A. Pascoal, Congresso Nacional de Senologia, Porto, Portugal, November 17-19, 2012 (poster). 2nd best scientific work award.
- *Assessment of the dose to the interventional radiologist in Fluoro-CT guided procedures*, J.G. Alves, M.F. Pereira, J.C. Pereira, A.D. Oliveira, L.M. Santos, J.V. Cardoso, S. Sarmento, J.A.M. Santos, M.J. Sousa, M. Gouvêa, 8th International Workshop on Individual Monitoring of Ionizing Radiation, Oarai, Japan, December 01-02, 2012 (invited talk).
- *Radiation protection dosimetry in Europe. An overview of activities of the EURADOS Working Group on Harmonization of Individual Monitoring*, J.W. van Dijk, J.G. Alves, H. Stadtmann, 11th Annual meeting of the Japanese Society of Radiation Safety Management, Osaka University, Osaka, Japan, December 04-06, 2012 (invited talk).

EDUCATION / THESES SUPERVISION

- Supervisor, Graduation research project in collaboration with S. Tecelão, *Occupational dose assessment in angiographic procedures for neuroradiology*. Rute Alves, Universidade Atlântica, Barcarena, licenciatura em Radiologia. July 2012.
- Organizing committee member and Lecturer, *Eurados Training Course on the European Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation (Radiation Protection 160)*, Krakow, Poland, November 12-16, 2012.

- Lecturer. *General criteria for approval of dosimetry services, Dose reporting, record keeping and information systems, Reliability of dose assessment, quality assurance and quality control*, Eurados Training Course Krakow, Poland, November 12-16, 2012.
- Lecturer. *Basis for procedures and criteria for mutual recognition of approved dosimetry services in Europe*, Eurados Training Course, Krakow, Poland, November 12-16, 2012.

PROJECTS

- *Digital Technologies in mammography: optimization using Monte Carlo simulation methods.* Fundação para a Ciência e a Tecnologia, ref: PTDC/SAU-BEB/100745/2008. Leading Institution: Universidade Católica Portuguesa, Faculdade de Engenharia. IST/ITN Coordinator: J.G. Alves.
- *Dose distribution and Monte Carlo simulations in CT fluoroscopy.* Fundação para a Ciência e a Tecnologia, ref: PTDC/SAU-ENB/115792/2009, Leading Institution: Instituto Português de Oncologia do Porto. IST/ITN Coordinator: J.G. Alves.
- *Harmonization of Individual Monitoring in Europe.* EURADOS WG02. Participating institutions: Babcock Intl, CIEMAT, Dozimed, ENEA, GAEC, HZM, HPA, IRSN, IST/ITN, NRG, PTB, RBI, SL, STUK. Chairman and IST/ITN Coordination: J.G. Alves.

CONTRACTS

Individual monitoring of external radiation with personal whole body dosimeters is provided by IST/ITN to facilities from the medical sector (80%), general industry (15%) and research fields (5%) on a contract basis. Two monitoring periods are offered (monthly and quarterly). The number of customers has increased throughout the year, particularly in the end of 2012 and beginning of 2013. The figures shown in the table below are the number of facilities and workers monitored in the end of 2012. The estimated income takes into account the first monitoring period.

Number of facilities	Monitoring period	Number of workers	Income (approx.)
155	Monthly	2000	€ 100.000,00
320	Quarterly	790	€ 22.000,00

Environmental monitoring is performed for the National Radiological Environmental Monitoring (NREM) programme with measurements at four sites at IST/ITN (twice every quarter period) and at nine sites in the country (Bragança. Castelo Branco, Faro, Funchal, Lisbon, Penhas Douradas, Ponta Delgada, Portalegre and Porto) monitored on a quarterly basis. Around 400 dosimeters are allocated to this task.

CONFERENCE ORGANIZATION / COMMITTEES

- J.G. Alves, Program organizing committee: *Eurados Training Course on the European Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation (Radiation Protection 160)*, Krakow, Poland, November 12-16, 2012.

COLLABORATIONS

- J.R. Pereira dos Santos, Autoridade Reguladora para a Energia Atómica de Angola, 13th February – 12th April, 2012. Trainee on individual monitoring of external radiation, supported by the IAEA.
- R. Alves, Universidade Atlântica, May – July, 2012. Training at the Individual Monitoring for External Exposure laboratory on TLD measurements for interventional procedures.
- A. Romero, CIEMAT (Spain), 07-08 October, 2012. Internal auditor. Evaluation of the activity performed by the Individual Monitoring of External Radiation laboratory.

PRIZES

- 2nd best scientific work award: *Mamografia digital – caracterização das práticas adotadas em 65 unidades de saúde em Portugal*, C. Reis, M. Oliveira, J.G. Alves, A. Pascoal, Congresso Nacional de Senologia, Porto, Portugal, November 17-19, 2012 (poster).

NAME: José Alberto Gil Corisco

CATEGORY: Auxiliary Researcher
ID NUMBER: 25453

R&D ACTIVITY

Nº	Activity Description	R&D
1	Development of a robotic system for radiological and heavy metal monitoring in an estuarine environment (acronym ROBOSAMPLER).	69%
2	Person in charge at the Laboratory for Handling Radioactive Sources, LMFR, at the Radiological Protection and Safety Unit, UPSR.	20%
3	Environmental radiological monitoring programmes of the UPSR.	8%
4	Regional Training Course, International Atomic Energy Agency, TC Project RER/9/117.	3%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	A proposal of a project on the development of a terrestrial robot adapted to environmental monitoring of estuarine mudflats, promoted by robotics enterprise Introsys, SA-Integrators for Robotic Systems, and with the participation of the Institute for the Development of New Technologies-UNINOVA and CTN, was submitted and approved for QREN funding. Project is mainly driven for the monitoring of NORM's from disabled phosphate industry at Barreiro, but also targets artificial radionuclides and heavy metals. Preparatory field sampling and laboratory work for this project has been carried through by the elements of CTN involved. Sediments from mudflats of Tejo estuary at Samouco, Sitio das Hortas and Valada do Ribatejo were processed and analysed by gamma spectrometry and neutron activation analysis for targeting heavy metals. The same was done for biota representatives *Zostera noltii* (seaweed) and *Ruditapes philippinarum* (Japanese clam) collected at Samouco mudflats. Presently available gamma spectrometry analysis reveal the presence of Th-234, Pb-210, Pb-212, Bi-212 and K-40 in the silt/clay (grain<63µm) fraction at Samouco, but with lower activity concentrations then those found at the upstream location of Valada. Interestingly, the silt/clay fraction at Valada has a wider diversity of natural radionuclides, also including Pa-234m, Ra-226, U-235 and Ac-228. Edible parts of Japanese clam *Ruditapes philippinarum*, an exotic invasive bivalve species, intensively captured at Samouco shoals for illegal human consumption, show measurable concentrations of Th-234, Pa-234m, Ra-226, Pb-212, 214, Bi-212, U-235, Ac-228, Bi-212 and K-40. However, some of these were not identified by gamma spectrometry analysis in de silt/clay fraction of Samouco.
2	Management of the laboratory for Handling of Radioactive Sources has been kept according to the demands of the analytical laboratories of the unit, and in compliance with the requirements of the quality assurance system, which will be audited in January 2013. Latest reviewed inventory in December 2012, accounts for the existence of radioactive solutions of Am-241,Cs-137, H-3, Ra-226, Ra-228 and Sr-90, described in the following table :

	Inventory of radioactive solutions in late 2012 in the Laboratory for Handling Radioactive Sources

nuclide	certified source code	solution code	estimated remaining mass in December 2012 (g)	activity (Bq)	reference date for activity
Am241 ($Tb_{1/2}$=432,2 y)	79667-706	SM	17,03	1,46E+04	30-04-2009
		Q1	47,73	46,63	
		Q2	49,23	60,47	
		P5	14,25	16,82	
		P6	3,17	402,36	
		P7	22,43	27,73	
		P8	5,58	437,58	
Cs137 ($Tb_{1/2}$=30,0 y)	CDZ24/S2/56/212	SM	43,97	1,86E+04	01-01-2003
	ELSL55 nº76841/1	SM	22,27	1,92E+08	15-09-2010
		Q1	26,26	8,46E+06	
		Q2	10,82	8,68E+06	
H3 ($Tb_{1/2}$=12,3 y)	73323-706	SM	63,87	2,71E+04	09-08-2006
		P1	10,32	265,45	
		P2	19,03	484,80	
		P3	19,97	490,94	
Ra226 ($Tb_{1/2}$=1600 y)	Ray44	SM	46,85	1,30E+05	11-08-1994
		P2	14,27	34,10	
		P6	7,68	9,79	
Ra228 ($Tb_{1/2}$=5,75 y)	75255-706	SM	18,63	2,00E+04	01-06-2007
Sr90 ($Tb_{1/2}$=29,1 y)	SIZ24	SM	31,18	1,32E+04	01-06-2002
		Q1	38,90	46,19	
		P7	18,67	16,33	
		P9	20,80	15,25	

3	Permanent member of field team for monthly sampling collection in Portuguese river basins, in support of the radiological monitoring of aquatic ecosystems. Sampling campaigns are undertaken monthly at the stations in rivers Tejo and Zêzere, and once a year at Douro, Mondego and Guadiana.
4	Invited to a regional Training Course on Public and Environmental Exposure Models and Related Radiation Monitoring, Tirana, Albania, 29 October – 2 November 2012. An IAEA training course under the framework of Project RER/9/117 Upgrading National Capabilities for Controlling Public Exposure.

PAPERS

- J. Bento, S. Barros, P. Teles, I. Gonçalves, J. Corisco, P. Vaz, Monte Carlo simulation of the movement and detection efficiency of a whole-body counting system using a BOMAB phantom, *Radiation Protection Dosimetry*, 148, 4, 403-413 (2012), doi: 10.1093/rpd/ncr201.

PROJECTS

- *Development of a Terrestrial Robotic System as a Tool for Radiological and Heavy Metal Monitoring in Estuarine Environments (ROBOSAMPLER)*, funding by QREN/IAPMEI (PORLisboa). Leading institution: Introsys, SA- Integrators for Robotic Systems. IST/ITN Coordinator: J. Corisco.

NAME: Mário João Capucho dos Reis

CATEGORY: Auxiliary Researcher
ID NUMBER: 04969

R&D 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 –	10%

	EMRP funding)	
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 7th Framework Programme – Grant agreement nº 323287)	3%
5	**MetroNORM –** Metrology for processing materials with high natural radioactivity. (JRP I13 – EMRP funding)	3%
6	Analytical Services on Radioactivity Measurements	15%
7	CTBTO Contract for the management of the RN53 radionuclide particulate station	6%
8	Coordination of the Measurement Laboratories (LM) group	30%
9	Radioactivity Monitoring Programme of the IST/ITN *campus*	15%
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 In relation to surface measurements and analysis of stratospheric tracers, a time series analysis of the natural atmospheric ^{7}Be (cosmogenic radionuclide) and ^{210}Pb (radionuclide of terrestrial origin) was performed. The analysis was mainly focused on the temporal evolution of ^{7}Be (series of 10 years with weekly frequency) given its great potential as natural tracer for tropospheric intrusion of air masses with stratospheric origin. Correlations with meteorological parameters were also attempted. Installation and operation of the equipment purchased using project funding (high volume particulate sampler with portability features) was done. The equipment was installed at the *Campus* of University Fernando Pessoa (Porto) to sample aerosol particles with a 48 hours frequency, enabling the detection of short duration events. The ^{7}Be activity of the aerosol samples is being measured by high resolution gamma-ray spectrometry.
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). The project started in December 2011 and a kick-off meeting was held at CIEMAT in January 2012. Since then a questionnaire for determining currently used devices/systems for measuring the activity of radionuclides in metallurgy was prepared and sent to steel factories in 14 European Countries. Data collected were processed and separate reports summarizing the systems and methods currently used for monitoring scrap loads, cast steel, slags and fume dusts were prepared. The Portuguese team has contributed for the writing of the questionnaire and for the reports realized based on the answers to the questionnaire. A Monte Carlo model of the spectrometric device for measuring the activity of cast steel and slag samples, the adequate shielding and the sample chamber was studied by the Portuguese team and will be proposed for all the partners.
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 modelling. 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.
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 PREPARE project has been approved in 2012 and will start in February 2013. 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, ranging from improved source term estimation and dispersion modeling to the inclusion of hydrological pathways for European water bodies. It is also proposed to develop means, on a scientific and operational basis, to improve information collection and exchange for such types of accidents. This will be achieved through a collaboration of industry, research and governmental organizations in Europe, taking into account the networking activities carried out under the NERIS-TP project.
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 has been submitted and approved during 2012 and will start in March 2013, with duration of 3 years. 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.
6	**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 IST/ITN 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).
7	**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 nº 2008-0065 *"Testing and Evaluation and Post-Certification Activities"*. On June 2012, CTBTO organized the first training course for radionuclide stations managers, with stations operating under PCA contracts: *Training Course on Operation and Maintenance for IMS Radionuclide Station Managers*, 18-22 June, Vienna, Austria. RN53 Participant: M. Reis.
8	**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. Some of the techniques were accredited by the Portuguese Accreditation Body (IPAC) on July 2012.
9	**Radioactivity Monitoring Programme of the IST/ITN *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.

PAPERS

- M. Reis, M.C. Freitas, H.M. Dung, A. Mateus, I. Paiva, M.J. Madruga, M.A. Gonçalves, L. Silva, I. Dionísio, Characterization of geomaterials from NE Portugal using k_0-based instrumental neutron activation analysis (k_0-INAA) and gamma spectrometry methods, *J. Radioanal. Nucl. Chem.*, 294, 363-369 (2012), doi:10.1007/s10967-012-1613-5.
- F.P. Carvalho, M.C. Reis, J.M. Oliveira, M. Malta, L. Silva, Radioactivity from Fukushima nuclear accident detected in Lisbon, Portugal, *Journal of Environmental Radioactivity*, 114, 152-156 (2012), doi:10.1016/j.jenvrad.2012.03.005.
- Pedro Duarte, Lídia 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.*, doi:10.1007/s12665-012-1758-0.

COMMUNICATIONS

- *Radioactive fallout in Portugal following the Fukushima nuclear accident*, Reis M., Madruga M.J., Silva L., Andrade E., 9th International Symposium on Environmental Geochemistry, Aveiro, Portugal, July 15-21 (2012), Oral.
- *Exposição ao gás radão no ar interior*, Mário Reis, Eva Andrade, M. José Madruga, 2º Encontro Riscos Ambiente e Qualidade do Ar, Fundação Calouste Gulbenkian, Lisbon, Portugal, November 8 (2012), Oral.
- *Assessment of natural Radioactivity levels and radiation hazards due to building materials*, M.J. Madruga, M. Reis, L. Silva, III Congresso de Protecção Contra Radiações dos Países de Língua Portuguesa, Lisbon, Portugal, November 20-23 (2012), Oral.

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	2012
Gamma spectrometry measurements	Several external clients	29.000 €
Indoor radon measurements	Several external clients	25.000 €
Contract nº. 2008-0065 *"Testing and Evaluation and Post-Certification Activities"* for the RN53 radionuclide particulate station	Comprehensive Nuclear-Test Ban Treaty Organization	30 000 €
	Total	**84.000,00 €**

COLLABORATIONS

- Conrado Miró Rodriguez, Departamento de Física Aplicada, Universidad de Extremadura, 26-27 July and 17 October, Collaboration regarding radon measurements.
- José Rubio Calcaño, Centro de Investigación y Aplicaciones Nucleares, Comisión Nacional de Energia, República Dominicana, 3 Sep. – 30 Nov. 2012, Training in gamma-ray spectrometry under the framework of the IAEA Technical Cooperation Project DOM12002.

NAME: Octávia Gabriela da Silva Viegas Monteiro Gil

CATEGORY: Auxiliary Researcher
ID NUMBER: 5380

R&D ACTIVITIES

Nº	Activity Description	R&D
1	RENEB Project - Realizing the European Network on Biological Dosimetry	
2	BioQuaRT Project- Biologically weighted quantities in radiotherapy	
3	International inter-comparison using chromosomal aberration assay	
4	Dose response curve for biological dosimetry	
5	Biological dosimetry using the γ-H2AX assay	
6	Diet exposure to acrylamide: study of cytogenetic biomarkers	
7	Supervision of M.Sc thesis and fellows	
8	Lecture	
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	*O. Monteiro Gil, V. Martins, A.C. Antunes, P. Vaz* This project, funded in the framework of the EU 7th Framework Program EURATOM, aims at establishing an European Network on Biological Dosimetry to guarantee, at the transnational level in Europe, the preparedness of response in situations of radiological or nuclear accidents and emergencies. It started on January 2012 and involves 23 institutions of 16 countries under the coordination of the German Bundesamt für Strahlenschutz (BfS). The staff of the Radiological Protection and Safety Unit of IST/ITN participates in: • Work Package 1 (WP1) – Operational Basis of the Network and • Work Package 4 (WP4) – Establishing the Organizational Structure. The on-going activities are related to the harmonization of the different existing protocols and in the establishment of the QA and QC procedures for the different laboratories involved. In WP1 we have already participated in a telescoring exercise -Task 1.1 *Dicentric Assay*- and made the corresponding dose estimation. Concerning the Task 1.5 *γ-H2AX* we have participated in the first inter-comparison exercise consisting of two parts. Part A includes the analysis of images to validate the scoring process, with known doses, and a second set of images with unknown doses. For part B, we performed studies with lymphocytes previously irradiated. For WP4 in Task 4.2 *Establish Concepts for the Sustainability of the Network*, we are working in a survey that will be disseminated in all the countries belonging to the RENEB project.
2	*O. Monteiro Gil* This project is a Joint Research Project belonging to the European Metrology Research Programme and it is supported by the EU and the EURAMET (European Association of National Metrology Institutes). It started on June 2012, involves 7 institutions of several EU countries and the principal leader is Physikalisch-Technische Bundesanstalt (PTB). In this project we belong to Work Package 4-*Biology*- "late effects" that together with the "early effects" will provide a set of biological data to use as benchmarks for the prediction of the multi-scale model. Before June 2012 the work began at IST/ITN, for late effects, with experiments on different cell lines (HeLa and A549) using micronucleus and chromosomal aberration assays. Until now we have performed two series of tests, at PTB ion microbeam, one concomitant with the kick-off meeting of the project in June 2012, other in November concomitant with the first progress report meeting. A series of technical problems were revealed during the first irradiations in June, so

	in November's irradiation time we changed the cell lines used before for NHDF, AG1522 and CHO, and tried to overcome the difficulties experienced. Unfortunately, after these irradiation times we confirmed that using human lines will not deliver small uncertainties.
3	*V. Martins, A. C. Antunes, O. Monteiro Gil* We have received an invitation from Prof. David Lloyd to participate in an inter-comparison exercise made between participants of the BioDoseNet project (we don't belong to this project). The exercise consisted in the estimation of dose using the chromosomal aberration assay. The HPA laboratory prepared slides from two high *in vitro* exposures to ^{60}Co gamma radiation. Two different scenarios were created, one simulating a whole body exposure and the other simulating a partial body exposure.
4	*V. Martins, A. C. Antunes, O. Monteiro Gil* Biodosimetry is a method to quantify an individual's absorbed dose in situations of occupational or accidental over-exposure to ionizing radiation. These curves are important, in biological dosimetry, allowing the estimation of dose in cases of accidental exposure to ionizing radiation where, often, no knowledge of the physical dose exists. Dose-response curves, using chromosomal aberration assay (CA) and the cytokinesis blocked micronucleus (CBMN) assay were finalized. The dose-response curves were obtained studying *in vitro* irradiated samples of 16 healthy, non-smoker individuals, from both genders, in the 20 to 60 years age range. Samples of peripheral blood lymphocytes were irradiated, using a ^{60}Co source from LMRI. For each individual and dose 200 metaphases and 1000 binucleated cells were scored for CA and CBMN assays respectively, which gave a total of 22,395 metaphases and 112,000 binucleated cells analysed. Following the establishment of the dose-response curves, a validation experiment was carried out with three individuals. Real and estimated doses, obtained with the dose-response curves, were in agreement. These results give us confidence to apply both dose-response calibration curves in future biological dosimetry requirements for dicentric chromosomes and micronuclei formation in the Portuguese population.
5	*O. Monteiro Gil, A. C. Antunes, V. Martins, A.S. Rodrigues[1]* When DNA is damaged and forms double stranded breaks (DSB), it is always followed by the phosphorylation of the histone, H2AX. This new phosphorylated protein, γ-H2AX, is the first step in recruiting and localizing DNA repair proteins. DSB can be induced by mechanisms such as ionizing radiation and subsequently, γ-H2AX foci quickly form. These foci represent the DSB in a 1:1 manner and can be used as a biomarker for damage being γ-H2AX a very important bioindicator for biodosimetry. An antibody can be raised against γ-H2AX which can therefore be visualized by immunofluorescence through secondary antibodies. Our objective is to perform a dose-response curve that can be used for biological dosimetry. We have now a preliminary calibration curve obtained after the study of 5 doses 0, 0.5, 1.0, 2.0 and 4.0 Gy in an individual. The samples of peripheral blood were irradiated at LMRI, incubated at 37ºC during 4h, and after the assay 200 lymphocytes per dose were analysed. We also intend to perform a kinetic study for different incubation times in order to test the technique's sensitivity up to 48h incubation after γ-rays radiation exposure. (1) Departamento de Genética, Universidade Nova de Lisboa.
6	*O. Monteiro Gil, N. G. Oliveira[1]* This work includes the study of biomarkers of early biological effects (micronuclei) associated with the dietary exposure of acrylamide in healthy individuals. This is a collaborative study with the R&D centres CIGMH/FCM-UNL and iMed.UL/FFUL. (1) iMed.UL/FFUL
7	*O. Monteiro Gil* Supervision of the M.Sc. thesis, "*Avaliação da lesão genética induzida por exposição a radiação ionizante na população Portuguesa"*, by Ana Catarina Monteiro Dias Antunes.

	In charge of the orientation of two FCT grant holders (SFRH/ BI / 33499 / 2008 and SFRH/ BI/ 33347/2008) in the area of biological effects induced by ionizing radiation.
8	*O. Monteiro Gil* *"Efeitos biológicos das radiações ionizantes* in *Curso teórico de Segurança no manuseamento de radioisótopos (CIMA)". Universidade do Algarve Gambelas*. Invited talk.

PAPERS

In international peer reviewed journals

- L.S. Santos, S.C. Branco, S.N. Silva, A.P. Azevedo, O.M. Gil, I. Manita, T.C. Ferreira, E. Limbert, J. Rueff, J.F. Gaspar, Polymorphisms in base excision repair genes and thyroid cancer risk, *Oncology Reports*, 28 (5), 1859-1868 (2012), doi: 10.3892/or.2012.1975.
- U. Kulka, L. Ainsbury, M. Atkinson, J.F. Barquinero, L. Barrios, C. Beinke, G. Bognar, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mortl, A. Montoro, J. Moquet, M. Moreno, A. Ogbazghi, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, M.J. Prieto, H. Romm, K. Rothkamm, L. Sabatier, S. Sommer, G. Terzoudi, A. Testa, H. Thierens, F. Trompier, I. Turai, V. Vandersickel, P. Vaz, P. Voisin, A. Vral, F. Ugletveit, C. Woda, A. Wojcik, Realising the European Network of Biodosimetry (RENEB), *Radiation Protection Dosimetry* 151 (4) 621–625 (2012), doi: 10.1093/rpd/ncs157.
- A. Louro, L. Peralta, S. Soares, A. Pereira, G. Cunha, A. Belchior, L. Ferreira, O.M. Gil, P. Pinto, A.S. Rodrigues, M.J. Silva, P. Teles, Human exposure to indoor radon: a survey in the region of Guarda, Portugal, *Radiat Prot Dosimetry*, 2012 Aug 16. [Epub ahead of print] (2012), pp. 1–8, doi:10.1093/rpd/ncs166.
- A. Belchior, O. Monteiro Gil, P. Almeida, P. Vaz, Dose and time dependence of targeted and untargeted effects after very low doses of α-particle irradiation of human lung cancer cells, *Dose Response*, accepted for publication (2012).
- V. Martins, A.C. Antunes, O.M. Gil, Implementation of a dose-response curve for γ-radiation in the Portuguese population by use of the chromosomal aberration assay, *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, Epub 2012 Oct 5 (2012), doi: 10.1016/j.mrgentox.2012.09.009.

COMMUNICATIONS

- *Efeitos biológicos das radiações ionizantes*, O. Monteiro Gil, *"Segurança no manuseamento de radioisótopos" "Segurança Radiológica em Laboratórios de Investigação" Curso teórico (6h) CIMA. Universidade do Algarve Gambelas, March 16 (2012)*. Invited talk.
- *Dose-response curve for γ-radiation using the chromosomal aberration assay*, V. Martins, A. C. Antunes, O. Monteiro Gil, *2nd Congresso Português de Protecção contra Radiações, Terceiro Congresso Português de Proteção contra Radiações dos Países e Comunidades de Língua Portuguesa. Polo Tecnológico de Lisboa, Lisboa, Portugal, November 20 - 23 (2012).* Invited talk.
- *RENEB – Realizing the European Network in Biological Dosimetry*, U. Kulka, L. Ainsbury, M. Atkinson, J. Barquinero, L. Barrios, C. Beinke, G. Bognar, A. CuCu, F. Darroudi, P. Fattibene, O. Gil, V. Hadjidekova, S. Haghdoos, R. Herranz, A. Jaworska, C. Lindholm, S. Mörtl, A. Montoro, M. Moreno, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, H. Romm, K. Rothkamm, L. Sabatier, S. Sommer, A. Testa, H. Thierens, F. Trombier, I. Turai, P. Vaz, P. Voisin, A. Vral, C. Woda, A. Wojcik, *13th International Congress of the International Radiation Protection Association (IRPA13), Glasgow, Scotland, May 13-18 (2012)*. Poster.
- *RENEB - Realizing the European Network of Biological Dosimetry*, U. Kulka, L. Ainsbury, M. Atkinson, J.F. Barquinero, L. Barrios, C. Beinke, G. Bognar, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mörtl, A. Montoro, J. Moquet, M. Moreno, A. Obazghi, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, M.J Prieto, H. Romm, K. Rothkamm, L. Sabatier, S. Sommer, G. Terzoudi, A. Testa, H. Thierens, F. Trompier, I. Turai, V.

Vandersickel, P. Vaz, P. Voisin, A. Vral, F. Ugletveit, C. Woda, A. Wojcik, *4th International MELODI Workshop, Helsinki, Finland, September 12-14 (2012)*. Poster.

- *How can the EURADOS Network on Retrospective Dosimetry contribute to research in low doses?*, P. Fattibene, L. Ainsbury, C. Burbidge; V. Chumak, H. Romm, K. Rothkamm, F. Trompier, C. Woda, A. Bajinskis, P. Barquinero, C. Bassinet, C. Bernhardsson, V. Cauwels, V. Correcher, S. D. Monaca, D. Ekendahl, E. Gregoire, O. E. Hole, A. Jaworska, E. Kouroukla, U. Kulka, M. Marrale, N. Maznyk, B. Michalec, O. M. Gil, J. Moquet, U. Oestreicher, J. Pajic, A. Testa, I. Veronese, V. Vinnikov, P. Voisin, A. Wieser, A. Wojcik, *4th International MELODI Workshop, Helsinki, Finland, September 12-14 (2012).* Poster.
- *RENEB – Realising the European Network in Biological Dosimetry*, P. Voisin, L. Ainsbury, M. Atkinson, J. Barquinero, L. Barrios, C. Beinke, G. Bognar, F. Darroudi, P. Fattibene, O. Gil, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, S. Mörtl, A. Montoro, M. Moreno, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, H. Romm, K. Rothkamm, L. Sabatier, S. Sommer, A. Testa, H. Thierens, F. Trompier, I. Turai, P. Vaz, A. Vral, C. Woda, A. Wojcik, U. Kulka, *HFM-223 Symposium on Biological Effects of Ionizing Radiation Exposure and countermeasures: Current Status and Future Perspectives, Ljubljana, Slovenia, October 8-10 (2012)*. Oral presentation.
- *Dose-response curves for Portuguese population: chromosomal aberrations and micronuclei assays*, O. Monteiro Gil, V. Martins, A. C. Antunes, *39th Annual Meeting of the European Radiation Research Society, Vietri sul Mare, Italy, October 15-19 (2012)*. Poster.
- *RENEB – Realizing the European Network in Biological Dosimetry*, U. Kulka, L. Ainsbury, M. Atkinson, J.F. Barquinero, L. Barrios, C. Beinke, G. Bognar, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mörtl, A. Montoro, J. Moquet, M. Moreno, A. Obazghi, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, M.J Prieto, H. Romm, K. Rothkamm, L. Sabatier, S. Sommer, G. Terzoudi, A. Testa, H. Thierens, F. Trompier, I. Turai, V. Vandersickel, P. Vaz, P. Voisin, A. Vral, F. Ugletveit, C. Woda, A. Wojcik, *39th Annual Meeting of the European Radiation Research Society, Vietri sul Mare, Italy, October 15-19 (2012)*. Poster.

EDUCATION / THESES SUPERVISION

- Supervisor, M. Sc. Thesis, *Avaliação da lesão genética induzida por exposição a radiação ionizante na população Portuguesa*, by Ana Catarina Monteiro Dias Antunes, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa.

Jury Membership:

- O. Monteiro Gil, M. Sc thesis, *Avaliação da lesão genética induzida por exposição a radiação ionizante na população Portuguesa*, by Ana Catarina Monteiro Dias Antunes, Mestrado em Genética Molecular e Biomedicina, Universidade Nova de Lisboa, 13 December 2012.

NAME: Pedro Manuel Peixoto Teles

CATEGORY: Auxiliary Researcher *(Ciência 2008)*
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R&D ACTIVITIES

Nº	Activity Description	R&D
1	Dose Datamed II Portugal Project	20%
2	Internal dosimetry activities: Whole body counter, localised organ counter, biokinetic models, calibrations and quality assurance	20%
3	BioQuaRT Project	15%
4	EURADOS (European Radiation Dosimetry Group) related activities	10%
5	CDT Project	10%
6	VADOSE Project	10%

7	Dosimetric assessment of prostate brachyterapy using Monte Carlo simulations and measurements in an anthropomorphic phantom, in collaboration with the Universidade Federal do Rio de Janeiro	10%
8	Dosimetric assessment of the angiography room of the Hospital Garcia de Orta, in Almada, using Monte Carlo simulations and TLD measurements	5%
Total		100%

WORK SUMMARY

Nº	Work Summary and main Achievements
1	The Dose Datamed II Portugal project aimed at evaluating the exposure of the Portuguese population to ionising radiation due to medical radiodiagnostic and nuclear medicine examinations. This was performed in coordination with the EC funded European Dose Datamed II project. In order to perform this evaluation, a consortium of about 50 public and private stakeholders was created. The collective dose in the Portuguese population was successfully estimated at about 1 mSv per person. More detailed data was sent to all collaborating European and international institutions in accordance with pre-established deadlines. It was the first time that such evaluation was performed in Portugal, which, unlike many of its European peers, does not have a proactive culture in radiological protection related issues in healthcare. We expect to continue periodic evaluations of the collective dose in the Portuguese population, as well as to optimise the evaluation methodologies. This work resulted in the publication of 1 article in an international peer reviewed journal, an internal UPSR report, and several talks and posters in international and national conferences. We also publicised it by emailing a digital version of the report to a group of about 2,000 recipients, and by means of the IST's public relations office.
2	The Whole Body Counter (WBC) present at the UPSR is the only facility of its kind in Portugal. It is designed to measure possible internal incorporations of radioactivity in individuals, either via their routine tasks or radiological accidents or emergencies. The equipment is calibrated on a yearly basis, and a Quality Assurance routine is performed on a weekly basis. In this way, performance parameters are routinely checked, benchmarked and evaluated for the quality and accuracy of the WBC's measurements. There is also a homemade localised radioactivity detector which aims at detecting incorporated radioactivity in localised organs (thyroid, kidneys, etc), which is also calibrated on a yearly basis. Both are prepared to serve the community in case of a radiological emergency. Committed effective doses can then be determined by making use of biokinetic models, of which we possess a library, and dedicated software. We have also developed a series of computational models of our detection systems which can be used to simulate contamination events. There are ongoing collaborations with the Nuclear Medicine centre of Hospital Garcia de Orta in order to measure the time curve of injected radiopharmaceuticals in individuals (adult or paediatric) for radiodiagnostic purposes in selected organs, aimed at optimising the dosimetry of the procedures. There is an ongoing MSc Thesis which will study the optimisation of dose in paediatric patients subjected to renal imaging procedures. Finally, internal dosimetry activities resulted in the publication of 4 articles in an international peer

	reviewed journal.
3	The Biologically Weighted Quantities for Radiation Therapy (BioQuaRT) project is a Joint Research Project of the European Metrology Research Programme (EMRP-JRP), which started officially in June 2012. This project aims at developing new metrological quantities that can take into account the biological response of the tissues at the DNA strand levels which can better suit the challenges of treatment planning by means of radiation therapy. The project gathers experts from the fields of Biology, Physics, Chemistry, Dosimetry and Radiation Protection, with the goal of creating a biophysical model which can help create new dosimetric standards for radiation therapy. The IST/ITN group is active in both the biological measurements in cell lines at the ion beam located at the PTB in Braunschweig, and in the Monte Carlo simulations both of the microdosimetry equipment, the biological tissues, and simulation of the reactive species which are created after DNA damage. So far, measurements in the ion beam have been performed at PTB, and the simulation of a microcalorimeter has started, in collaboration with the NPL, the University of Surrey, and the Laboratori Nazionali de Legnaro.
4	The European Radiation Dosimetry group (EURADOS) has many ongoing activities, of which participation was mainly on two of its work groups: - The Internal Dosimetry group (WG7) - The EURADOS European medical ALARA platform group (WG12) In the framework of the WG7 activities, we have finished the intercomparison of our Monte Carlo simulations of a dedicated lung counter for uranium contaminations, which resulted in the publication of 1 article in an international peer reviewed journal. Furthermore we are now participating in a new similar intercomparison which aims at simulating an internally contaminated skull using Monte Carlo simulations. We have also presented work concerning comparisons of *in vivo* measurements with Monte Carlo simulations using voxel phantoms and biokinetic model predictions, which resulted in the publication of 2 articles in an international peer reviewed journal In the framework of the WG12 activities, we developed a study in collaboration with KIT (Karlsruhe, Germany), and ESTeSC -Coimbra, which consisted in assessing extremity doses in staff during interventional CT-fluoroscopy procedures, by means of measurements in a CT-fluoroscopy equipment using an anthropomorphic hand phantom and Monte Carlo simulations. This resulted in the submission of a paper to an international peer-reviewed journal. We have also undertaken a coordinated bibliographical study of all publications concerning CT-fluoroscopy for a review paper, which is now in draft form.
5	The project CDT is a European Union co-financed Collaborative Project in the 7th Framework Program EURATOM (Grant agreement n^{o}: FP7-232527). An important issue regarding the MYRRHA/FASTEF nuclear reactor design is the in-vessel fuel storage facility, both for fresh and spent fuel. The model design and calculations were done with the state-of-art MCNPX Monte Carlo code. In particular a parametric study with the fuel assembly pitch on the multiplication factor (K_{eff}) was performed. The fuel assembly pitch was calculated in order to reach a K_{eff} value less than 0.95 for safety purposes. Moreover neutron flux, displacement per atom (dpa) and decay heat calculations were performed in order to fully characterize the four in-vessel fuel storage facilities.
6	The VADOSE project aims at using several dosimetric techniques to determine radioactivity in soils and sediments. As a first step, we have used the Monte Carlo code MCNPX to simulate a sample irradiation device for sediment samples, using a SR/Y source. The main goal of this first task is to determine the dose fields in and around the device. A second step will consist in simulating real particle transport in soils and sediments using the same code.
7	In collaboration with the Universidade Federal do Rio de Janeiro (UFRJ) we have developed a Monte Carlo simulation model using a voxel phantom, to determine dose fields around the prostate and surrounding sensitive tissues in prostate brachytherapy treatments. We have determined the changes

	in the dose fields due to the several uncertainties which are paramount to this technique (seed arrangements, prostate swelling, and movement of the seeds inside the prostate during treatment) and compared it with a real treatment planning. We validated our Monte Carlo model with a measurement of dose fields in an anthropomorphic phantom of the prostate, performed in the UFRJ. This work was submitted for publication in an international peer-reviewed journal.
8	In collaboration with the Hospital Garcia de Orta, in Almada, we are using Monte Carlo simulations, and measurements with TLDs, to determine the dose fields in the Hospital's Angiography room where several interventional procedures occur. Our aim is to determine the dose to staff. In particular, we are interested in studying dose in the eye lens of all workers which are inside the room during the interventional procedures.

PAPERS

- J. Bento, S. Barros, P. Teles, P. Vaz, M. Zankl, Efficiency Correction Factors of an Accuscan Whole-Body Counter due to the Biodistribution of ^{134}CS, ^{137}CS and ^{60}CO, *Radiation Protection Dosimetry* (2012), doi:2012 doi:10.1093/rpd/ncs308.
- P. Teles, M. C. de Sousa, G. Paulo, J. Santos, A. Pascoal, G. Cardoso, I. Lança, N. Matela, L. Janeiro, P. Sousa, P. Carvoeiras, R. Parafita, A. I. Santos, P. Simãozinho, P. Vaz, Estimation of the Collective Dose in the Portuguese Population due to Medical procedures in 2010, *Radiation Protection Dosimetry* (2012), doi: 10.1093/rpd/ncs258.
- A. Louro, L. Peralta, S. Soares, A. Pereira, G. Cunha, A. Belchior, L. Ferreira, O. Gil, H. Louro, P. Pinto, A. S. Rodrigues, M. J. Silva, P. Teles, Human Exposure to Indoor Radon: A Survey in the Region of Guarda, Portugal, *Radiation Protection Dosimetry* (2012), doi:10.1093/rpd/ncs166.
- D. Broggio, J. Bento, M. Caldeira, E. Cardenas-Mendez, J. Farah, T. Fonseca, C. Konvalinka, L. Liu, B. Perez, K. Capello, P. Cowan, J.A. Cruzate, L. Freire, J.M. Gómez-Ros, S. Gossio, B. Heide, J. Huikari, J. Hunt, S. Kinase, G.H. Kramer, O. Kurihara, A. Kyrieleis, A.L. Lebacq, D. Leone, C. Li, J. Li, L.C. Mihailescu, M. Moraleda, J.F. Navarro, C. Oliveira, N. Puerta, U. Reichelt, C. Simões, D. Sommer, M. Takahashi, P. Teles, F. Vanhavere, T. Vrba, D. Franck, G. Gualdrini, M.A. Lopez, Monte Carlo modelling for the in vivo lung monitoring of enriched uranium: Results of an international comparison, *Radiation Measurements*, 47, 492-500 (2012), doi:10.1016/j.radmeas.2012.04.020.
- J. Bento, S. Barros, P. Teles, M. Neves, I. Gonçalves, J. Corisco, P. Vaz, Monte Carlo simulation of the movement and detection efficiency of a whole-body counting system using a BOMAB phantom, *Radiation Protection Dosimetry*, 148, 403-413 (2012), doi: 10.1093/rpd/ncr201.
- J. Bento, B. Martins, P. Teles, M. Neves, P. Colarinha, F. Alves, N. Teixeira, P. Vaz, M. Zankl, Performance assessment and uncertainty evaluation of a portable NaI-based detection system used for thyroid monitoring, *Radiation Protection Dosimetry*, 151, 252-261 (2012), doi: 10.1093/rpd/ncs011.
- M.A. Lopez, I. Balásházy, P. Bérard, E. Blanchardon, B. Breustedt, D. Broggio, C.M. Castellani, D. Franck, A. Giussani, C. Hurtgen, A.C. James, W. Klein, G.H. Kramer, W.B. Li, J.W. Marsh, I. Malatova, D. Nosske, U. Oeh, G. Pan, M. Puncher, P. Peixoto Telles, J. Schimmelpfeng, T. Vrba, EURADOS coordinated action on research, quality assurance and training of internal dose assessments, *Radiation Protection Dosimetry*, 149, 349-352 (2012), doi: 10.1093/rpd/ncq435.
- J. Bento, P. Teles, Estudo da evolução temporal dos parâmetros de desempenho do Contador de Corpo Inteiro, Report UPSR-C, nº4/2012.
- P. Teles, M. C. de Sousa, G. Paulo, J. Santos, A. Pascoal, G. Cardoso, I. Lança, N. Matela, L. Janeiro, P. Sousa, P. Carvoeiras, R. Parafita, A. I. Santos, P. Simãozinho, P. Vaz, Relatório sobre os resultados do projecto Dose Datamed 2 Portugal, Report UPSR-C, nº 18/2012.

COMMUNICATIONS

- *Frequency and collective dose for the Nuclear Medicine and the TOP 20 X-ray examinations in Portugal,* P. Teles *Workshop on European Population Doses from Medical Exposure, Athens, Greece, Apr 24-26 (2012),* Oral Communication.
- *Prostate brachytherapy dosimetry using voxel phantoms,* S. Barros, P. Teles, S. Cardoso, A. Facure, L. da Rosa, M. Santos, P.P. Pereira Jr., P. Vaz, M. Zankl, *Workshop on Computational Medical Physics, Nara, Japan, Sep 2 (2012),* Oral Communication.
- *Avaliação da Exposição da População Portuguesa a Radiações Ionizantes devido a Exames Médicos de Radiologia de Diagnóstico e Medicina Nuclear, P. Teles, M. C. de Sousa, G. Paulo, J. Santos, A. Pascoal, G. Cardoso, I. Lança, N. Matela, L. Janeiro, P. Sousa, P. Carvoeiras, R. Parafita, A. I. Santos, P. Simãozinho, P. Vaz, FISICA 2012, Aveiro, Portugal, Sep 6-8 (2012),* Poster Presentation.
- *Avaliação da Exposição da População Portuguesa a Radiações Ionizantes devido a Exames Médicos de Radiologia de Diagnóstico e Medicina Nuclear, P. Teles, III Congresso Nacional de Saúde Pública, Coimbra, Portugal, Oct 25-26 (2012),* Oral Communication.
- *Dose Datamed 2 em Portugal: da ideia à realidade, P. Teles, II Congresso Internacional de Radiologia, Coimbra, Portugal, Nov 9-10 (2012),* Invited Talk.

EDUCATION / THESES SUPERVISION

- Jury member (examiner) of the M.Sc. Thesis, *Medições de Dose no Cristalino e na Tiróide em Tomografia Computorizada*, by Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa, 31 May 2012.
- Jury member (examiner) of the M.Sc. Thesis, *Proteção Radiológica em Mamografia*, by Mafalda Sofia Pinto Duarte, Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa, 30 November 2012.
- Jury member (examiner) of the M.Sc. Thesis, *Medição dos Níveis de referência em Mamografia*, by João Paulo Lampreia Fantana, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 10 December 2012.
- Jury member (as vowel) of the M.Sc. Thesis, *Proteção Radiológica nos Procedimentos de Pesquisa Radioguiada do Gânglio Sentinela*, by Ana Catarina Camejo Barreto, Instituto Superior Técnico, Universidade Técnica de Lisboa, 12 December 2012.
- Joint teaching classes of "Produção e Dosimetria das Radiações", 12 hours, MSc in Radiações Aplicadas às Tecnologias da Saúde, Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa.
- Joint teaching classes of "Protecção contra Radiações I", 11 hours, Msc in Radiações Aplicadas às Tecnologias da Saúde, Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa.

PROJECTS

- *Biologically weighted Quantities in Radiation Therapy (BioQuaRT),* A Joint Research Project within the European Metrology Research Programme EMRP, EMRP JRP-SIB06, Leading Institution: Physikalisch-Technischen Bundesanstalt (PTB). IST/ITN Coordinator: P. Teles

CONFERENCE ORGANIZATION

- Chair of the Track in Radiation Science, Medical Applications & Non Base-load Nuclear Applications for the *International Youth Nuclear Congress (IYNC) 2012*, Charlotte, USA, 5-11 August 2012.