
DOSIMETRY AND RADIOBIOLOGY

Annual Activity Report 2013

UNIT: Radiation Protection and Safety

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 (<i>Ciência 2008</i>)	100%
Maria Neves	Principal Researcher (retired)	Collaborator
Yuriy Romanets	Technician (PhD)	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 (IST)	100%
Vanda Martins	Fellow (IST)	100%
Ana C. Antunes	Fellow (IST)	100%
Miguel Pereira	Fellow (IST)	100%
Filipa Costa	Fellow (IST) ²	100%
Mónica Mendes	Fellow (IST) ²	100%
Mariana Baptista	Project Fellow (FP7-Security)	100%
Joana Pereira	Project Fellow (FCT)	100%
Mário Oliveira	Project Fellow (FCT) ³	100%
Ana Belchior	PhD Fellow (FCT)	100%
Raul Luís	PhD Fellow (FCT)	100%
Sílvia Barros	PhD Fellow (FCT)	100%
Cecília Borges	PhD 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:

¹ Accumulate with Coordination functions of the Unit.

² Until October 2013

³ Until September 2013

- Participation in R&D projects funded by the:
 - 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 was successfully pursued and the accreditation of the individual monitoring techniques was granted by the IPAC (Portuguese Institute for Accreditation).

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, FREYA, MARISA, PREPARE, 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:
 - “Improvement of Image Quality and Dose Reduction in Digital Breast Tomosynthesis using Statistical Image Reconstruction Algorithms”
 - “Tecnologias digitais em mamografia: otimização utilizando métodos de simulação de Monte Carlo”
 - “Distribuição de doses e simulações Monte Carlo em fluoroscopia CT”
 - The project “Dose Datamed (2011) – Portugal - Assessment of the exposure of the Portuguese population to ionizing radiation due to medical practices – Nuclear Medicine”

- EURADOS Working Groups (in individual monitoring, internal dosimetry, computational dosimetry, dosimetry in the medical applications of radiation and retrospective dosimetry).

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 (including tomosynthesis), Computer Tomography, Fluoro-CT.
 - Research activities and studies in Nuclear Medicine, radiotherapy and brachytherapy were pursued in the framework of PhD 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, namely in Nuclear Medicine examinations (“*DoseDataMed II – Portugal (2011)*” 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 dicentric, 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 (3), brachytherapy (1) and nuclear medicine (2) facilities as well as of industrial installations (1) continued at a sustained pace.
- The radiological safety assessment of the Linac cargo scanners and the training of the staff in 3 harbours of Cape Verde was performed with the collaboration of GDR staff.
- 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.

Organization of International Conferences

Members of the Group organized the international Conference “*PRS2013 - Conferência “Protecção Radiológica na Saúde 2013”*”, in Lisbon, Portugal, 18-20 September 2013, with 250 participants.

Accreditation of Dosimetry Techniques

Two individual monitoring techniques were audited and continued to receive 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.
- Co-supervision of 8 PhD theses (1 concluded during 2013, 3 to be concluded during 2014, 2 started in 2013).
- Supervision of 5 Master’s degree theses (2 concluded during 2013).
- 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

- C. Borges *et al.*, Comparison of different breast planning techniques and algorithms for radiation therapy treatment. *Physica Medica*: <http://dx.doi.org/10.1016/j.ejmp.2013.04.006>.
- C. Figueira *et al.*, Medical staff extremity dosimetry in CT fluoroscopy: an anthropomorphic hand voxel phantom study. *Phys. Med. Biol.* 58, 5433-5448 (2013), doi: 10.1088/0031-9155/58/16/5433.
- C. Lederer *et al.*, Neutron capture cross section of unstable ⁶³Ni: implications for stellar nucleosynthesis. *Phys. Rev. Lett.* 110, 022501 (2013), doi: org/10.1103/PhysRevLett.110.022501.
- A. Belchior *et al.*, Dose and time dependence of targeted and untargeted effects after very low doses of α -particle irradiation of human lung cancer cells. *Dose-Response* 11(3), 431-46 (2013), doi: 10.2203/dose-response.
- S. Bandarra *et al.*, Mechanistic insights into the cytotoxicity and genotoxicity induced by glycidamide in human mammary cells. *Mutagenesis*, 28(6), 721-9 (2013), doi: 10.1093 /mutage/get052.
- L. S. Santos *et al.*, The role of CCNH Val270Ala (rs2230641) and other nucleotide excision repair polymorphisms in individual susceptibility to well-differentiated thyroid cancer. *Oncology Reports*, 30(5) 2458-66 (2013), doi: 10.3892/or.2013.2702.
- V. Martins *et al.*, Implementation of a dose-response curve for gamma-radiation in the Portuguese population by use of the chromosomal aberration assay. *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, 750(1-2), 50-4 (2013), doi: 10.1016/j.mrgentox.2012.09.009.

FUNDS

Project/Service	Reference	Timeframe	2013
Projects			
FREYA	FP-7 EURATOM	2011-2015	0,00
MARISA	FP-7 EURATOM	2013-2016	0,00
PREPARE	FP-7 EURATOM	2013-2016	48.422,00
REWARD	FP7-EURATOM	2011-2014	0,00

RENEB	FP7-EURATOM	2012-2016	7.238,34
TRASNUSAFE	FP7-EURATOM	2010-2014	6.922,39
BioQuaRT	EMRP/EURAMET	2012-2014	0,00
Cooperation with CERN - Optimization studies of the ISOLDE targets and design of HIE-ISOLDE (CERN/FP/123598/2011)	FCT funded	2012-2014	1.912,10
“Improvement of Image Quality and Dose Reduction in Digital Breast Tomosynthesis using Statistical Image Reconstruction Algorithms” (PTDC/BBB-IMG/3310/2012)	FCT funded	2013-2015	9.912,90
Tecnologias digitais em mamografia: otimização utilizando métodos de simulação de Monte Carlo (PTDC/SAU-BEB/100745/2008)	FCT funded	2009-2012	10.448,10
Distribuição de doses e simulações Monte Carlo em fluoroscopia CT (PTDC/SAU-ENB/115792/2009)	FCT funded	2011-2014	11.486,26
Services			
Radiological Safety Assessment of installation	Service	2013	80.000,00 (estimation)
Individual dosimetry and monitoring	Service	2013	190.000,00 (estimation)

TEAM RESEARCHERS

NAME: José Pedro Miragaia Trancoso Vaz

CATEGORY: Principal Researcher (Habilitation)

IST-ID: 2286

GROUP: Dosimetry and Radiobiology (GDR /UPSR – until mid-September) / Radiological Protection and Safety Group (GPSR /C²TN - starting mid-September).

ACTIVITIES

Nº	Activity Description	% of time before / after mid-September
1	Coordination and management of research and technical services activities (approx. 50 staff members and fellows), ⁴ / Coordination of research activities (16 PhD staff members and approx. 10 research fellows) ⁵	50 / 50
2	Research activities (projects)	15 / 30
3	Organization of Scientific Conferences (as Chairperson or as members of the Scientific Programme Committees)	15 / 0
4	Teaching, education and training – including supervision of Master´s degree and PhD students	15 / 15
5	Representation in international Committees and Working Groups	5 / 5
Total		100

⁴ Until mid-September 2013

⁵ Starting mid-September 2013

WORK SUMMARY

N°	Work Summary and Main Achievements
1	<p>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.</p> <p>Planning and definition of the activities of the UPSR Programme of Work.</p> <p>Administrative and financial management of the activities in the aforementioned topical areas and the associated budget.</p> <p>Identification of the main lines of development of new activities, new projects and new programmes.</p> <p>Coordination and management of the Dosimetry and Radiobiology Group (20 members).</p> <p>Organization of working meetings with the responsables for the UPSR groups.</p> <p>Organization of meetings with the members of the Working Groups (on Accreditation, Dosimetry, Radiobiology, Radiological Safety Assessment, amongst others).</p> <p>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.</p>
2	<p>Participation in national and international R&D projects, namely:</p> <ul style="list-style-type: none"> • FCT funded projects (related to experiments at the ISOLDE and n-TOF facilities at CERN and project “<i>Improvement of Image Quality and Dose Reduction in Digital Breast Tomosynthesis using Statistical Image Reconstruction Algorithms</i>”) • FP7-EURATOM funded projects (FREYA, MARISA, PREPARE, RENEB and TRASNUSAFE) • FP7-SECURITY funded project (REWARD) <p>Undertaking of activities involving cooperation with national or international teams in the framework of the aforementioned projects, in laboratories and research centres in Portugal or in foreign countries, in hospitals, etc.</p> <p>Fostering of NEW research activities, in cooperation with national or international teams in the framework of the aforementioned projects, in laboratories and research centres in Portugal or in foreign countries, in hospitals, etc.</p> <p>Drafting and submission of scientific articles to international peer reviewed journals.</p> <p>Participation in project meetings, in Portugal and abroad.</p> <p>Participation in national and international Conferences and Workshops.</p> <p>Participation in the drafting of R&D projects, to be submitted in the framework of FCT or the EU FP7/EURATOM Calls and Programmes.</p> <p>Reviewing and refereeing of scientific articles submitted to international journals.</p>
3	<p>Teaching of disciplines in the framework of Master’s degree courses in Radiation Protection and Dosimetry in several Higher Education establishments, namely:</p> <p>ESTeSC - Escola Superior de Tecnologias de Saúde de Coimbra</p> <p>ESTeSL – Escola Superior de Tecnologias de Saúde de Lisboa</p> <p>Co-supervision of 7 PhD theses (3 to be concluded during 2014, 2 started in 2013).</p> <p>Supervision of 5 Master’s degree theses (2 concluded during 2013).</p> <p>Participation in the jury of two PhD thesis (one as thesis examiner) and in the jury of three Master’s degree thesis.</p>
4	<p>Participation in meetings of national and international Committees and Working Groups, as representative of IST/ITN or as national delegate, namely:</p> <ul style="list-style-type: none"> • 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)

	<p>– 2 meetings per year</p> <ul style="list-style-type: none"> • CNER – Comissão Nacional para as Emergências Radiológicas <p>Comments on scientific and technical reports in the framework of the activities of the aforementioned Committees and Working Groups.</p> <p>Replies to questionnaires and surveys launched by international organizations and institutions.</p>
5	Chairperson and Organizer of the international Conference “ PRS2013 - Conferência “Proteção Radiológica na Saúde 2013” ”, in Lisbon, Portugal, 18-20 September 2013, 250 participants

PUBLICATIONS

- [1] J. Bento *et al.*, Efficiency correction factors of an Accuscan Whole-Body Counter due to the biodistribution of ^{134}Cs , ^{137}Cs and ^{60}Co . *Radiat. Prot. Dosimetry* 155 (1): 16-24 (2013), doi: 10.1093/rpd/ncs308.
- [2] S. Barros *et al.*, 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. *Radiat. Prot. Dosimetry* 154 (3): 346-355 (2013), doi: 10.1093/rpd/ncs246
- [3] P. Teles *et al.*, Estimation of the Collective Dose in the Portuguese Population Due to Medical Procedures in 2010. *Radiat. Prot. Dosimetry* 154 (4): 446-458 (2013), doi: 10.1093/rpd/ncs258.
- [4] C. Borges *et al.*, Comparison of different breast planning techniques and algorithms for radiation therapy treatment. *Physica Medica*: <http://dx.doi.org/10.1016/j.ejmp.2013.04.006>.
- [5] C. Carrapiço *et al.*, Neutron induced capture and fission discrimination using calorimetric shape decomposition. *Nuclear Inst. and Methods in Physics Research, A* pp. 60-67 (2013), doi: 10.1016/j.nima.2012.11.082.
- [6] A. Belchior *et al.*, Dose and time dependence of targeted and untargeted effects after very low doses of α -particle irradiation of human lung cancer cells. *Dose-Response*, 11 (3): 431-46 (2013), doi: 10.2203/dose-response.
- [7] C. Lederer *et al.*, Neutron capture cross section of unstable ^{63}Ni : implications for stellar nucleosynthesis. *Phys. Rev. Lett.* 110, 022501 (2013), doi: org/10.1103/PhysRevLett.110.022501.
- [8] G. Taglienti *et al.*, The $^{93}\text{Zr}(n,\gamma)$ reaction up to 8 keV neutron energy. *Phys. Rev. C* 87, 014622 (2013), doi:org/10.1103/PhysRevC.87.014622.
- [9] Y. Romanets *et al.*, Radiation Protection, Radiation Safety and Radiation Shielding Assessment of HIE-ISOLDE. *Radiat. Prot. Dosimetry* 155 (3): 351-363 (2013), doi: 10.1093/rpd/nct005.
- [10] C. Guerrero *et al.*, Performance of the neutron time-of-flight facility n_TOF at CERN. *Eur. Phys. J. A* 49:27 (2013), doi: 10.1140/epja/i2013-13027-6.
- [11] C. Figueira *et al.*, Medical staff extremity dosimetry in CT fluoroscopy: an anthropomorphic hand voxel phantom study. *Phys. Med. Biol.* 58, 5433-5448 (2013), doi: 10.1088/0031-9155/58/16/5433.
- [12] C. Weiß *et al.*, A new CVD diamond mosaic-detector for (n, α) cross-section measurements at the n_TOF experiment at CERN. *Nuclear Inst. and Methods in Physics Research, A* pp. 190-194 (2013), doi:org/10.1016/j.nima.2013.07.040.
- [13] M. Barbagallo *et al.*, High-accuracy determination of the neutron flux at n TOF. *Eur. Phys. J. A* 49:156 (2013), doi: 10.1140/epja/i2013-13156-x.
- [14] “Dosimetric Effect of Tissue Heterogeneity for ^{125}I Prostate Implants”, S.M. Oliveira *et al.*, submitted to Reports of Practical Oncology and Radiotherapy (2013)
- [15] “Experimental tests of an advanced proton-to-neutron converter at ISOLDE-CERN”, A. Gottberg *et al.*, submitted to Nuclear Instruments and Methods in Physics Research A (2013)

Conference Proceedings

- [1] C. Lederer *et al.* (2013). Neutron capture reactions on Fe and Ni isotopes for the astrophysical s-process, in Proceedings of the International Conference on Nuclear Data for Science and Technology (ND2013), U.S.A, March 4-8.
- [2] P. Teles *et al.* (2013). Estudo dosimétrico de braquiterapia da próstata utilizando técnicas de simulação de Monte-Carlo, medidas experimentais, e comparação com um procedimento de plano

- de tratamento, in Proceedings of the “IX Latin American IRPA Regional Congress on Radiation Protection and Safety - IRPA 2013, Rio de Janeiro, Brazil, April 15-19.
- [3] S. Barros *et al.* (2013). Comparison of Unfolding Codes for Neutron Spectrometry with Bonner Spheres, in Proceedings of the Neutron and Ion Dosimetry Symposium (NEUDOS-12), France, 3-7 June, accepted for publication in Radiation Protection Dosimetry (2013)
- [4] Y. Romanets *et al.* (2013). Evaluation of the Radiation Field and Shielding Assessment of the Experimental Area of HIE-ISOLDE, in Proceedings of the Neutron and Ion Dosimetry Symposium (NEUDOS-12), France, 3-7 June, accepted for publication in Radiation Protection Dosimetry (2013).
- [5] P. Vaz (2013). Radiation Protection and Dosimetry issues in the medical applications of ionizing radiation, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June. accepted for publication in Radiation Physics and Chemistry (2013)
- [6] M. Baptista *et al.* (2013). Image quality and dose assessment in digital breast tomosynthesis: A Monte Carlo study, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June. Radiation Physics and Chemistry, <http://dx.doi.org/10.1016/j.radphyschem.2013.12.036>.
- [7] M. Baptista *et al.* (2013). Assessment of the dose distribution inside a cardiac cath lab using TLD measurements and Monte Carlo simulations, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June. Submitted for publication in Radiation Physics and Chemistry.
- [8] M. Coelho *et al.* (2013). Dosimetry and Uncertainty Analysis in Gynecologic Brachytherapy, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June.
- [9] M. Baptista *et al.* (2013). Monte Carlo simulations of radiological and nuclear terrorist threat scenarios: preliminary results of REWARD project, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June.
- [10] N. Colonna *et al.* (2013). Neutron research at the N_TOF facility (CERN): Results and perspectives, in Proceedings of the 22nd International Conference on Application of Accelerators in Research and Industry (CAARI), Fort Worth, Texas, 5-10 August, AIP Conf. Proc. 1525, p. 570; ISBN: 978-0-7354-1148-7.
- [11] E. Mendoza *et al.* (2013). The Am-243 Neutron Capture Measurement at the n_TOF Facility, in Proceedings of 14th International Symposium on Capture Gamma-Ray Spectroscopy and Related Topics (CGS-14), World Scientific Publishing Co, pp. 442-449.
- [12] L.S. Leong *et al.* (2013). Angular distribution in the neutron-induced fission of actinides, in Proceedings of the Fission 2013 – Fifth International Workshop on Nuclear Fission and Fission Product Spectroscopy, “Château de Caen”, France 28-31 May, EPJ Web of Conferences 62, 08003, <http://dx.doi.org/10.1051/epjconf/20136208003>
- [13] P. Vaz *et al.* (2013). Status of the Safety and Security of Radioactive Sources in Portugal, in Proceedings of the IAEA International Conference on the Safety and Security of Radioactive Sources: Maintaining continuous global control of sources throughout their life cycle, Abu Dhabi, United Arab Emirates, 27-31 October.

COMMUNICATIONS

Invited Presentations

- “Radiation Protection and Dosimetry issues in the medical applications of ionizing radiation”, P. Vaz, in Proceedings of the International Conference on Dosimetry and its Applications (ICDA), Prague, 23-28 June 2013, accepted for publication in Radiation Physics and Chemistry (2013).

TECHNICAL REPORTS (in the framework of international projects)

- “Radiation protection, radiation safety and radiation shielding assessment of HIE-ISOLDE”, Y. Romanets *et al.*, CERN Technical note, ref. HIE-JS-EN-0001 (2013).
- “Status report on the research activities of the consortium members” Deliverable 4.2. of the RENEB project, O. Monteiro Gil, H. Romm, P. Vaz. June 2013.

EDUCATION

Supervision of PhD Theses

- Mestre 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**”, concluded in February 2014.
- Mestra 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**”, on-going, to be concluded during 2014.
- Mestra 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**”, on-going, to be concluded during 2014.
- Mestra 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**”, on-going, to be concluded during 2015.
- Mestra Maria João Furtado Raminhas Carapinha (Doutoramento em Saúde Pública e Ambiental, Escola Nacional de Saúde Pública), thesis entitled “**Avaliação da Exposição Ambiental a Radiações Ionizantes em Medicina Nuclear**”, on-going, to be concluded during 2015.
- Carina Marques Coelho (Doutoramento em Engenharia Biomédica e Biofísica pela Faculdade de Ciências da Universidade de Lisboa), thesis entitled “**Avaliação da dose absorvida em órgãos de risco de doentes submetidas a braquiterapia ginecológica através de simulações por métodos de Monte Carlo**”, on-going, initiated in 2013.
- Ana Cravo Sá (Doutoramento em Engenharia Biomédica e Biofísica pela Faculdade de Ciências da Universidade de Lisboa), thesis entitled “**Avaliação da Dose Fora do Campo de Tratamento em Doentes Pediátricos Submetidos a Radioterapia: Comparação das Técnicas 3DCRT e IMRT**”, on-going, initiated in 2013.

Member of the Jury (thesis examiner) of other PhD Theses

- Jury member (thesis examiner) of the PhD thesis in Physics entitled “**Da Temática do Radão na região da Guarda à construção de um modelo microdosimétrico – Caso particular do Acino pulmonar humano**”, by the Faculty of Sciences of Universidade da Beira Interior, of Alina Rosa Coelho Louro, March 2013.
- Jury member of the PhD thesis in Biomedical Engineering entitled “**Mammography: Impact of digital imaging technologies and optimisation of their use in breast cancer screening and diagnosis**”, by the Faculty of Engineering of the Portuguese Catholic University, of Cláudia Reis, June de 2013.

Supervision of Master's Degree Theses

- “**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, 2013).
- “**A comparison between breast digital tomosynthesis and mammography: dosimetric and image quality characterization of a clinical system**”, Licenciada Margarida Santos Nobre Felix, (Mestrado em Engenharia Biomédica da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 2013).
- “**Redução da dose em órgãos sensíveis em exames médicos de Tomografia Computadorizada por aplicação de proteções de bismuto**”, Licenciada Joana Isabel Serrão Simões (Mestrado em Engenharia Biomédica da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 2013).
- “**Caracterização neutrónica e dosimétrica do alvo de espalação do espectrómetro de tempo de voo do CERN por métodos de Monte Carlo**”, Licenciado Piménio Ferreira (Mestrado em Engenharia Física, Faculdade de Ciências da Universidade de Lisboa, 2014).

- *“Redução de dose em órgãos radiosensíveis em exames de Tomografia Computorizada por aplicação de protecções de Bismuto”*, Técnica Ana Margarida Ribeiro Fernandes (Mestrado em Ciências Nucleares Aplicadas à Saúde, Escola Superior de Tecnologias de Saúde de Coimbra, 2014).

Member of the jury (thesis examiner) of other Master’s Degree Theses

- Member of the jury (thesis examiner) of the Master’s thesis of Sónia Cláudia Lin Chin entitled “Dosimetria numa População de Profissionais Expostos a Radiações Ionizantes” (Mestrado em Radiações Aplicadas às Tecnologias da Saúde – Área de especialização “Protecção Contra Radiações, Escola Superior de Tecnologia da Saúde de Lisboa), February 2013.
- Member of the jury (thesis examiner) of the Master’s thesis of Catarina Ramos de Mendonça entitled “Radionuclide Therapy in Nuclear Medicine: Applying Monte Carlo Simulation to Investigate Bremsstrahlung Imaging with a Gamma Camera” (Mestrado em Engenharia Clínica, Faculdade de Engenharia da Universidade Católica Portuguesa), September 2013.

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

- **FREYA** (*“Fast Reactor Experiments for hYbrid Applications”*) – *on-going* - P.I. of the Portuguese team.
- **MARISA** (*“MYRRHA Research Infrastructure Support Action”*) - *on-going* - P.I. of the Portuguese team.
- **PREPARE** (*“Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe”*) *on-going* - P.I. of the Portuguese team
- **RENEB** (*“Realizing the European Network on Biodosimetry”*) – *on-going* - member of the Portuguese team.
- **TRASNUSAFE** (*TR*aining *S*chemes on *NU*clear *SAFE*ty *C*ulture) – *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, approved during 2013, in the framework of the European Union’s 7th Framework Programme EURATOM

- **ENETRAP-III** (*“European Network on Education and Training in Radiation Protection – part III”*) – *kickoff meeting in April 2014*

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, started in May 2012 (2 years), *on-going*.

- **“Improvement of Image Quality and Dose Reduction in Digital Breast Tomosynthesis using Statistical Image Reconstruction Algorithms”**, project PTDC/BBB-IMG/3310/2012 – started in July 2013 (2 years), on-going.

CONFERENCE ORGANIZATION

General Chair and Chair of the Scientific Programme Committee of the Conference

- **“PRS2013 - Protecção Radiológica na Saúde 2013”**, in Lisbon, Portugal, 18-20 September 2013, 250 participants.

Member of the Scientific Committee of the following International Conferences:

- **SNA + MC2013** (“Joint conference on Supercomputing in Nuclear Applications & Monte Carlo), in Paris, 27-31 October 2013.
- **ICENES 2013** (“16th International Conference on Emerging Nuclear Energy Systems”), in Madrid, Spain, 26-30 May 2013.
- **RPSD 2014** (18th Topical Meeting of the Radiation Protection & Shielding Division of the American Nuclear Society), in Knoxville, Tennessee, E.U.A., 14-18 September 2014.

Co-organizer of the following Workshop(s)

- Workshop entitled **“Managing Complexity in Nuclear Accidental Situations - Experts Interacting with Experts and Society”**, in the framework of the PREPARE project, co-funded by the European Union 7th Framework Programme EURATOM, 28-29 November 2013, in Lisbon, Portugal. 40 participants from European countries and Japan.

NAME: João Henrique Garcia Alves

CATEGORIA: Auxiliary Researcher

IST-ID: 5363

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Head of the Laboratório de Protecção e Segurança Radiológica	
2	Individual monitoring service for external radiation exposure	20%
3	Environmental monitoring with passive dosimeters for the National Radiological Environmental Monitoring programme	5%
4	Dose assessment for staff and patients (research projects): Mammography, ref. PTDC/SAU-BEB/100745/2008 Fluoro-CT, ref. PTDC/SAU-ENB/115792/200	15% 20%
5	Chairman of the EURADOS WG02 on Harmonization of Individual Monitoring	15%
5	EURADOS Council membership	5%
7	Technical expert: reports, audits and referee of papers	5%
8	Supervision of Fellows	Included above
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<i>J.G. Alves, LPSR staff</i> Appointed Head of the Laboratório de Protecção e Segurança Radiológica by the president of IST since 19 th of September.

2	<p><i>J.G. Alves, M.F. Pereira, S. Rangel, M. Saraiva</i></p> <p>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 $H_p(0.07)$ and extremity dosimeters of the EXT-RAD type for the evaluation of $H_p(0.07)$. The service is Accredited in conformity with the EN ISO/IEC 17025 standard, awarded by the IPAC-<i>Instituto Português de Acreditação</i>, Technical annex n° 620. In 2013, approximately 3800 workers from 700 facilities were monitored, 1700 on a monthly basis and 2100 quarterly.</p>
3	<p><i>J.G. Alves, M.F. Pereira, S. Rangel, M. Saraiva</i></p> <p>The individual monitoring service also performs environmental monitoring at CTN campus and in nine sites spread in the country for the National Radiological Environmental Monitoring (NREM) programme. Passive dosimeters of LiF:Mg,Ti (TLD-100) detectors inserted in the Harshaw 8855 holder are used for the assessment of the ambient dose equivalent $H^*(10)$. The measurements are performed at four sites at CTN and nine other sites in Portugal on a quarterly basis and the results are published in the annual report of the NREM programme. In 2013 IST took part in an Intercomparison exercise organized by the Spanish Nuclear Safety Council.</p>
4	<p><i>J.G. Alves¹, M.F. Pereira^{1,2}, M.F. Oliveira^{1,2}, J.C. Pereira^{1,2}, A.D. Oliveira¹, J.V. Cardoso¹, L.M. Santos¹, C. Reis^{3,4}, A. Pascoal^{4,5}, S. Sarmento⁶, J.A.M. Santos⁶</i></p> <p><i>Digital technologies for mammography: optimization using Monte Carlo simulation techniques</i> (ref. PTDC/SAU-BEB/100745/2008) is a research project funded by <i>Fundação para a Ciência e a Tecnologia</i> (FCT) in collaboration with <i>Universidade Católica Portuguesa</i> as the leading institution. The project aimed at the characterization of digital mammography in Portugal and ended on the 31st of July.</p> <p><i>Dose distribution mapping and Monte Carlo simulations in CT-fluoroscopy</i> is also a research project PTDC/SAU-ENB/115792/2009 funded by FCT. The work is performed in collaboration with <i>Instituto Português de Oncologia do Porto</i> as the leading institution and <i>Faculdade de Engenharia da Universidade do Porto</i>. The project is running and will end in August 2014.</p> <p>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</p>
5	<p><i>J.G. Alves, P. Ambrosi¹, C. Cherestes², M.A. Chevalier³, J.W. van Dijk⁴, E. Fantuzzi⁵, M. Figel⁶, P. Gilvin⁷, T. Grimbergen⁸, O. Hupe¹, M. Lehtinen⁹, A. McWhan¹⁰, R. Kopec¹¹, A. Romero¹², F. Rossi¹³, H. Stadtmann¹⁴, B. Vekic¹⁵</i></p> <p>Chair of EURADOS WG02 on Harmonization of Individual Monitoring in Europe. Four subgroups were operational in 2013: a) Intercomparison exercise for whole body dosimeters for photon fields ended in 2013 (A. McWhan). A new IC was prepared to start in 2014; b) IC for neutron fields (E. Fantuzzi) ended in 2013; c) Survey on QA/QC practices in Europe (P. Gilvin); d) Training Course on the implementation of RP160 the European technical recommendations for monitoring individuals occupationally exposed to external radiation, took place in Zagreb (Croatia) last November, with 21 attendants.</p> <p>1 PTB, Germany; 2 Dozimed, Romania; 3 IRSN, France; 4 Netherlands; 5 ENEA, Italy; 6 Helmholtz-Zentrum, Germany; 7 PHE, UK; 8 NRG, Netherlands; 9 STUK, Finland; 10 Cavendish Nuclear, UK; 11 IFJ, Poland; 12 CIEMAT, Spain; 13 AOUC-Firenze, Italy; 14 Seibersdorf Lab, Austria; 15 RBI, Croatia.</p>
6	<p>Member of the EURADOS (European Radiation Dosimetry Group) Council and Treasurer.</p>
7	<p>Technical appraisal of companies as part of their respective approval process as service providers in compliance with Decree-Law n. 167/2002. This work was performed upon request of the <i>Direcção-Geral da Saúde</i>.</p> <p>Collaboration with IPAC-<i>Instituto Português de Acreditação</i> acting as technical expert at external audit of an individual monitoring laboratory in compliance with ISO/IEC 17025.</p>
8	<p>Miguel Pereira, grant holder supported by the <i>Individual monitoring of external radiation</i> activity, also performs research work on TLD dose assessment to staff and patients in fluro-CT guided procedures (PhD preparation work).</p> <p>Cláudia Reis, presented her PhD thesis entitled <i>Mammography: Impact of digital imaging</i></p>

<p><i>technologies and optimisation of their use in breast cancer screening and diagnosis</i>, presented to Universidade Católica Portuguesa, within the project PTDC/SAU-BEB/100745/2008.</p> <p>Mário Oliveira, grant holder on the project <i>Digital Technologies in mammography: optimization using Monte Carlo simulation methods</i>, PTDC/SAU-BEB/100745/2008, from January until July 2013.</p> <p>Joana Pereira, grant holder on the project <i>Dose distribution and Monte Carlo simulations in CT-fluoroscopy</i>, PTDC/SAU-ENB/115792/2009.</p>
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PUBLICATIONS

- J.W.E. van Dijk, J.G. Alves, P. Ambrosi, D.T. Bartlett, L. Currivan, E. Fantuzzi, V. Kamenopoulou. *A review of the New European Technical Recommendations for Monitoring Individuals Occupationally Exposed to Ionizing Radiation.*, Radiation Measurements, 55, 30-33 (2013).

COMMUNICATIONS

- *Hand monitoring in Fluoro-CT guided procedures* J.C. Pereira, J.G. Alves, M.F. Pereira, A.D. Oliveira, J.V. Cardoso, L.M. Santos, S. Sarmiento, J.A.M. Santos, M.J. Sousa, M. Gouvêa. International Conference on Medical Physics, Brighton (UK), September 2013 (poster).
- *Quality Assurance in Individual Monitoring: a Summary of the EURADOS Survey 2012*. P. Gilvin, J.G. Alves, C. Cherestes, J.W.W. van Dijk, M. Lehtinen, F. Rossi, B. Vekic. 17th International Solid State Dosimetry Conference, Recife (Brasil), September 2013 (poster).
- *Actividades do IST-LPSR*. J.G. Alves. Unidade Especial de Polícia. December 2013

EDUCATION

- PhD supervisor of C. Reis in collaboration with A. Pascoal, entitled *Mammography: Impact of digital imaging technologies and optimisation of their use in breast cancer screening and diagnosis*, presented to Universidade Católica Portuguesa, July 2013.
- Organizing committee member and Lecturer, *Eurados Training Course on the European Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation (Radiation Protection 160)*, Zagreb, Croatia, November 25-29, 2013
- Lecturer. *Certification, accreditation and approval of dosimetry services; Dose reporting, record keeping and information systems; Implementation of ISO/IEC 17025; Auditor's point of view. Opening and Closure sessions*. Eurados Training Course Zagreb, Croatia, November 25-29, 2013

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 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 Coordinator: J.G. Alves
- *Harmonization of Individual Monitoring in Europe*. EURADOS WG02. Participating institutions: Cavendish Nuclear, CIEMAT, Dozimed, ENEA, HZM, PHE, IRSN, IST, NRG, PTB, RBI, SL, STUK. Chairman and IST 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 figures shown in the table below are the number of facilities and workers monitored in the end of 2013.

Number of facilities	Monitoring period	Number of workers	Income (approx)
136	Monthly	1700	140.000,00
574	Quarterly	2100	50.000,00

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

COURSE ORGANIZATION

- 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)*, Zagreb, Croatia, November 25-29, 2013

NAME: Octávia Gabriela da Silva Viegas Monteiro Gil

CATEGORY: Auxiliary Researcher

IST-ID: 5380

ACTIVITIES

Nº	Activity Description	R&D (%)
1	RENEB Project - Realizing the European Network on Biological Dosimetry (FP7 EURATOM)	
2	BioQuaRT Project- Biologically weighted quantities in radiotherapy (EMRP/EURAMET)	
3	PREPARE Project - Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe (FP7 EURATOM)	
4	Biological dosimetry using dicentric chromosomes and micronuclei	
5	Study of the effect of age and gender in response to γ -radiation using chromosomal aberration and micronucleus assays	
6	Biological dosimetry for low dose exposure	
7	Diet exposure to acrylamide: study of cytogenetic biomarkers	
8	Education and Training	
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>The 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 work developed is related with:</p> <p>Work Package 1 – Operational basis of the network consist of:</p> <ul style="list-style-type: none"> • Task 1.1 - Dicentric assay- intercomparison exercise made from previously irradiated blood and distributed to all the participants of the task. • Task 1.3 - Micronucleus assay- first intercomparison exercise was made also from previously irradiated blood.

	<ul style="list-style-type: none"> • Score of the slides and the respective dose estimation were made for both assays. • Task 1.5 - Gamma-H2AX assay- also a first intercomparison was done. After, experimental studies involving the upgrading of the assay were made. <p>Work Package 4 – Establishing the organizational structure and in Task 4.2 - Establish Concepts for the Sustainability of the Network, a survey was conducted and the results from all laboratories, universities and hospitals involved in the project were compiled. A deliverable “Status report on the research activities of the consortium members” was made.</p>
2	<p>The 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 coordinated by Physikalisch-Technische Bundesanstalt (PTB).</p> <p>The work performed in Work Package 4- <i>Biology</i>- “late effects” concerning the two end points (micronuclei and chromosomal aberrations) was made in CHO cell line.</p> <p>A new protocol for microbeam irradiations, that allowed us to perform in the same dish, both chromosomal aberrations and micronuclei assays, was implemented.</p> <p>Irradiations at PTB ion microbeam (April) for CHO–K1 cells were performed with a counted number of 10 MeV protons (LET 5 keV/μm) and 20 MeV α-particles (LET of 37 keV/μm). Three different values of seeded cells per dish: 2500, 4000 and 5000 were used and different types of controls were performed. The IST/CTN results from April irradiations were presented in the 3rd Project Meeting.</p> <p>In November, and for CHO-K1 cells, irradiations with 3 and 10 MeV protons and 10 MeV α-particles were performed with the same protocol for both assays. At IST/CTN the dishes scoring is ongoing.</p>
3	<p>The project was approved in 2012 but the kick-off meeting was in February 2013. The objective of the project is to close gaps that have been identified in nuclear and radiological preparedness following the first evaluation of the Fukushima disaster.</p> <p>As the management of the Fukushima event in Europe was far from being optimal, it is proposed the development of means on a scientific and operational basis to improve information collection, information exchange and the evaluation for such types of accidents.</p> <p>The work was performed in:</p> <ul style="list-style-type: none"> • Work Package 3 (Task 1) – Establishment of the national panels <p>The work related to WP3 will be started in 2014.</p> <ul style="list-style-type: none"> • Work Package 6 – Information and participation of the public <p>Concerning the WP6 one of the main tasks is to conduct interviews with persons who somehow may be involved with this issue. A group of questions were elaborated and send to these intervenient.</p> <p>A workshop was organized from 27 to 29 November 2013 in Portugal at IST/CTN.</p>
4	<p>Biodosimetry is a method to quantify an individual’s absorbed dose in circumstances of occupational or accidental over-exposure to ionizing radiation where, often, no knowledge of the physical dose exists. Cytogenetic indicators, such as dicentric chromosomes and micronuclei are widely used in biological dosimetry to evaluate deleterious effects of ionising radiation.</p> <p>The estimated dose is obtained by comparing the observed yield of dicentric chromosomes or micronuclei in peripheral blood lymphocytes of the subject, with a standard dose-response curve obtained <i>in vitro</i>. Both dose-response curves were obtained at IST/CTN studying <i>in vitro</i> irradiated samples (0.25, 0.50, 0.75, 1.00, 2.00 and 3.00 Gy for each donor, as well as a non-irradiated control) of non-smoker individuals. The resultant dose-response curves for dicentric chromosomes and micronuclei were: $Y = (0.0011 \pm 0.0006) + (0.0105 \pm 0.0035)D + (0.0480 \pm 0.0019)D^2$ and $Y = (0.0122 \pm 0.0010) + (0.0241 \pm 0.0023)D + (0.0193 \pm 0.0007)D^2$, respectively. Both curves were validated. These results give us confidence to apply both calibration curves in future biological dosimetry requirements in the Portuguese population.</p>
5	<p>A particular interest of biodosimetry has been not just to obtain absorbed dose estimates using adequate calibration curves, under the assumption that all individuals respond equally to radiation, but also to find a way to demonstrate inter-individual radiosensitivity and a possible correlation with age and gender. The study population was divided in 2 age</p>

	<p>groups, from 20 to 39 and 40 to 59 years, each group consisting of 4 men and 4 women. The results were analysed in terms of chromosomal aberrations/cell, dicentric chromosomes/cell (chromosomal aberration assay) and micronuclei/binucleated cell (micronucleus assay). Women presented higher values of dicentrics/cell and chromosomal aberrations/cell for 2 and 3 Gy ($p < 0.01$ for 3 Gy). The baseline micronucleus frequencies are higher for women and for the older age group. For 2, 3 and 5 Gy, men showed more micronuclei/cell than women. Also, for all doses except 5 Gy the older age group shows higher micronucleus frequencies.</p> <p>In this work inter-individual variability was observed for different cytogenetic biomarkers induced by high doses of ionising radiation. Moreover, the results suggest a difference between genders in the biological response to higher doses of ionising radiation.</p>
6	<p>A study of the effects induced by exposure to low levels of ionising radiation using the three different assays already implemented: chromosomal aberration, micronucleus and γ-H2AX assays, was started. The study is being performed in peripheral blood lymphocytes of two healthy non-smoker donors, with no previous exposure to ionising radiation for at least the last six months. The donors completed a questionnaire on demographic data, smoking habits, intake of drugs and diet. Blood samples were irradiated at LMRI with 25, 50, 100 and 250 mGy air kerma, using a ^{60}Co source. A non-irradiated control was also performed for both donors. Results from one donor have already been achieved. The analysis of the results from both donors and the construction of low dose calibration curves for chromosomal aberration, micronucleus and γ-H2AX assays is ongoing.</p>
7	<p>The study of biomarkers of early biological effects (micronuclei) associated with the dietary exposure of acrylamide in healthy individuals was completed. This is a collaborative study with the R&D centres CIGMH/FCM-UNL and iMed.UL/FFUL.</p>
8	<p>Supervision of the PhD thesis, “Is there a role for isothiocyanates in the modulation of the biological effects induced by ionising radiation?” by Vanda Sofia Cardigos Martins. In charge of the orientation of two IST grant holders (BL295/2012 and BL264/2013) in the area of biological effects induced by ionising radiation. Lectures on biological effects of ionising radiation in companies.</p>

PUBLICATIONS

- A.C. Antunes, V. Martins, J. Cardoso, L. Santos, O. Monteiro Gil, The cytokinesis-blocked micronucleus assay: Dose estimation and inter-individual differences in the response to γ -radiation. *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*: doi: 10.1016/j.mrgentox.2013.09.012.
- S. Bandarra, A.S. Fernandes, I. Magro, P.S. Guerreiro, M. Pingarilho, M.I. Churchwell, O.M. Gil, I. Batinic-Haber, S. Gonçalves, J. Rueff, J.P. Miranda, M.M. Marques, F.A. Beland, M. Castro, J.F. Gaspar, N.G. Oliveira, Mechanistic insights into the cytotoxicity and genotoxicity induced by glycidamide in human mammary cells. *Mutagenesis*, 28(6), 721-9 (2013), doi: 10.1093/mutage/get052.
- L. S. Santos, B.C. Gomes, R. Gouveia, S.N. Silva, A.P. Azevedo, V. Camacho, I. Manita, O.M. Gil, T.C. Ferreira, E. Limbert, J. Rueff, J.F. Gaspar, The role of CCNH Val270Ala (rs2230641) and other nucleotide excision repair polymorphisms in individual susceptibility to well-differentiated thyroid cancer, *Oncology Reports*, 30(5) 2458-66 (2013), doi: 10.3892/or.2013.2702.
- V. Martins, A.C. Antunes, O.M. Gil, Implementation of a dose-response curve for gamma-radiation in the Portuguese population by use of the chromosomal aberration assay, *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, 750(1-2):50-4 (2013), doi: 10.1016/j.mrgentox.2012.09.009.
- 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*, 11(3):431-46 (2013), doi: 10.2203/dose-response.
- 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*, 154(2):237-44 (2013), doi: 10.1093/rpd/ncs166.

Abstract Books

- U. Kulka, E.A. Ainsbury, M. Atkinson, J.F. Barquinero, C.Bassinet, L. Barrios, C. Beinke, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mört, 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, A. Wieser, C. Woda, A. Wojcik (2013). RENEb – Realizing the European Network of Biological Dosimetry. Oral presentation to ConRad 2013, Global Conference on Radiation Topics, Munich, May 13 – 16. Book of abstracts, publication of Beta Publishing Group (Special Edition) April 2013, pp 11.
- S. Sommer, O. Montero Gil, A. Jaworska, U. Kulka, U. Oestreicher, F. Ugletveit, P. Vaz, H. Romm (2013). Critical parameters that influence efficient cooperation inside the biological dosimetry network (RENEb) in an emergency situation. Poster presentation to ConRad 2013, Global Conference on Radiation Topics, Munich, May 13 – 16. Book of abstracts, publication of Beta Publishing Group (Special Edition) April 2013, pp 34-35.
- Testa, C. Patrono, O. Monteiro Gil, U. Giesen, F. Langner, M. Pinto, H. Rabus (2013). Study of radiation-induced chromosome damage at microbeam facilities: Development of a novel in situ protocol designed within the “Bioquart” project. Oral presentation to the 11th Microbeam Workshop 2013- Microbeam probes of cellular radiation response, Bordeaux, October 3-4. Abstract booklet, pp 45.

TECHNICAL REPORT

In the framework of the EU FP7 RENEb Project

- “Status report on the research activities of the consortium members” Deliverable 4.2., O. Monteiro Gil, H. Romm, P. Vaz. June 2013.

COMMUNICATIONS

- *The first gamma-H2AX biodosimetry intercomparison exercise of the developing European Biodosimetry Network RENEb*, S. Barnard, E.A. Ainsbury, J. Al-hafidh, V. Hadjidekova, R. Hristova, C. Lindholm, O. Monteiro Gil, J. Moquet, M. Moreno, U. Rößler, H. Thierens, C. Vandevoorde, A. Vral, M. Wojewódzka, K. Rothkamm, *EPR – BioDose 2013 Leiden, The Netherlands, March 24-28 (2013)*. Poster.
- *Critical parameters that influence efficient cooperation inside the biological dosimetry network (RENEb) in an emergency situation*, S. Sommer, O. Montero Gil, A. Jaworska, U. Kulka, U. Oestreicher, F. Ugletveit, P. Vaz, H. Romm, *ConRad 2013 Global Conference on Radiation Topics – Preparedness, Response, Protection and Research*, Munich, Germany, May 13 – 16 (2013). Poster.
- *RENEb – Realizing the European Network of Biological Dosimetry*, U. Kulka, E.A. Ainsbury, M. Atkinson, J.F. Barquinero, C.Bassinet, L. Barrios, C. Beinke, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mört, 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, A. Wieser, C. Woda, A. Wojcik, *ConRad 2013 Global Conference on Radiation Topics – Preparedness, Response, Protection and Research*, Munich, Germany, May 13 – 16 (2013). Oral presentation.
- *Biological dosimetry using cytokinesis-blocked micronucleus assay: establishment of a dose-response curve and study of the effect of age and gender*, A.C. Antunes, V. Martins, O. Monteiro Gil, *PRS 2013- Proteção Radiológica na Saúde*, Lisboa, Portugal, September 18-20 (2013). Poster.
- *Comparison of dose-response relationships using three different endpoints: dicentric*

chromosomes, micronuclei and γ -H2AX foci, V. Martins, A.C. Antunes, O. Monteiro Gil, *PRS 2013- Proteção Radiológica na Saúde*, Lisboa, Portugal, September 18-20 (2013). Poster.

- *Study of radiation-induced chromosome damage at microbeam facilities: Development of a novel in situ protocol designed within the “Bioquart” project*, A. Testa, C. Patrono, O. Monteiro Gil, U. Giesen, F. Langner, M. Pinto, H. Rabus, 11th Microbeam Workshop 2013- Microbeam probes of cellular radiation response, Bordeaux, France, October 3-4 (2013). Oral presentation.
- *Comparison of physical and biological dosimetry for internal emitters*, K. Rothkamm, M.A. Lopez, J-F. Barquinero, C. Challeton-de Vathaire, G. Etherington, O. Gil, A. Giussani, E. Gregoire, İ. Güçlü, A. Jaworska, C. Lindholm, I. Malatova, S.L. McComish, J. Marsh, N. Maznyk, J. Moquet, D. Nosske, J. Oško, A.M. Rojo, H. Romm, A. Testa, S. Y. Tolmachev, A. Wieser, M. Youngman, P. Fattibene, MELODI Workshop, Brussels, Belgium, 7-10 October (2013). Oral presentation.
- *RENEB – Progress of the Biodose Network*, U. Kulka, E.A. Ainsbury, M. Atkinson, J.F. Barquinero, C.Bassinot, L. Barrios, C. Beinke, A. Cucu, F. Darroudi, P. Fattibene, O. Gil, E. Gregoire, V. Hadjidekova, S. Haghdoost, W. Hempel, R. Herranz, A. Jaworska, C. Lindholm, R. Mkacher, S. Mört, N. Fabregat, A. Montoro, J. Moquet, M. Moreno, M. Noditi, A. Ogbazghi, U. Oestreicher, F. Palitti, G. Pantelias, I. Popescu, M.J. Prieto, S. Roch-Lefevre, 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, A. Wieser, C. Woda, A. Wojci. MELODI Workshop, Brussels, Belgium, 7-10 October (2013). Oral presentation.
- *BioQuaRT” Project: design of a novel in situ protocol for the simultaneous visualization of chromosomal aberration and micronuclei after irradiation at microbeam facilities*, C. Patrono, O. Monteiro Gil, U. Giesen, F. Langner, M. Pinto, H. Rabus, A. Testa, MICROS 2013 - 16th International Symposium on Microdosimetry, Treviso, Italy, 20-25 October 2013. Poster.

EDUCATION

- Supervisor, PhD thesis “Is there a role for isothiocyanates in the modulation of the biological effects induced by ionising radiation?” Vanda Sofia Cardigos Martins. IST. Co-supervisors: Nuno Oliveira (F. Farmácia UL), Isabel Sá Correia (IST) (2013-).
- Lectures on biological effects induced by ionising radiation in companies (ANAREPRE (May 13), ODEBRECHT (July 31)).
- “Efeitos biológicos das radiações. Consequências na saúde humana”. 1st Workshop for Stakeholders - Projecto EMRP MetroMetal, (<http://projects.itn.pt/metrometal>). December 6, IST/CTN.

TRAINING

- IAEA Regional training course. “**Regional Workshop on Applications of Biodosimetry in Case of a Radiation Emergency**”, 2 - 5 de April 2013. Belgrade, Serbia.

PROJECTS

- Realizing the European Network on Biological Dosimetry (RENEB) FP7 EURATOM. Leading Institution: German Bundesamt für Strahlenschutz (BfS), Germany. IST/CTN on-going Coordinator of the Portuguese team.

CONFERENCE ORGANIZATION

- WP 4 – WP5 Meeting of RENEB Project. CTN/IST. Lisbon, Portugal, 7th – 11th October 2013.
 - Project PREPARE WP6.1 Workshop –Managing Complexity in Nuclear Accidental Situations. CTN/IST. Lisbon, Portugal 28-29 November 2013.
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NAME: Augusto Manuel Dias de Oliveira

CATEGORY: Auxiliary Researcher

IST-ID: 04851

ACTIVITIES

N°	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	40%
3	Responsibility and management of radiation safety assessments of facilities and activities	15%
4	Applied research in radiation safety assessment and dosimetry	15%
5	Training courses	10%
Total		100

WORK SUMMARY

N°	Work Summary and Main Achievements
1	<p>Dose distribution mapping and Monte Carlo simulations in CT-fluoroscopy.</p> <p>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.</p>
2	<p>Radiation safety assessment of facilities and activities</p> <p>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.</p> <p>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. 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.</p> <p>Radiological safety assessment, implementation of safety culture and training in facilities and activities with LINACs cargo-scanners of three harbours in Cape-Verde of ENAPOR (Empresa Nacional de Portos)</p>
3	<p>Responsibility and management of radiation safety assessments</p> <p>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</p>

	shielding calculations, dose measurements and radiological safety culture (DCS).
4	Applied research in radiation safety assessment and dosimetry <ul style="list-style-type: none"> Models of computational dosimetry using compartments for human body incorporation of radionuclides. Application of the software BiokinModels to the determination of time of release of a patient submitted nuclear medicine therapy. Development of a new method to determinate the focal spot size of an X-ray tube.
5	Training courses.

PUBLICATIONS

- Hand monitoring in Fluoro-CT guided procedures*, Joana Pereira, João Alves, Miguel Pereira, Augusto Oliveira, João Cardoso, Luís Santos, Sandra Sarmento, João Santos, Maria José Sousa, Luís Cunha, Anabela Dias, Margarida Gouvêa; 09/2013; *In proceeding of: 20th International Conference on Medical Physics (ICMP2013), At Brighton, UK, Volume: Medical Physics International, vol 1, N° 2, 2013, pp 624.*

COMMUNICATIONS

- Introdução ao cálculo de blindagens em instalações radiológicas*, Augusto Oliveira, seminar at LPSR/CTN; 2013.

EDUCATION

- ANAREPRE. Short training course on "*Radiological Protection for workers exposed to ionizing radiation*" (total of 3 h):
 - Física das radiações ionizantes;
 - Detecção e medição da radiação ionizante.
- ODEBRECHT. Short training course on "*Radiological Protection for workers exposed to ionizing radiation*" (total of 1.5 h):
 - Detecção e medição da radiação ionizante.
- ENAPOR (Cape-Verde). Short training course on "*Radiological Protection for workers exposed to ionizing radiation in linacs cargo-scanners facilities and activities*" (total of 20 h):
 - Fontes de radiação;
 - Física e dosimetria das radiações,
 - Grandezas de dosimetria e protecção radiológica;
 - O sistema de protecção radiológica;
 - Fundamentos de protecção radiológica;
 - A imagem radiológica em equipamentos de inspecção de carga;
 - O programa de protecção radiológica;
 - Preparação de monitorização da radiação em instalação de inspecção de carga;
 - Monitorização de uma instalação de inspecção de carga.

CONTRACTS

This activity provided an approximate income of 54000.00 euros, corresponding to 0.6 assessments per month and a total of 15 reports, approximately 1.25 reports per month.

- Radiological safety assessment of a brachytherapy facility and activity with a sealed source, no Hospital de Santa Mariaa, Concluded in 06-02-2013, value: 3050.40 euros
- Radiological safety assessment of an industrial facility and activity with linear accelerator, COFICAB, Guarda, Concluded in 16-07-2013, value: 6253.32 euros
- Radiological safety assessment of a nuclear medicine facility and activity with open sources, Clínica Quadrantes Funchal, Concluded in 20-09-2013, value: 1525.20 euros.

4. Radiological safety assessment of a nuclear medicine facility and activity with open sources, Clínica Quadrantes Natália Chaves, Concluded in 20-09-2013, value: 1525.20 euros.
5. Radiological safety assessment of a radiotherapy facility and activity with linear accelerator, Clínica Quadrantes Natália Chaves, Concluded in 16-12-2013, value: 13879.30 euros.
6. Radiological safety assessment of two radiotherapy facility and activity with linear accelerator, Clínica Quadrantes em Funchal, Concluded in 18-12-2013, value: 27758.60 euros.

Radiological safety assessment, implementation of safety culture and training in facilities and activities with LINACs cargo-scanners of three harbours in Cape-Verde of ENAPOR: Praia, Mindelo and Palmeira (income: 26000.00 euros). List of reports produced:

1. “Apoio à implementação de cultura de segurança radiológica em actividades e instalações de inspecção de carga. Porto marítimo da cidade da Praia, ilha de Santiago”; A.D. Oliveira and L. Portugal; IST/ITN; March 2013.
2. “Apoio à implementação de cultura de segurança radiológica em actividades e instalações de inspecção de carga. Porto marítimo da cidade do Mindelo, ilha de S. Vicente”; A.D. Oliveira and L. Portugal; IST/ITN; July 2013.
3. “Apoio à implementação de cultura de segurança radiológica em actividades e instalações de inspecção de carga. Porto marítimo de Palmeira, ilha do Sal”; A.D. Oliveira and L. Portugal; IST/ITN; July 2013.

NAME: Pedro Manuel Peixoto Teles

CATEGORY: Auxiliary Researcher (Ciência)

IST-ID: 5487

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Nuclear Medicine/Internal Dosimetry Activities	20%
2	Internal dosimetry activities: Whole body counter, localised organ counter, biokinetic models, calibrations and quality assurance	20%
3	BioQuaRT project	20%
4	EURADOS (European Radiation Dosimetry Group) related activities	10%
5	FREYA Project	10%
6	VADOSE Project	10%
7	Dose Datamed Portugal project	10%
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	There are ongoing collaborations with the Nuclear Medicine centre of Hospital Garcia de Orta and Fundação Champalimaud 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. The use of three different techniques: in vivo measurements, biokinetic model application and Monte Carlo simulations with voxel phantoms allow for a more adequate estimation of the committed dose. This values is of particular importance for paediatric patients.
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.

	<p>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.</p> <p>Both are prepared to serve the community in case of a radiological emergency.</p> <p>Committed effective doses can then be determined by making use of biokinetic models, of which we possess a library, and dedicated software.</p> <p>We have also developed a series of computational models of our detection systems which can be used to simulate contamination events.</p>
3	<p>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.</p> <p>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 in areas comprising biological to computational topics, which will serve to create biophysical models for the elaboration of new standards for radiation therapy.</p> <p>At this stagem the group at CTN led by this researcher is in charge of performing MC calculations of the different microdosimeters under development within the consortium with different available codes and benchmark the results, discussing the different physical models used.</p>
4	<p>The European Radiation Dosimetry group (EURADOS) has many ongoing activities, of which participation was mainly on two of its work groups:</p> <ul style="list-style-type: none"> - The Internal Dosimetry group (WG7) - The EURADOS European medical ALARA platform group (WG12) <p>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 <i>in vivo</i> 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</p> <p>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 has now been submitted.</p>
5	<p>Within the FREyA project, the group has investigated various aspect connected to the physics and operation of Accelerator Driven Systems (ADS). The experimental facility which enables for this studies, consists of the GENEPI-3C deuteron accelerator coupled to the VENUS-F fast reactor. The study of robust and convenient methods for online reactivity monitoring in different operating conditions is one of the primary goals of the FREYA project. A study of two such methods applied to a deep subcritical configuration ($k_{eff} \approx 0.90$) of the VENUS-F reactor: the area method, was performed in Pulsed Neutron Source (PNS) experiments, and the source jerk technique, suitable in case of a continuous source. Both strategies require, to some extent, input from models or simulation. Theoretical and experimental uncertainties were discussed. This work will be presented in an international conference.</p>
6	<p>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.</p>
7	<p>The collective dose in the Portuguese population was successfully estimated at about 1 mSv</p>

<p>per person in 2010 More detailed data was sent to all collaborating European and international institutions in accordance with pre-established deadlines.</p> <p>For 2011 and 2012 we performed an estimation of the population dose due to nuclear medicine exams. The obtained values are submitted in a paper where the comparison is made with Spain and other European countries, and the results discussed.</p>
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PUBLICATIONS

- Estimation of the collective dose in the Portuguese population due to medical procedures in 2010, P. Teles, M. Carmen de Sousa, G. Paulo, J. Santos, A. Pascoal, G. Cardoso, I. Lança, N. Matela, L. Janeiro, P. de Sousa, P. Carvoeiras, R. Parafita, A. I. Santos, P. Simãozinho, P. Vaz, *Radiation Protection & Dosimetry* 154(4), 446-58 (2013)
- Efficiency correction factors in whole body counting due to the biodistribution of radionuclides, J. Bento, S. Barros, P. Teles, P. Vaz, M. Zankl, *Radiation Protection Dosimetry* 155(1), 16-24 (2013)
- Medical staff extremity dosimetry in CT fluoroscopy: an anthropomorphic hand voxel phantom study C. Figueira, F. Becker, C. Blunck, S. di Maria, M. Baptista, B. Esteves, G. Paulo, J. Santos, P. Teles, P. Vaz, *Physics in Medicine and Biology* 58 5433-5448 (2013)
- Human exposure to indoor radon: a survey in the region of Guarda, Portugal. Louro A, Peralta L, Soares S, Pereira A, Cunha G, Belchior A, Ferreira L, Monteiro Gil O, Louro H, Pinto P, Rodrigues AS, Silva MJ, Teles P., *Radiat Prot Dosimetry*. 154(2):237-44.(2013)

COMMUNICATIONS

- *IRPA Conference*, P. Teles, et al., *Estimation of the population dose in the Portuguese population due to nuclear medicine and diagnostic radiology exams in 2010, Rio de Janeiro, Brazil Apr 14-19 (2013)*, Talk.
- *IRPA Conference*, P. Teles, et al., *A dosimetric study of prostate brachytherapy using Monte Carlo simulations with a VOXEL phantom,, measurements and a comparison with a treatment planning procedure, Rio de Janeiro, Brazil Apr 14-19 (2013)*, Talk.
- *RPM 2013 conference*, P. Teles, et al., *Estimation of the population dose in the Portuguese population due to nuclear medicine and diagnostic radiology exams in 2010, Lisbon, INFARMED Sep 18-20 (2013)*, Talk.

EDUCATION

- Supervisor, M. Sc. Thesis, *Estimativa da dose em procedimentos de cintigrafia renal e renogramas em pacientes pediátricos, utilizando medidas 'in vivo', modelos biocinéticos e técnicas de Monte Carlo*, by Vanessa Marie de Sousa, Faculdade de Ciências, Universidade de Coimbra, September 2013
- Jury Member; Secca, Mario; Teixeira, Nuno; Teles, Pedro Manuel Peixoto; Cunha, Gilda. Dissertation; *Débito de Dose e Qualidade da Imagem em Fluoroscopia*, José Guilherme de Mendonça Coutinho. 2013. (Engenharia Biomédica) - Universidade Nova 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

- Member of the organising and scientific committees of *Protecção Radiológica na Saúde – PRS2013*, Lisbon, INFARMED Portugal, September 18-20th, 2013.