EUROPEAN TRAINING AND EDUCATION IN RADIATION PROTECTION FOUNDATION

# BOOK OF ABSTRACTS

## 8th EUTERP Workshop
## Optimizing radiation protection training

**April 10-12, 2019**
**Qawra, St. Paul's Bay, Malta**


Westerduinweg 3
1755 LE Petten
The Netherlands
www.euterp.eu

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- EUTERP Secretary, Penelope Allisy-Roberts, EFOMP, United Kingdom
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## Introduction

Welcome to Malta and the 8th EUTERP Workshop!

It is now 12 years since the 1st EUTERP Workshop in Vilnius, Lithuania. Over that time EUTERP has evolved from a funded project to a self-sustaining Foundation, made a significant contribution to the development of the definitions of, and supporting guidance in respect of, the RPE and the RPO and latterly initiated consideration of wider issues associated with delivery of training and worker training.

The theme of our workshop this year – *Optimization of Radiation Protection Training* – picks up on these emerging topics. The importance of ensuring that training is effective in delivering the intended outcomes is acknowledged by all, as is the importance of efficiency in delivery. However, in the reality of ever present financial and resource pressures are we finding the optimum balance between the two? Are we prioritising our training activities appropriately? Should there be competence standards for trainers? Are we acknowledging innovative ideas and approaches?

One of EUTERP's most important roles is to act as a focus for the sharing of information on events, standards development and innovation and that is an important driver for out workshops, as is the objective to create a stimulating environment that will facilitate constructive discussion and useful output. We continue to value your active participation and look forward to hearing your views and suggestions the topics for discussion this year.

Best wishes for an enjoyable and thought provoking workshop .

J E Stewart
EUTERP President

## Programme

| **Tuesday April 9, 2019** | |
|---|---|
| 18.30 – 19.00 | Registration |
| 19.00 | Welcome cocktail |

| **Wednesday April 10, 2019** | | |
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| 09.00 – 09.30 | Registration | |
| 09.30 – 09.50 | Opening of the Workshop | Joanne Stewart, EUTERP President<br>Lourdes Farrugia, Chairperson of the Maltese Radiation Protection Commission<br>Peter Johnston, Director of Radiation Transport and Waste Safety (NSRW) Division, IAEA<br>Eduardo Gallego, IRPA E&T WG Chair and IRPA Vice President , IRPA |
| **Session 1: Setting the international scene – Chairperson: Joanne Stewart** | | |
| 09.50 – 10.20 | Key note presentation - Train the trainers for Radiation Protection Officers of medical and industrial facilities, as part of the IAEA's approach to support Member States in building competence | Amparo Cristobal, IAEA, Austria |
| 10.20 –10.50 | Key note presentation - IRPA's recommendations and contributions to enhance radiation protection culture through educational activities | Eduardo Gallego, IRPA, Spain |
| 10.50 – 11.00 | Overview of the poster contributions | Michèle Coeck, EUTERP & SCK•CEN, Belgium |
| *11.00 – 11.30* | *Break & poster session* | |

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| **Session 2: Design of training – facilitator: Marcel Schouwenburg** | | |
| 11.30 – 11.35 | Introduction by the facilitator | |
| 11.35 – 11.50 | International training in nuclear technology and radiation protection with a good balance between academic and generic employability skills: training the future trainers | Sonja Schreurs, University of Hasselt, Belgium |
| 11.50 – 12.05 | Teaching safety culture in radiation protection courses - is it feasible or mission impossible? | Matjaž Koželj, Jožef Stefan Institute, Slovenia |
| 12.05 – 12.20 | On the design and implementation of a specific radiological/nuclear training curriculum for police officers | Tom Clarijs, SCK•CEN, Belgium |
| 12.20 – 12.35 | Maximizing overall radiation safety of hospital employees through radiation protection training at the Academic Hospital Paramaribo | Coulor Whitney, Academic Hospital Paramaribo, Suriname |
| 12.35 – 12.50 | Creation of core-course in Georgian language from national specificity and needs of Georgia in radiation safety, with structure of additional modules and creation and publishing the handbook | Davit Nadareishvili, Ivane Beritashvili Center of Experimental Biomedicine, Georgia |
| 12.50 – 13.00 | Q&A | |
| *13.00 – 14.00* | *Lunch* | |
| **Session 3: Workers' training – facilitator: Liz Grindrod** | | |
| 14.00 – 14.05 | Introduction by the facilitator | |
| 14.05 – 14.20 | Focussing on workers | Jos van den Eijnde, Amsterdam UMC, The Netherlands |
| 14.20 – 14.35 | IRA and CERN collaboration on radiation protection awareness | Diana Dalban, IRA & Meriem Chniba, CERN, Switzerland |
| 14.35 – 14.50 | Radiation self-protection workers' basic training program at CNE Cernavoda NPP | Catalina Chitu, S.N. Nuclearelectrica SA - CNE Cernavoda Nuclear Power Plant, Romania |
| 14.50 – 15.05 | From operations to decommissioning: decline into fear | Mikkel Øberg, Danish Decommissioning, Denmark |
| 15.05 – 15.15 | Q&A | |
| *15.15 – 16.00* | *Break & poster session* | |

| **Session 4: Trainer standards and competencies – facilitator: Matjaž Koželj** | | |
|---|---|---|
| 16.00 – 16.05 | Introduction by the facilitator | |
| 16.05 – 16.20 | Train-The-Trainers activities in radiation protection | Marisa Marco, CIEMAT, Spain |
| 16.20 – 16.35 | Trainers' skills development: yes ... but not only training | Floriane Marcuccini, INSTN – Institut National des Sciences et Techniques Nucléaires (CEA), France |
| 16.35 – 16.50 | Design of education and training program based on the experiences from risk analysis in therapeutic nuclear medicine | Zayda Amador Balbona, Centre of Isotopes CENTIS, Cuba |
| 16.50 – 17.00 | Q&A | |
| *17.30 – 18.30* | *EUTERP Workshop reception* | |

| **Thursday April 11, 2019** | | |
|---|---|---|
| 09.00 – 09.30 | Introduction to the working groups | Joanne Stewart, EUTERP President |
| 09.30 – 11.00 | Working groups discussions:<br>- WG1 Trainer standards and competences<br>- WG2 Evaluation of training<br>- WG3 Radiation worker training | Amparo Cristobal, IAEA, Austria<br>Tom Clarijs, SCK•CEN, Belgium<br>Marcel Schouwenburg, Technical University Delft, The Netherlands |
| *11.00 – 11.30* | *Break* | |
| 11:30 – 12.30 | Working groups discussions - continued:<br>- WG1 Trainer standards and competences<br>- WG2 Evaluation of training<br>- WG3 Radiation worker training | Amparo Cristobal, IAEA, Austria<br>Tom Clarijs, SCK•CEN, Belgium<br>Marcel Schouwenburg, Technical University Delft, The Netherlands |
| *12.30 – 13.30* | *Lunch* | |

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| **Session 5: New developments – facilitator: Celso Osimani** | | |
| 13.30 – 13.35 | Introduction by the facilitator | |
| 13.35 – 13.50 | Follow-up of implementation of the radiation protection expert and radiation protection officer from the European basic safety standards in The Netherlands | Barbara Godthelp, ANVS, The Netherlands |
| 13.50 – 14.05 | Radiation protection training challenges and innovations at Sellafield in the UK | Jim Bishop, Sellafield Ltd, United Kingdom |
| 14.05 – 14.20 | A picture is worth a thousand words and an experiment is worth fifty slides: development of experiments in health physics to reinforce basic radiation protection concepts | Sheldon Landsberger, University of Texas at Austin, USA |
| 14.20 – 14.35 | Sharing experience on the use of a 3D serious game and radiation simulator in radiation protection training | Paul Livolsi, INSTN – Institut National des Sciences et Techniques Nucléaires (CEA), France |
| 14.35 – 14.50 | Q&A | |
| *14.50 – 15.30* | *Break & poster session & demos* | |
| **Session 6: Outreach and networks – facilitator: Penelope Allisy** | | |
| 15.30 – 15.35 | Introduction by the facilitator | |
| 15.35 – 16.05 | Key note presentation - Strategic Human Resource Management in Radiological Protection: A Career Path Framework Agreement | Ted Lazo, NEA/OECD, France |
| 16.05 – 16.20 | EURADOS education and training: a key issue to support dissemination of knowledge and skills in radiation dosimetry | Joao Alves, EURADOS & CTN, Portugal |
| 16.20 – 16.35 | MEET-CINCH - a modular European education and training concept in nuclear and radio chemistry | Jan Willem Vahlbruch, Leibnitz University Hannover, Germany |
| 16.35 – 17.15 | Panel – beyond EUTERP – collaborations and outreach | Panel members:<br>Barbara Godthelp, HERCA<br>Adriaan Lammertsma, EFOMP<br>Fernand Vermeersch, ALARA Network<br>Joao Alves, EURADOS & CTN, Portugal |
| *19.00 – 22.30* | *Cocktail and Workshop dinner at the Dolmen Hotel (dress code: smart casual)* | |

| **Friday April 12, 2019** | | |
|---|---|---|
| 09.30 – 10.30 | Working groups discussions - continued | |
| **Working groups' reporting – Chairperson: Michèle Coeck** | | |
| 10.30 – 11.15 | Reporting of working groups & discussion | |
| **Closing session: Workshop outcome and recommendations – Chairperson: Michèle Coeck** | | |
| 11.15 – 11.45 | EUTERP awards and update | |
| 11.45 – 12.00 | Summary of the Workshop and recommendations | Joanne Stewart, EUTERP President |
| 12.00 – 12.15 | Closing remarks | Peter Johnston, IAEA, Austria<br>Eduardo Gallego, IRPA, Spain<br>Joanne Stewart, EUTERP President |
| *12.15* | *Farewell lunch* | |

## Poster presentations

| Poster title | Name | Organisation | Country |
|---|---|---|---|
| Radiation protection expert technician course - 10 years of online experience, innovation and improvement | Marco M. | CIEMAT | Spain |
| Strengthening Knowledge and Skills in Radiotherapy Quality and Safety in Latvia | Bajinskis A. | University of Latvia | Latvia |
| Radiation Protection Awareness Challenges at CERN | Chniba M. | CERN | Switzerland |
| Radiation protection education and training in Croatia – current situation and needs | Suric Mihic M. | Institute for medical research and occupational health | Croatia |
| Radiation Protection Workers' Continuing Training Program at CNE Cernavoda NPP | Gisnac M. | S.N. Nuclearelectric a SA | Romania |
| E&T requirements for the recognition of RPEs and MPEs: The Greek experience | Thrapsanioti Z. | Greek Atomic Energy Commission | Greece |
| Does radiation exposure at the workplace affects worker's happiness and satisfaction? A European perspective. | Soares S. | University of Beira Interior | Portugal |
| System for educating Radiation Protection in the Czech Republic | Cechak T. | Czech Technical University in Prague | Czech Republic |
| Training on software for shielding and organ dose calculations in the X-ray diagnostic | Zicari C. | INAIL | Italy |
| The Programs of Training in Radiation Protection and the Safe Use of Radiation Sources in China | Wu Q. | Tsinghua University of Peking | China |
| EUTERP foundation activities | Allisy-Roberts P.J. | EUTERP | United Kingdom |
| European Federation of Organisations for Medical Physics: the mission and the pillars to advance Medical Physics in Europe | Koutsouveli E. | EFOMP | United Kingdom |

# Oral presentations

# Train the trainers for Radiation Protection Officers of Medical and Industrial Facilities, as part of the IAEA's approach to support Member States in building competence

A. Cristobal, A. Luciani, J. Wheatley

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**Abstract**

The International Atomic Energy Agency (IAEA) has a statutory function to establish standards of safety for the protection of health, life and property against ionizing radiation and to provide for the application of these standards to peaceful nuclear activities, through, inter alia, education and training.

To build competence in radiation, transport and waste safety, the IAEA offers a range of education and training services and activities to its Member States. The support is offered in line with the IAEA's mandate, the safety standards and the Strategic Approach to Education and Training in Radiation, Transport and Waste Safety, 2011-2020. The vision of this Strategic Approach is for Member States to have established a sustainable education and training infrastructure that addresses national needs for building and maintaining competence in radiation, transport and waste safety, and is consistent with the IAEA's safety standards. For that purpose, the IAEA supports Member States to train key personnel to ensure the safe use of ionizing radiation. One of the most important and effective means of optimizing resources and transferring the skills necessary for building competence is the train the trainers approach.

This paper describes the train the trainers workshops for Radiation Protection Officers (RPO) of medical and industrial facilities that IAEA offers to Member States with the purpose to: provide theoretical knowledge of roles, duties and competence of RPOs of the mentioned facilities; as well as practical skills to design and deliver training sequences on related topics; in order that they act as trainers of RPOs in their own countries.
With these workshops Member States are supported to build a pool of national trainers in radiation safety with a cascading effect that makes available many trained personnel in a reasonable timeframe. Noting that RPOs have a key role to oversee the application of regulatory requirements in facilities and activities, in the long term the IAEA is supporting Member States in their efforts to improve their radiation safety infrastructure.

The interest and demand of train the trainers for RPOs is increasing and in 2018 the number of these workshops, provided in English, French, Russian, Spanish (and very soon in Arabic), has increased in terms of the number of both, participants and courses, in comparison to previous years.

The IAEA also supports train the trainers activities for other categories of personnel to be trained in radiation safety of Member States to support the creation of a pool of trainers with technical competence, practical experience and teaching and communication skills in order to allow the establishment of a sustainable and self-supporting training programme in the country.

## IRPA's recommendations and contributions to enhance radiation protection culture through educational activities

Eduardo Gallego

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**Abstract**

The International Radiation Protection Association (IRPA) promotes excellence in the practice of radiation protection (RP) through national and regional Associate Societies (AS) for RP professionals. Education and Training (E&T) is a key pillar in establishing effective national RP programmes. In 2014 IRPA adopted the "Guiding Principles for establishing a Radiation Protection Culture" whose application by the AS is being encouraged. The document clearly recognizes that education is an essential factor for the development and improvement of the RP culture. It is stated that "Radiation protection culture is a learned way of life", and it is obvious that such learning must start with a proper education. RP culture must be present in all the initial academic curricula on radiation applications. Then, along professional life, continuous educational processes and training are usual ways to improve the level of culture, by allowing a proper sharing of competence looking for new and better RP methods. RP professionals should keep a continued proactive updating on the evolution of scientific knowledge and related assessments of relevance in RP. E&T should contribute to raise an adequate awareness among people directly or indirectly involved in RP, to make sure that all radiological aspects are well known to workers, and everybody has the correct training to take care, prevent unnecessary exposure and evaluate RP aspects. In addition, learning from events, incidents and near misses is an important part of culture development.

As part of its traditional activities, the IRPA congresses include a number of refresher courses (RC) that provide participants with the opportunity to update their knowledge in specific areas of RP science and practice. The RC are aimed either at providing a broad overview of the current state of a given topic, or at giving experienced practitioners a more detailed understanding of up-to-date developments in a field. This has obvious benefits in terms of RP culture enhancement. Subjects range from fundamentals of radiation protection to radiobiology, patient dose and optimization, radon and associated risk, NORM, radiation security of radioactive sources, decommissioning and remediation, eye lens dose, safety culture, risk perception and communication, non-ionizing radiation, etc.

The number of RC in the last few years is large and they constitute a valuable asset for all RP professionals, which IRPA wishes to preserve properly on its website, making them accessible to everyone. From the last international congresses, IRPA12 (Buenos Aires, 2008) offered 20 RC, IRPA13 (Glasgow, 2012) 25 and IRPA14 (Cape Town, 2016) 20. The IRPA regional congresses have also included an important offer of courses, with the European congresses standing out in the head: Helsinki (2010) with 16 RC, Geneva (2014) with 10 courses and specially The Hague (2018) with 25. The 2018 last regional congresses in Latin America, Asia-Oceania and Africa offered 10 courses (Havana), 9 (Melbourne) and 6 (Tunis) respectively. Attendees have evaluated the RC and their assessment, comments and suggestions give also good hints to help keeping their high level.

The IRPA RC have given RP professionals –both young and more veterans– an opportunity to improve their knowledge on given subjects. This is a key line integrated in the IRPA Plan on E&T. However, IRPA also encourages its AS to jointly organize E&T activities, to promote creation of E&T networks –of which EUTERP can be a model to follow– and to activate the emergence of activities to attract young generations to the profession, through their participation in the recently created Young Generation Network (YGN). All these are bricks relevant for the building and maintenance of RP culture.

# International training in nuclear technology and radiation protection with a good balance between academic and generic employability skills : training the future trainers

S. Schreurs[1], W. Schroeyers[1], I. Gerardy[2]

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**Abstract**

During a previous Erasmus strategic partnership (2015-2017) with actors from the Cherne network, 6 e-learning modules and 6 on-site training modules in radiation protection and radioecology were successfully developed. In a follow-up 2 years strategic partnership, 'Train the future trainers in nuclear technology and radiation protection' (recently started at 1/10/2018), the educational approach was modified, expanding the target competences, in order to improve the blended learning process. Generic skills, such as SDGs and soft skills, are becoming very important for the future nuclear engineers. Different innovative ways will be explored in the new strategic partnership and adopted to define a new methodological approach. This new approach encompasses a dedicated workshop for current trainers (academic and associate partners) of the partnership on the following topics : work floor learning and professional job training, gradual transformation of blended learning activities and an SDG workshop. Furthermore, the e-modules will be optimized by the incorporation of an evaluation tool for students in order to guide their e-learning pre-training activities.

In addition, pre-training tasks are guided using tele-teaching (coaching first year and video lectures second year of the project) during 1 month before the real training.

Thereafter, in the first year, real face-to face training weeks are organised in 3 topics (nuclear reactors and waste management, radiochemistry and medical dosimetry, environmental radioactivity). In the second year a real trainer activity to a specific audience will be prepared and organised. Through these activities, the participants will get real experience in training. Moreover nuclear and radiation protection topics are disseminated to a larger public (students and teachers) and this can attract more interest to these topics for future professionals which is really a necessity for the labour market.

The blended learning activities of each year have the value of 4 ECTS for each topic, i.e. 2 for pre-training activities, 2 for the training school. Individual students will be encouraged to follow the activities of both years.

Our project is especially dedicated to master students in the field of nuclear engineering with no to a little experience on the work floor.

# Teaching safety culture in radiation protection courses – is it feasible or mission impossible?

M. Koželj, V. Slapar Borišek

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**Abstract**

Use of the term "safety culture" is common among people involved in nuclear technology. It is a non-technical term that, according to IAEA definition, describes "The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance." The term has been in use for almost three decades now and has deeply penetrated the minds and behaviour of the nuclear community. Implementation of safety culture in facilities is supported by general and dedicated procedures and involvement of all services and departments. Consequently, safety culture has also influenced radiation protection implementation and practice and has become one of the important keystones of radiation safety in nuclear facilities.

Due to the positive influence on radiation safety, one would expect that safety culture tools and approaches would penetrate other radiation practices and facilities. However, this holds only partially. For example, neither safety culture, nor radiation protection culture (as recommended by IRPA for safety culture elements related to radiation safety), are not mentioned in the new Council Directive 2013/59/EURATOM, which lays down basic safety standards for protection against the dangers arising from exposure to ionising radiation in EU.

In the recent Slovenian Ionising  Radiation Protection and Nuclear Safety Act (ZVISJV-1), there is the definition of safety culture but the term is used only in relation to nuclear and radiation facility management system. However, in the secondary legislation care for the safety culture (and good condition of radiation protection) has been declared as one of the key duties of a person responsible for radiation protection. The list of tasks is also added for clarification, but it contains only regular tasks related to fulfilling legal requirements imposed by licence and relevant rules. Secondary legislation also requires that radiation safety culture should be a part of training for radiation workers.

So what is safety culture in radiation protection? How can we introduce safety culture in a non-nuclear environment where radiation practice is not the major activity and requirements of radiation protection legislation are considered more like obstacles? What can a person responsible for radiation protection actually do to ensure that safety culture is a part of a practice? What support does he need from facility management? And finally, what knowledge and training he needs to be able to perform as required by legislation and what information should be delivered to a radiation worker to support the improvement of safety culture?

Considering the established understanding of safety culture in radiation protection the basic ways to impact safety culture in certain organisation are:

1. Strong leadership,
2. Educating and training,
3. Awareness,
4. Communication,
5. Learning from events, incidents and near misses.

It is clear that we cannot address all these values during the training event (or even process!) and that implementation and development of safety culture strongly depend on organisational and cultural characteristics of the organisation. In the nuclear facilities, the values are communicated to all managers and workers through numerous channels and occasions in support of (general) safety culture. In other (non-nuclear) facilities and organisations, this is not the case and safety culture in radiation protection could be crippled and limited without the support of organisational leaders, who are not aware of safety culture requirements, or other organisational characteristics (and habits) which are not favouring safety in general.

We can conclude that the success of teaching safety culture in radiation protection training is highly dependent on "external" factors that cannot be influenced by the training process and ould lead to an unsuccessful outcome.

## On the design and implementation of a specific Radiological/Nuclear training curriculum for police officers

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**Abstract**

Under the Erasmus+ program the European Commission currently funds the CBRN-POL project, which has as a general objective to create a fit-for-purpose, multidisciplinary Chemical, Biological, Radiological and Nuclear (CBRN) training curriculum and training educational materials, especially dedicated for Police officers and universally applicable to all EU Member States. The scope of the educational program shall meet the demand for safe, responsible and effective behavior of police officers on the scene in the onset of an intentionally induced mass casualty incident.

As a pre-requisite for the design and development of the CBRN training curriculum, an overview of the actual knowledge and awareness of police officers with regard to CBRN agents and on emergency situations that might involve them was surveyed in Belgium, Cyprus and Poland. The implementation of the training curriculum involved a centralized train-the-trainer approach focussing on didactic, pedagogical and CBRN issues, as well as local training courses for the trainees in their respective native languages.

This paper elaborates on the basic design concepts as well as on the challenges encountered during the analysis, design, implementation and evaluation of the training courses. Examples of such challenges were addressing basic principles of nuclear physics and radiation protection when the vast majority of the audience does not have an academic background, the amount of time allocated to train the trainers and trainees, as well as the different languages. This paper also elaborates on the results of the implementation of the training curriculum at operational level and on plans for the future.

# Maximizing overall radiation safety of hospital employees through radiation protection training at the Academic Hospital Paramaribo

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**Abstract**

For the past years, radiation protection education and training has been focused on hospital employees who are actively using ionizing radiation in their daily practice. Less focus has been placed on other hospital employees who, as a result from their duties may come in contact with ionizing radiation either directly or indirectly.

A complete overview was made of all hospital employees who are directly or indirectly involved in working with ionizing radiation. Based on their level of involvement and prior training in radiation protection, a training program was developed which included different knowledge levels in radiation protection. To assist employees in determining their education need in radiation protection, a decision tree was constructed. Finally, a calendar was established which included training dates for all different groups.

Results showed that 14 different groups could be identified, belonging to either category I (those who have received radiation protection training as part of their study programme), category II (those who are directly involved in ionizing radiation but have not received formal training) or category III (those who closely work in or around areas where ionizing radiation is being used). Included in the latter group were employees involved in decision making processes, human resource management, technical maintenance and housekeeping and employees at the Health, Safety, Environment and Quality department. Lack of knowledge in radiation protection may lead to fear which in turns may cause unnecessary absence of employees which is why a separate session was planned for members of the labour union. The decision tree was constructed in such a way that all groups could be included. Furthermore, it distinguished the education need for current employees and new employees. All new employees who fall under category II and III are required to first register at the Education, Development and Training unit of the hospital. The responsibility of this department is to schedule a date for induction training of new employees from aforementioned categories and to provide education passports to all trained employees from these categories. The proposed calendar included dates spread throughout the year with single or multiple sessions per group depending on the group size to allow maximum participation. Training material was composed based on information from international organizations such as the International Atomic Energy Agency, the European Commission amongst others. Training content differed for each group and included general topics such as "Basics of (ionizing) radiation, uses of ionizing radiation in the hospital, historical incidents, effects from exposure to ionizing radiation, radiation warning signs and practical examples for protection. Specific topics were primarily focused on groups from category I. Since employees from this category are required to receive formal training in radiation protection during their studies, the focus of training was a brief refreshment of the basics and furthermore in-depth training on radiation protection during high dose procedures. The training was delivered by the hospital radiation protection expert.

Assessments were given after the training and participants from category III that have received training thus far, evaluated the content as informative and helpful. They also indicated that they feel safe working at the hospital while ionizing radiation is being employed and that knowing how to protect themselves against unnecessary radiation adds weight to their feeling of safety. Training sessions for other categories are scheduled for the near future.

# Creation of Core-Course in Georgian language from National Specificity and Needs of Georgia in Radiation Safety, with Structure of Additional Modules and Creation and publishing the Handbook

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**Abstract**

In 2016, the EduTA mission was conducted in Georgia, as a result Ivane Beritashvili Center of Experimental Biomedicine (later center), which has been conducting training courses of nuclear and radiation safety issues for several years and is the leading organization in the field of education and science in Georgia resumed existing programs according to the requirements of international and national legislation. On the basis of the center exists International Nuclear Information System Office (INIS) with it officer.

Scientific articles are published periodically in the journal "Radiation Studies" whose editorial office is located on the basis of the center. The syllabus of the training was developed for three types of listeners working in the field of medicine with agreement to the Regulatory Authority (Nuclear and Radiation Safety Agency). These include: average medical personnel (x-ray labors), medical personnel with higher education (doctors) and persons responsible for nuclear and radiation safety. During composition of mentioned syllabuses experience of the AES and other international organizations, as well as national interests was taken into consideration. The necessity of modifying existing courses in the

country was primarily due to the lack knowledge of listeners of the modern standards of safety. The Core-course was created, which included the theoretical material required for all three above-mentioned listeners. Course starts with the types of listeners and ends with practical part. All three types of programs are presented in such a way that the listeners have opportunity to an active discussion and feedback. Additional modules include directions such as Nuclear Medicine, PET and PET-CT, where the number of listeners is much smaller than dentists or the general profile radiologists and X-ray labors. It should be noted, that besides the regulatory body, the center works closely with professional and higher medical education institutions. It should be noted that the handbook and training demonstration materials (power-point and other formats) have been developed in Georgian language, which is also an important novelty for workers working in Nuclear and Radiation field. Despite not a large number of trainers, training courses are conducted not only in the capital, also in large regional centers, which enables professionals to save the time and supply required material timely.

## Focussing on Workers

J.H. van den Eijnde[1], L. Roobol[2]

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**Abstract**

In this contribution, the needs are analysed for the radiation safety training of workers with an educational background on a high vocational level.
We state that any radiation worker should:

- understand the hazards of ionising radiation;
- understand the measures that are taken by the Government and the employer, and
- understand which measures to take themselves in order to achieve an acceptable level of risk.

In our opinion, the order in which the training is presented should follow the order of these three items. For each item, we discuss the content of the training, with emphasis on the content that is normally not presented in radiation safety textbooks. In the discussion of item three - the measures the worker should take- we explain the importance of the source-oriented strategy and discuss the measures using this strategy.

*Introduction*
In the Netherlands, in the past 20 years, the law has described a list of subjects to be presented in the training of radiation protection officers and experts. This list was presented in the ENETRAP II document 'Comparison Table for Training Material'[1]. The training of officers on the lowest level was called 'level 5A/B'.
We have 15 years of experience with a book called 'Practical Radiation Protection', which covers all of the recommended content for the training of a 5A/B radiation supervisor[2]. The book is however originally written, and basically meant, for radiation workers on a higher vocational school level; workers can dismiss the passages that are specifically meant for the 5A/B radiation supervisors.
Our experience with this book is presented in this contribution.

*Choices for structure and content*
Firstly, in our experience the section order in discussing the physical basic knowledge should be so that it is possible to make a difference between on the one hand the necessary knowledge for workers and on the other hand background information which might interest them. For instance, we think that a radiation worker should be fully aware of the concept 'half-life' but not necessarily be competent in using powers of e.
Secondly, focussing on workers implies that the more practical issues need much emphasis, like how to work in a fume hood.
And thirdly, focussing on workers means that it is necessary to connect to the way workers handle hazards and risks. Among other things, that has an implication for the sequential order of the chapters: this order should be aimed at empowerment of workers in handling hazards and risks; the next section will elaborate this aspect.

*Empowerment of workers*

People all over the world will normally try to find out what will happen if they do not follow the rules: in the behavioural field there is a tendency to cut corners  In normal life, this isn't that bad, because only in this way new creative ideas will develop and dysfunctional rules will be abolished.

However, a hazardous agent like radiation cannot be sensed and thus has no warning that the actual risk is getting too high; therefore, in applying radiation, the trial-and-error way of dealing with hazards cannot be tolerated. A strict control is necessary to deal with this situation, and it is also necessary to motivate the workers involved to follow the rules and to take the necessary actions.

The training of the controllers, like rpo's and rpe's, should make them fully aware of the laws and regulations.

However, for radiation workers the situation is different. They are not the controllers, and above that, they are normally highly educated in their own profession (researchers, medical doctors, etc.) and not used to strict control. For them, the training should  concentrate on  motivating them to follow the rules by explaining the principles behind them. Among other things this implies that their training should not start with an elaborate chapter on rules and regulations.

The structure of the training should endorse this concentration on the motivational approach.

Therefore, sequential order of the chapters should be so that the radiation worker will

- understand the hazards of ionizing radiation;
- understand the measures that are taken by the Government and the employer, and
- understand which measures to take him- or herself in order to achieve an 'acceptable level of risk'.

It is important to explain the concept of 'acceptable risk'. Radiation can be hazardous, but if applied well, it is not risky. Only by defining and using the terms hazard and risk in a clear way, the idea of 'acceptable risk' (their ultimate goal) can be explained and understood. Unfortunately, using this difference is not common in the radiation protection community: even in the 2013/59/Euratom Directive this difference is not made.

It will motivate  the student to comply, if the order of the presentation/chapters follows the order of the three items mentioned above.

*The first item: understanding the hazards*

In presenting the first item, it will be necessary to start explaining the nature of radiation and the interaction of radiation with matter. These are standard subjects, presented in every textbook.

When presenting these subjects to workers it will be wise to present half-life in an easy manner of sequentially dividing by a factor two, then a section with formulae using $T_{1/2}$, and then a separate section using λ and powers of e, meant for radiation protection officers and interested workers. In addition, it is necessary to give many examples on this issue, because it appears to be counterintuitive, in some way or another. It has proven to be useful to explain and show that 10 half-lives means a reduction of a factor of 1000.

We think that knowledge of a concept like 'kerma' is not necessary for workers. However, a warning, with examples, should be added for the dual and confusing use of the sievert.

In discussing the hazards (biological effects), the important difference between stochastic and deterministic effects should be treated relatively extensively: the worker must be able to explain at home that he will not lose his hair because of his work with ionising radiation.

The important difference between hazard and risk should be explained in this first item: hazards are controlled to get an acceptable risk.

The concept of 5% per sievert and comments on the LNT hypotheses are important too.

Very important is that the worker will get a feeling for the risk associated with a dose in the order of magnitude of a  few microsieverts. In our opinion, a good way to do this is to present two examples. The cigarette equivalent dose -10 microsievert equals roughly the risk of smoking one cigarette- gives a feeling for the hazard. The other example is the dose received in a flight with an aeroplane; this shows students that we are used to accept a risk if the advantage is high enough.

*The second item: rules and regulations*
As said previously, rules and regulations should not be the focus of the training; however they of course stay an important aspect.
In treating them, justification, ALARA and limits are the starting point, relevant for both workers and officers.
Aspects like the role of the ICRP, IAEA, Euratom, national laws, institutional licences, etcetera are relevant for officers but much less so for workers. The same holds for complex issues like transport, rules concerning high activity sources, how to apply for a licence, etc.
However, there are specific rules and regulations the worker certainly must know, like the obligation to have a risk analysis, the categories of workers and workspaces, rules for pregnancy, personal dose control, and waste collection. Therefore, having a separate chapter or section 'Rules and Regulations at work', aimed at the workers will be a good idea.
It will be interesting both for workers and officers to provide a section on ethics and perception.

*The third item: measures one can take oneself*
The third and to our opinion most important part of the educational text for workers should explain to the worker which measures one can and should take oneself, with practical examples and warnings against commonly made mistakes.
But firstly, to really understand the importance of these measures, it is proven to be functional to give the worker some easy formulae.
In reading the preceding chapters, the worker will already have developed a feeling of the risk associated with a microsievert. Using the formulae, he will be able to roughly estimate how many microsieverts he will receive, so what is own risk will be, if he does not take the necessary measures.
For evaluating the hazard of internal exposure, the formula $E(50) = e(50) \cdot A$ will do for a first estimation. For external radiation, rules of thumb can be used, like $\dot{H}^*(10) = 2\ A$ at a distance of 30 cm (in MBq and µSv/h).
For evaluating the effect of the measures, a simple formula showing the effect of shielding and taking distance (inverse square law) will show the worker how he can reduce the hazard to an acceptable risk.

For the treatment of the measures the worker can take himself, the 'source-oriented strategy' should be used.
This strategy is the basis of the safety science when working with hazardous agents. Unfortunately, this strategy is not yet common practice in the radiation protection community.
The strategy states that one should take five types of measures, in the following order: Reduce, Administrative controls, Enclose, Remove, Individual protection.

It starts by Reducing the activity of the source, for instance to zero by using a non-radioactive application. Another way is to have as low activity as diagnostically achievable, or to reduce the amount of time that one is exposed.
Administrative controls are for instance the personal dosimeters, the entrance control, etc. This type of measure is not always seen as part of the source-oriented strategy, because it is on non-material issues.
Enclosing the source means for instance shielding it, or -for open sources- use leakage trays.
Then one should Remove the radiation before it enters the body, e.g. by using ventilation. The existence of the different kinds of local exhaust systems is part of this item, and the way one should work with them.
And as a last step, Individual Protection should be used, like lead aprons or gloves. The many mistakes that can be made using them, is part of this item.
Added to these 'source-oriented' items, the measures to be taken in case of calamities should be treated.

The elaboration of the source-oriented strategy will differ between open sources, closed sources and X-ray equipment. Therefore, it may be functional to make three different chapters, one on open sources, one on closed sources and one on X-ray equipment.
As the radiation protection education must be application specific, it may be functional to make special, optional, sections within these chapters for specific applications. For instance, the information on X-ray diffraction can be given in a separate section in the chapter on X-ray equipment. Some applications are however so special that they better have an own chapter; in our experience this holds for instance for medical applications; here, a special chapter turned out to be necessary.

*Conclusion*
We have made the point that the education of radiation workers should focus on motivating them to comply. Therefore, the radiation worker should:

- understand the hazards of ionizing radiation;
- understand the measures that are taken by the Government and the employer, and
- understand which measures to take him- or herself in order to achieve an acceptable level of risk.

The order in which the subject-matter is presented should follow the order of the three above-mentioned items.
It should be possible to understand the text without knowledge of powers of e and logarithms. Easy-to-understand rules of thumb should therefore be given. The source-oriented strategy should be explained and used in the treatment of the practical measures the worker should take himself.

[1] *Comparison Table for Training Material, 2013, L.H. van Elsäcker-Degenaar, F.S. Draaisma and M. Sutmuller, ENETRAP II WD 5.1*
[2] *Practical Radiation Protection, 2017 Fourth Edition, Jos van den Eijnde, Lars Roobol, Syntax Media*

# IRA and CERN collaboration on Radiation Protection awareness

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**Abstract**

The European organisation for nuclear research (CERN) operates the largest research laboratory in high-energy physics in the world and employs over 2,500 scientific, technical, and administrative staff members and hosts every year about 12,000 users. The safety of all personnel and users working at CERN is the highest priority. To answer the great challenge of multi-hazard risks management for a pluridisciplinary and international community, CERN has set an extensive safety programme.
This safety programme is based on raising workers' awareness of the multiple hazards they may face in an extremely specific and complex working environment through specialised online and classroom training.
In addition to the dedicated radiation protection awareness made by CERN, trainings with a broader scope of radiation protection applications are proposed. Two specific training programme have been developed. One for Radiation Safety Support Officers (RSSO) and another for Radiation Protection Experts (RPE) trainings. Both RSSO and RPE play an important role within the different CERN's experiments , in support of RP Group. The goal is also to strengthen the RP culture in the laboratory and to offer to staff and temporary personnel the opportunity to gain expertise in radiation protection besides CERN's specific
conditions.

A collaboration has thus been established with the institute for radiation physics (IRA) of Lausanne University hospital (CHUV), which offers expertise in the use of ionizing radiation in medicine and organise training certified by the Swiss authorities. All RPE at CERN hold a Swiss RP certificate.
Within the context of a close collaboration for joint RP training programmes, both CERN and IRA created a working group that gathers the different actors in radiation protection training in the French speaking part of Switzerland. This working group is part of the "Association Romande de Radioprotection" (ARRAD) and has the mission to discuss about RP training issues, standardise training practices and proposed improvements. One of the achievement is to create a common database of all existing trainings. The platform is mainly intended for people searching for specific RP training, which corresponds best to their needs. This platform will gather information on each training programmes, links to training organisations and registration forms.
This presentation will present the collaboration between CERN and IRA, how complementary experiences, each facing different environments and safety cultures, helped
to develop joint courses and improve pedagogic approaches and soundness.

# Radiation Self-Protection Workers' Basic Training Program at CNE Cernavoda NPP

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**Abstract**

A knowledgeable workforce is a fundamental element in Cernavoda NPP program for the optimization of protection and control of exposure. Station personnel have radiation protection qualification according to necessities; there are four qualification levels, with different skills and responsibilities. Untrained persons are RED qualified; they cannot enter and performed Radiation Work without special approvals.

ORANGE qualification level is the basic radiological training and a requirement for obtaining initial access to any radiation area and for performing work in these areas. Orange qualified persons can perform Radiation Work only under the supervision of a Radiation Protection Assistant.

YELLOW qualified personnel are given thoroughly knowledge for radiation protection, but without enough practical experience. These persons may perform Radiation Work without any assistance; they may be held responsible only for their own radiation protection.

Workers are trained on the basic practices and the principles of radiological work that need to be employed in the specific radiological environment in which they are working, in practical matters (how to dress and undress protective clothing, wearing hoods and gloves, respiratory protection equipment) and on other techniques related to optimization of exposure: entry and exits points so that time spent in radiation areas is minimized, general dose rates in the area, hot spots, low dose waiting areas.

GREEN qualified personnel are radiation protection experienced personnel, with thoroughly radiation protection knowledge. These persons may also act as Radiation Protection Assistant in order to ensure radiation protection for Red and Orange qualified persons and are specially trained.

Each radiation protection qualification level requires a refresh course at 5 years.
Re-qualification training includes a reminder of the initial basic worker training and a review of new regulations, guidance documents and work protocols relevant to the concept of optimization.

Specialized training provides greater detail and could allow greater responsibilities for workers.
Specialized training is commensurate with the workers' risks and is given prior to the performance of any job in which exposure is high.
Mock-up training and exercises allow workers to practice tasks without the associated risk.

Optimization of the RP training program is in progress; all the documents (training materials, procedures and regulatory authorization) will be finalized at the end of 2019.
Radiation Protection Training and Qualification program optimization will increase the share of practical application aspects in the training materials; decrease the duration of the RP training program; increase performance of the RP assistants.

## From Operations to Decommissioning: Decline into fear

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**Abstract**

Radioactivity is a health hazard. However, it is a manageable hazard, one that we in this field keep in check by the use of safety measures, to protect the people: personnel, public, stakeholders. We create intricate processes for checking equipment and clearing materials, for workflow and handling, for the behaviour of the people themselves. However, the greatest risk factor is, and will always be, people; in this field as well as all other fields of hazardous work. Not the failure of equipment, not the mislabelling of sources, but workers doing what humans do best: forming habits. It is banal to note that good habits are a cornerstone of safety, but few seem to consider the implications of this, especially when moving from operations to decommissioning.

Effective doses from the handling of radioactive material is different from most other hazardous work in that it is effectively unavoidable when dealing gamma-emitters: if you are looking at what you're doing, and it isn't through 112 cm of leaded glass into a Hot Cell, measurable energy is being absorbed. As a consequence, a certain dose is not only expected, but unavoidable. During operations, this dose is sufficiently well-defined, based on detailed descriptions of work processes and handling. Your personnel is used to doses,
However, when the organization turns to decommissioning, as it happened in Denmark in 2003 at the Risø site, the hazards change. No longer do you have set procedures or hands-on experience with the specific tasks you perform. You are tearing down not only facilities but your safety railings, processes and experiences as well.

This leads to a decline in understanding of the concept of dose, as workers become less experienced with routine work and less used to a certain expected working dose. With this comes an increase in uncertainty, which leads to a poorer work environment and, in few cases, something akin to a fear of doses. How do you train your workers, planning as well as technical, to handle doses as a optimizable consequence of the work that needs to be done, instead of as a health risk that must be avoided at all costs?

However, all is not lost, and with careful planning and constant vigilance we can reduce the avoidable dose and increase understanding of the inevitable.

Note that this presentation isn't based on research, on interviews or other scientific methods – it is simply experience working in waste management and health physics, seeing the annual doses decline in conjunction with awareness, practice and the understanding of dose.

## Train-The-Trainers activities in Radiation Protection

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**Abstract**

The training of competent professionals in the design, management and evaluation of training programs in radiation protection, providing the tools and technological knowledge necessary to assess the main needs in the area is part of a National sustainable E&T system. Building competence through Education & Training is essential to guarantee radiation safety.

Ciemat has integrated the TTT actions into their E&T standard activities, mostly in an informal way: meetings with the lecturers at the beginning of a new E&T activity; the elaboration of training guides for tutors; elaboration of templates for the lectures; etc., but in the last years has been done in a formal way, and the most of them in the context of collaborations with the IAEA.

The content for the first TTT course was developed in 2007 based on the CIEMAT experience of more than 40 years of teaching professionals and experts in Energies. The first TTT courses aimed to provide teaching materials, resources and technical tools to design training actions according to the needs of each country in the area of energies. During the development of the course, the main contextualized methodological training tools were exposed through practical cases. At the end of the course the participants had acquired a series of skills that were evaluated by means of the proposal of an evaluation system for the online and face-to-face activities attending to the level of each of the designed training events.

During the last years, CIEMAT has collaborated with the IAEA in several TTT experiences doe to the great experience delivering E&T activities in RP by the e-learning and the Face-To-Face (FTF) methodologies and with a special emphasis in the Spanish-speaking countries. At this communication will be described a summary of the most relevant ones and in deep the lasts actions, one for the Face-To-Face (FTF) training and other referred to the e-learning system.

The first experience accomplished in the framework of the IAEA was devoted to the Radiation Protection Officer (RPO) and their FTF training. The mission had place in Montevideo, Uruguay from 12th to 16th March 2018: "Curso Regional capacitación de capacitadores para Oficiales de Protección Radiológica de instalaciones médicas e industrials".
The workshop had the objective to ensure that the countries have enough radiation protection trainers to support the establishment of sustainable national safety infrastructure. It included modules on fundamental topics applicable to all practices. In this way a pool of trainers with the technical competence, practical experience and teaching skills has been created to support a sustainable national training programme for radiation protection officers.

The workshop covered on one side the RPO IAEA training program, to provide participants with theoretical knowledge of role, duties and competence of a radiation protection officer (RPO) of medical and industrial facilities and on the other side the soft skills to design and deliver a training sequence on technical topics: Learning factors such as motivation, perception, memorization, understanding; Communication, including active listening and teaching styles; Training tips and techniques; Training programme design; and Tools and teaching aids.

The second experience, also coordinated by the IAEA, was devoted to develop and implement an E-learning system for radiation protection for the Argentine Nuclear Regulatory Authority, mainly for the PGEC (Postgraduate Educational Course in Radiation Protection). This mission had place in Argentina, during a week from 5th to 12th May.

The objective of this second workshop was not only focused on the RP but also in the establishment of a complete e-learning system: creating instructional strategy and design; transforming the FTF content to the suitable form for e-learning - including creation of storyboards, defining of the learning objectives, right sequencing of the modules; working with Moodle platforms since the side of the coordinator/administrator, the teacher and the student; taking full advantage of the tools included in the basic package as well as additional plugins; working with authorizing software to produce SCORM packages, etc.

## Trainer's skills development: yes … but not only training

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### Abstract

Under the European ENETRAP III project, the INSTN, then WP4 work package leader, developed and implemented the train-the-trainer course for radiation protection professionals, according to ECVET approach promoted by the European Commission.
To design this training course, the INSTN considered and relied upon several inputs: the 2013/59/Euratom European Directive, background documents (trainer position, trainer competency frameworks, professional card, etc.) as well as syntheses or recommendations from various European actions related to train-the-trainer course.

Since the design of the training, three training sessions were held: two sessions in 2017 and one session in 2018, welcoming almost 40 participants. Each training session was the subject of an evaluation of satisfaction (Level 1 evaluation of the Kirkpatrick model) as well as an evaluation of the training some months afterwards (Level 2 evaluation of the Kirkpatrick model). On the one hand, these evaluations helped to include the training course in a continuous improvement plan. On the other hand, they helped to highlight the additional needs of trainers about the development of their competencies.

Meanwhile, the world of education has continued to evolve: European standards, regulation on vocational training in France…undoubtedly with impacts on skills development. The trainer's line of work has also evolved and keeps on evolving: skills and learning outcomes become central.
The INSTN keeps on researching innovations and development of skills. It took the opportunity to establish a working group called "Design Training", composed of programme manager and project managers; the objective of this working group is to support and develop the skills of teaching staff (project managers, programme managers, trainers, etc.). The first action of the working group was to organize a workshop on programme managers needs to identify, in advance of any action, the skills they need to complete their mission. When talking about skills, it is not uncommon to think that training is THE solution, while it is only part of a complete device, alongside the teaching approaches and innovative tools.

A profound process of reflection is on, leading the working group and the train-the-trainer course for radiation protection professionals to evolve collectively. The aim ultimately is to imagine and develop a skills development device for the teaching staff without necessarily assuming that training is the solution but rather reasoning in terms of objectives and skills needs. We no longer speak about training but support.

From this link between the working group, the train-the-trainer course, changing needs ... the train-the-trainer course for radiation protection professionals originally developed as part of the ENETRAP III project will evolve in order to respond effectively to the trainers needs of trainers and needed skills for their mission. The aim is to integrate these new developments for the next train-the-trainer course for radiation protection professional session scheduled in autumn 2019.

But what will be the new highlighted skills? According to what support method? What modalities for recognition? and what challenges will be faced with what solutions?
That is the purpose of the ongoing work at the INSTN.

# Design of education and training program based on the experiences from risk analysis in therapeutic nuclear medicine

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**Abstract**

There is evidence that approximately 70% of incidents in nuclear medicine have been due to human error. For this reason the education and training (E&T) on the risk analysis results is a necessity for the continuous improvement of quality and safety in the health care. The aim of this study is to share a structured E&T program on quality and safety designed specifically for a generic service of therapeutic nuclear medicine (TNM), as an answer of the Bon Call for action, based on the main contributors obtained from the risk analysis results. Seven key topic areas were identified in the syllabus of course, drawn from recommendations on safety and quality. These topics are reported incidents and near-miss in TNM, risk matrix (RM), failure modes and effect analysis (FMEA), incident learning system (ILS) and safety culture, principles in error proofing and quality improvement and quality audits and use of the Cuban code SECURE MR-FMEA version 3.0 with combination of RM, FMEA and ILS. A didactic component was developed, which includes an extensive reading list supported by a series of lectures. This was coupled with practice-based learning which includes one project, for example, FMEA and also continued participation in the created international incident learning system (ILS) including the basic causes, corrective actions and preventive actions analyses exercises. Experiences from an experimental course which took place in February of 2008, were taken into account. The E&T program supports the reducing of the contribution of the human errors to the incidents during the radionuclide treatment of the patients. Although this study dealt with reported errors, underreporting is an inherent issue in the field of nuclear medicine as in the medical field as a whole. Some have suggested that nuclear medicine departments whose medical physicists would be more likely to report a radiation incident because they better understand the regulatory process. Our program is focusing in their paper in promoting the active support of leadership and strengthening the safety culture in their organizations. Based on the outputs of this study, the medical physicist could make E&T activities for each workplace in their services. In addition this program may be adapted for medical physicists' certificate programs, nuclear physicians, or as a self-directed educational project for practicing physicists. The program described here is expected to evolve and develop further. One future direction might be a distributed program that is coordinated between a few centres. This might include a combined teaching component, which leverages the expertise of faculty at various centres, and/or a resident exchange program which facilitates a shared learning experience.

## Follow-up of implementation of the radiation protection expert and radiation protection officer from the European basic safety standards in The Netherlands

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**Abstract**

In the European basic safety standards radiation protection (EU-BSS) a clear distinction has been made between the different roles and responsibilities of experts and services involved in radiation protection. The advising radiation protection expert (RPE) and the supervising radiation protection officer (RPO) have been introduced in the European basic safety standards for this purpose.

In the new Dutch Decree on basic safety standards for radiation protection of February 2018 the term RPE has been implemented literally, whereas the RPO has been implemented as supervisory employee radiation protection. The learning outcomes and registration requirements for the RPE are similar to those that were previously laid down in legislation for the (general) coordinating expert. RPE requirements for expertise and training are laid down in the new Regulation on basic safety standards for radiation protection.

The addition of the technical competence relevant for a given type of practice that was demanded in the basic safety standards for the educational programme of an RPE will be part of ongoing modification of the educational system for RPE in The Netherlands.
To comply with the RPO requirements of the EU-BSS, the Dutch system of radiation protection had to be modified in order to become application specific i.e. relevant for a given type of practise. Therefore, the professional associations in collaboration with the teaching institutes drafted learning outcomes for the new application specific training for the supervisory employee radiation protection. This was done for nine specific applications namely: 1) medical applications, 2) dentistry, 3) veterinary applications, 4) nuclear fuel cycles, 5) dispersible radioactive materials 6) naturally occurring radioactive materials, 7) accelerators, 8) industrial radiography (including non-destructive testing and exploration research) and 9) gauging techniques. These approved learning outcomes for the nine application-specific courses for the supervisory employee radiation protection have been incorporated in the new Regulation on basic safety standards for radiation protection.

In February 2019, the Dutch teaching institutes have started with the new RPO application-specific training courses. At present RPO courses for all nine applications are available. Besides the new application-specific RPO training modules an additional training module specific for nuclear power plant security personnel was developed. Learning outcomes for this course will be incorporated in the new Dutch nuclear safety Ordinance that will be in force in July 2019.

## Radiation protection training challenges and innovations at Sellafield in the UK

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**Abstract**

The Sellafield nuclear licenced site occupies an area of 6 square kilometres with more than 200 nuclear facilities ranging in age from the 1950's to others currently undergoing commissioning. These facilities are supported by 15,000 personnel, approximately one third contractors. Work over this time has encompassed defence, power generation, research, fuel reprocessing, fuel manufacture, waste processing and decommissioning, giving the site diverse and challenging radiological challenges. Major changes are underway which impact on training requirements, training methods, who needs to be trained and how often. The changes include: the end of reprocessing with the site transitioning to decommissioning and environmental remediation, increased workforce mobility, partnering with other organisations and moving from a prescriptive "rule based" management system to a more flexible "competence based" system.

Sellafield uses a systematic approach to training to ensure training is efficient, timely, effective and enjoyable. Professional trainers develop a training design plan with the subject matter expert that identifies gaps in skills and knowledge and learning objectives for the training. The method of training selected depends on the task's difficulty, importance and frequency. Training is all performance based with course assessments. For practical skills this is supplemented with on plant assessments by qualified assessors.

Recent innovations at Sellafield have included:

- The use of a nuclear plant simulator for plant access training.
- Radiography and contamination simulation.
- Use of modern media techniques in training materials.
- Pre course learning and assessments to enable courses to focus on use of that knowledge.
- Development of refresher training for RPAs focused on practically exercising infrequently used skills and facilitating sharing to transfer knowledge from more experienced RPAs to the new generation of RPAs.
- Use of "how to" videos as part of training that can be watched at any time as a refresher.
- Mock ups for training personnel on specific tasks.

# A Picture is Worth a Thousand Words and an Experiment is Worth Fifty Slides: Development of Experiments in Health Physics to Reinforce Basic Radiation Protection Concepts.

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**Abstract**

Education in radiation protection has dramatically evolved over the last two decades. With the advent of internet platforms such as YouTube, the abundance of websites along with on-line training the transmission of concepts in radiation protection have proliferated for the professionals working in the field and the general public at large as well. However, practical training in dealing with various radiation sources including neutrons is not easily available. In particular universities and national laboratories can be ideal institutions to perform radiation protection training along with experiments. In addition those institutions that have a research reactor can give training in health physics concern such as Ar-41 emissions or general neutron measurements around a reactor. While detailed lectures are essential, the addition of experiments can truly reinforce the basic concepts of radiation protection concepts. At the Nuclear Engineering Teaching Laboratory which houses the 1.1 MW TRIGA research reactor we have carefully developed a series of lectures and related experiments that can be completed in a one or two week period. At the end of the course the students should know how radiation detectors work, design photon and neutron shields, put together electronics for simple radiation detector systems and how they all relate to basic radiation protection. An overview of the lectures and experiments will be given.

# Sharing experience on the use of a 3D serious game and radiation simulator in Radiation Protection training

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**Abstract**

The National Institute for Nuclear Science and Technology (INSTN - E&T Unit of Cherbourg-Octeville) and OREKA (Company specialized in 3D engineering software) developed an innovative teaching tool named O.S.I.R.I.S. (Tool for Simulation of work under ionizing radiation).
This serious game type of software is relevant for the training dealing with the optimization of radiation protection and ALARA approach.

This serious game has been presented in May 2014 at Rovnij for the 15th European ALARA Network Workshop and 5th EUTERP Workshop. For all RPO-type training courses, participants create and quantify different options of radiation protection action by using O.S.I.R.I.S. software.

The first version of this tool dealt with radiation protection activities in the steam generator building during tubes testing.
Through the use of this serious game, trainees have to:

- establish a predictive dose evaluation and perform several dosimetric maps depending on the configuration of circuit and equipment, i.e. dose rate measures, radioactive contamination control,...
- perform the operating radioactive zoning (signs of radiological risks required at the workstation i.e. warning signs, barriers, dose rate information panels...),
- define the necessary collective or portable control instruments (atmospheric contamination monitor, gamma dose rate area monitor, ...),
- implement the principles of radiation protection (justification, optimisation and limitation).

Particularly, learners elaborate strategies to reduce the staff exposure (shielding, distance, activity and exposure time) to achieve an optimized assessment of dose.
With this training software, trainees are in position to supervise the daily collective dose performed and to react appropriately in case of dosimeters alarm or increase of collective dose. They are able to analyze dose alarm events, to investigate the origin of the dose alarm and to take safety measures.
O.S.I.R.I.S allows learners to perform the analysis of the exposure dose results, to analyze the gap between the predictive collective dose and the collective dose achieved, and enrich the lessons learnt to provide effective feedback.

In 2019, the partners decide to make a major upgrade of O.S.I.R.I.S. serious game to improve the functionalities (wider playground area, creation of a teaching interface to set the nature of radiation term sources: radionuclides, activity ...) and integration of a participant competence assessment tool (end of mission report printing).

Other training tools related to the optimization of radiation protection have recently appeared. Thus, the INSTN uses DosiCase®, a physical simulator that reproduces a simulated radiation field, to make "real" the dose received during a training sequence on practical facilities. The recording of the real-time dose with the DosiCase®system, combined with video recording, allows us to improve trainees' behavior by showing them theirs good practices.
Moreover, to add the internal exposure risk through contamination, the STS' simulator SBM-2D (simulated probe of CANBERRA SB-2D) is used for contamination level assessments.

The combination of these three teaching tools makes it possible to create "realistic" and complementary training sequences while eliminating the risk of exposure to ionizing radiation.

The 8th EUTERP workshop is a good opportunity to share training experience while using improved training tools in the framework of optimization training courses.

## Strategic Human Resource Management in Radiological Protection: A Career Path Framework Agreement

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**Abstract**

Radiological protection careers have existed and thrived for many years, offering employment in many areas. However, the nuclear power industry post-TMI, post-Chernobyl, and post-Fukushima "reconsideration" periods seem to have had significant effects on the number of students entering university RP degree programmes, and on the number of universities offering RP degrees, thus affecting RP specialist availability in virtually all areas. In this context it is important to address these circumstances in a broad sense, focusing on: giving more visibility to the many possible RP career paths; giving more visibility to the need for experts in all aspects of RP; and facilitating career mobility to support RP experts' ability to work where they are needed.

To assist in better creating such a path, several aspects were seen as potentially useful:

1. international and national agreement (informal or formal) to encourage the acceptance of RP experts trained in another country would facilitate career path mobility and advancement (note achievements of ENETRAP);
2. international and national agreement (informal or formal) to encourage position-mobility (i.e. to positions in post-university research, industry, regulation and international organisations) to develop broad career experience would be useful (note achievements of ENETRAP);
3. the previous two items would form an international career path framework that would need to be supported by a broad communications strategy;
4. a web library of good training materials would facilitate knowledge management (see existing materials, e.g. IRPA, ENETRAP); and
5. international recognition (informal or formal) of qualifications and certifications (note work by HERCA and IRPA).

The NEA's Committee on Radiological Protection and Public Health will be working on this project, in cooperation with IRPA, EUTERP, HERCA, and other relevant organisations.

# EURADOS Education and training: a key issue to support dissemination of knowledge and skills in radiation dosimetry

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**Abstract**

Education and training (E&T) has always been a key issue in EURADOS activities. By means of training courses, intercomparisons and networking activities EURADOS promotes the maintenance of expertise and hence of sustainability in radiation protection, whose activities are often carried out by small numbers of highly specialised staff.
Within its 8 Working Groups focusing on different applications of dosimetry (occupational, medical, environmental, and public exposure, and also technological development) senior and junior researchers work together allowing for all participants a continuous learning process and updating of knowledge.
In addition, EURADOS regularly organises specific training events like training courses, winter schools and scientific symposia.
As for training courses, they usually last 3 to 5 days, with limited participation to about 40 attendees and they are related to specific topics in the field of the EURADOS Working Groups. In the past, some of the training courses had two or more editions and were slightly updated if necessary, according to the demand. EURADOS *Winter Schools* have taken place at EURADOS Annual meetings since 2007. They usually last one or half a day and they provide "refresher courses" on topics relevant to radiation dosimetry. In contrast, scientific symposia also organized at EURADOS Annual Meetings, are usually related to research topics or results from EURADOS Working Groups or related research projects. Proceedings of the symposia have been published in peer-reviewed journals.

On one hand one-day Winter Schools at Annual Meetings are lecture-based and intended for students and those new to the subject area, on the other hand Training Courses are mainly meant for training of junior staff or young scientists either on implementation of dosimetry techniques as well as on novel or improved dosimetric methods.
Past training courses included were "Methods in Radiation Measurement", "Internal Dosimetry", "Use of MCNP in Radiation Protection and Dosimetry", "Voxel Phantom Development and Implementation for Radiation Physics Calculations", "EPR/OSL and TL dosimetry for retrospective dosimetry"
Since 2012 TC on the implementation of EC Technical recommendations, produced by EURADOS for EC, took places (5 on external exposure, the first in 2019 on dosimetry for internal contamination). The courses involve lectures, exercises, laboratory or workplace visits.

The continuing professional development is also included in the strategic plan through, for example, EURADOS Intercomparison Participant's meeting where results and dosimetry state of the art are discussed. Since 2016, a new format was launched: the "Learning Network" on individual monitoring combined with the Annual meeting. The Learning Network meetings are designed to give participants just such opportunities to for discussion on a range of relevant topics.

Since 2015, EURADOS also specifically supports young scientists to collaborate within EURADOS activities and at its Voting Members. EURADOS Grant and EURADOS Award have been offered to under 35 scientists: the former to support a short research stay of a for Research work within EURADOS working groups activities, the latter to recognize the scientific value of research work carried out within EURADOS working groups.
Recently, coordination with other European platforms, also for E&T, has been promoted and realized within the CONCERT project.

While at first started to respond mainly to the need of the EURADOS community, EURADOS E&T activities are now well structured, provided on a regular basis and with established formats contributing to international Education and Training activities in the field of radiation dosimetry.

## MEET-CINCH - A Modular European Education and Training Concept In Nuclear and Radio Chemistry

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**Abstract**

The MEET-CINCH project, supported within HORIZON 2020, follows two previous projects (CINCH I and II) with the aim to foster Education and Training in the field of Nuclear and Radio Chemistry and to sustain the results obtained in CINCH I and II. In this contribution, the main aims and objectives of MEET-CINCH are presented and discussed. Special attention will be given to new learning-forms like remote controlled experiments (Robo-Labs) and Interactive Screen Experiments (ISE)s. Also the development of an MOOC (Massive open Online Course) in order to increase the awareness and the number of students that select a career path in the nuclear and radiochemistry sector will be introduced and a modern Flipped Classroom (Inverted Classroom) concept for regular university courses in chemistry or physics that will complement the available tools for teaching and training in the nuclear and radiochemistry will be presented.

# Poster presentations

## Radiation protection expert technician course – 10 years of online experience, innovation and improvement

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**Abstract**

The figure of Radiation Protection Expert Technician (RPET) in Spain has been defined in The National Regulatory Body guidance IS-03. The RPET works in a Radiation Protection (RP) service under the responsibility of the RP Expert. A RP service advises in RP matter and has the technical responsibility, as is stablished in the Council Directive 2013/59/EURATOM, for the tasks of RP of workers and members of the public.

The qualification to be recognised as a RPTE, as defined in guidance IS-03, is based on a 40-hour face-to-faces (FTF) training course and an experience of three months in the specific tasks at the work place. The CIEMAT's Virtual Classroom (Aula Virtual del Ciemat) developed a training course to get this recognition, and was delivered for the first time in Spain during 31st March to 13th June of 2008 in the "Radioactive facilities" area. The methodology selected, "blended learning", is a combination of both, FTF and distance learning.

Just one year after, the course was extended to cover the "nuclear facilities" modality, which was taught for the first time from 13th October 2009 to 29th February 2010
In both specialized courses, the theoretical conferences and some of the practical sessions are virtualised into a standard multimedia format, placed on a Virtual Learning Environment, available through Internet. Experts in matter are in charge of the student track. The presence part consists of two days practical sessions in different facilities, industrial and hospital facilities for the radioactive area, and in a nuclear power plant for the nuclear area, and a final exam is also carried out the third FTF day.

Ten years have passed from the first edition of the course, with eleven editions for the radioactive area and three for the nuclear one, delivered with a great demand. Now it is time to look back and to make a reflexion about the main aspects of this course, and making minor adaptation to the transposition to the national law of the Council Directive 2013/59/EURATOM.

New editions of both modalities have been programmed from:
- 11st March to 28th June 2019 - Radiation Protection Technicians in Nuclear Facilities.
- 9th September to 20th December 2019 Radiation Protection Technicians in Radioactive Facilities

At this moment the Ciemat Virtual Classroom is working on the updating of the contents, doing a revision of the methodologies and adapting the online materials to the new standards of reproduction used by the small portable devices with connection to the Internet.
At the presentation, will be exposed the results of this period through statistics of the main aspects of this training activities, as well as the new actions taken for the new editions of the course.

## Strengthening Knowledge and Skills in Radiotherapy Quality and Safety in Latvia

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**Abstract**

Training on radiation protection and safety in Latvia is organized according to Cabinet Regulation No. 752 of 22 December 2015, which states the requirements of training in radiation safety issues within the scope of a course programme developed by an educational establishment not less than once every five years for employees working with ionizing radiation, both in medical and non-medical areas. This training is coordinated by the Radiation Safety Centre and the professional association of the relevant sector. Currently, the course programme in the medical area covers only radiation safety at low doses in diagnostic imaging. The University of Latvia provides the radiation protection and safety course module with predominantly theoretical training within undergraduate and graduate studies for radiation therapists (RTTs) and radiographers. But there is no specific training on radiation safety issues for practicing RTTs in Latvia: every five years, they have to undergo training on radiation safety issues for radiographers working with low radiation doses only. Thus, RTTs should also be trained on radiation safety issues at high radiation doses and dose rates. The IAEA TC project LAT0003 "Strengthening Knowledge and Skills in Radiotherapy Quality and Safety in Latvia" is to train the trainers, upgrade existing equipment and to introduce new visual aids for training in radiation safety, thus improving knowledge and practical skills for RTTs.

## Radiation Protection Awareness Challenges at CERN

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**Abstract**

At CERN (European Organization for Nuclear Research), physicists and engineers are probing the fundamental structure of the universe. They use the world's largest and most complex scientific instruments - particle accelerators and detectors - to study the basic constituents of matter: the fundamental particles.
CERN's safety policy is based on raising workers' awareness of the multiple hazards they might face in a working environment as complex as that of CERN.
The diversity and professional wealth of the organisation's population motivate us to develop and improve our safety courses, especially the radiation protection awareness. Over the last 20 years, more than 40 000 person have been trained. Between 2019 and 220 major challenges are ahead with the second long shutdown (LS2) where CERN facilities will be stopped for the big work site
With the aim of continually improving quality and to meet the requirements of the demanding long technical shutdowns, CERN has modified the radiation protection awareness approach and revised the methodology behind its design.
This presentation will trace the history allowing us to reach these objectives, gives an assessment of the current situation and outlines the challenges for the Second Long shutdown (LS2) of CERNs facilities and for the upcoming years.

# Radiation protection education and training in Croatia – current situation and needs

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**Abstract**

Radiation protection education in Croatia is organized in two branches – education of radiation protection professionals and education of radiation protection officers and radiation workers. Technical Support Organizations (TSOs), employing radiation protection professionals, and national regulatory body share more than 60 years long tradition of implementing the national radiation protection framework in Croatia.

TSOs were, and still are, providing QC of ionising radiation sources, including those in medicine, dentistry, veterinary, industry and science; although, after implementation of the EURATOM BSS [1] in national legislation, medical physicists, under supervision of a MPE, could also perform QC of radiation sources within their hospital. TSOs perform personal dosimetry, environmental dosimetry, measurements and assessments in radioecology and many other services in the field of radiation protection. Professionals employed in three licensed TSOs have MSc or PhD in physics (a majority of them), some in chemistry, biotechnology and other fields. In Croatia, no official national radiation protection education for Radiation protection experts (RPE) or other professionals has been established yet, although in the Ordinance on radiation protection experts [2], a presumption for formal education is set. The authors suggest that curriculum for education and a practical training for RPEs and radiation protection officers (RPOs) should be based on recommendations and guidance from the ENETRAP III project [3] and to achieve aforementioned, an assistance of experts from other EU member countries with long RP education tradition is essential.

Currently, most of the professionals employed in TSOs build their competences graduating PhD courses in Medical physics, attending available courses provided by the EU/EURATOM, IAEA or professional/scientific associations. Two TSOs are part of two major national public scientific institutes and their specialists are involved and closely collaborate in scientific research and national and international research projects. The scientific community in Croatia have recognized complexity in the field of radiation science and radiation protection forming interdisciplinary branch Radiation science in field of Interdisciplinary natural sciences. Most of the training in the field of radiation protection is on the job provided by more experienced colleagues. In order to maintain the licence, TSOs must have accreditation in compliance with ISO/IEC 17025 standard for dosimetry measurements, ambient dose equivalent rate measurements, high resolution gamma spectrometry, etc., as well they must employ radiation protection experts. The ISO/IEC 17025 standard requires continuous professional education of the TSO's staff, both institutional and work based.

The scheme for recognizing RPEs in Croatia has been established in 2018 [2], but details on required competences and acceptable evidence were not clearly defined neither in the quantitative nor the qualitative sense. The second important issue is that competence of assessors in the RPE recognizing process is not defined, leading to situations where experts are judged by non-experts. At the moment, there are 11 recognised RPEs in Croatia.

Radiation protection education for RPOS and radiation workers is performed via e-learning system since 2014. A candidate must read and learn prepared documents and presentations and pass the on-line exam. There is no opportunity for the candidate to ask questions or have additional explanations. There is no graded approach within the same practice, medical doctors, nurses and cleaning service members in nuclear medicine are required to pass the same exam. The authors propose a modular approach, on-line phase with appropriate obligatory literature to be studied by the candidate and on site phase where a RPE is involved in training adjusted for a certain practice or candidates' needs.

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# Radiation Protection Workers' Continuing Training Program at CNE Cernavoda NPP

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**Abstract**

The goals of successful training and qualification programs are to produce and maintain well-qualified, competent personnel to safely and reliably operate, maintain, and improve the performance of nuclear power stations. Continuing training is used to refresh and improve the application of knowledge and job-related skills to meet management's expectations for individual and station performance.

Radiation protection training program is part of plant personnel training process.
Station personnel have radiation protection qualification according to job requirements; there are three RP qualification levels, with different skills and responsibilities.
Each radiation protection qualification level requires a refresh course at 5 years.

Re-qualification training includes a review of initial worker training and a review of new regulations, guidance documents and work protocols relevant to the concept of optimization.

Practical abilities of workers with higher RP qualification (YELLOW and GREEN) are tested twice between refreshing courses (after every 18 months): accessing contaminated areas; selecting proper equipment; using RP field instruments; using Radiation Work Permit etc.

RP training program also includes RP continuing training by using brief materials (RP fundamentals flyers, RP Info Bulletins, RP Subject of the month, "Info Supervisor").
These kinds of materials are updated and disseminated into organization and they address the most actual RP issues identified by abnormal conditions reports, trend analysis of performance indicators, etc.

## E&T requirements for the recognition of RPEs and MPEs: The Greek experience.

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**Abstract**

The roles and responsibilities of the Radiation Protection Experts (RPEs) and the Medical Physics Experts (MPEs) are clearly established in the European Directive 2013/59/Euratom which has been recently transposed to the Greek legislation with the Presidential Decree (No 101/2018). Moreover, within the national framework provisions are foreseen for the elaboration of certain legislative documents to set the required qualifications and mechanisms for their recognition.
More specifically, a Ministerial Order will set the criteria for the recognition of the RPEs and MPEs with specific E&T requirements (postgraduate studies, non-formal education, experience, etc.) These E&T requirements will be in line with the RPEs and MPEs respective roles and responsibilities as well as with the types of practices they are involved in. The recognition will be valid for a certain period of time after which a renewal will be needed. The main criteria for this renewal will be directly related to the non-formal training the experts have received in the area of their expertise.

Additionally, the process, the related procedures as well as the committees responsible to evaluate the submitted applications for the experts' recognition will be defined in a regulatory body's decision.

# Does radiation exposure at the workplace affects worker's happiness and satisfaction? A European perspective

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**Abstract**

Workplace conditions regarding ionizing radiation may influence workers' happiness and satisfaction. The present work is based on an Erasmus strategic partnership (2017-2019) comprehending 12 expert organizations from 6 European countries (Italy, Bulgaria, Cyprus, Greece, Portugal and Spain), which carried out a survey for assessing workplace Health, Wellbeing and Quality of work life.
According to the World Health Organization (WHO) radon is the most important cause to lung cancer, following smoking. Radon is present in the ground and penetrate buildings through the foundations, cracks in the walls, the hydraulic drainage systems and building materials. At the workplace level, several industries are responsible for the occupational exposure to ionizing radiation, namely, medical establishments, research and educational institutions, plants, nuclear fuel facilities and mines. There is a strong need to undertake mitigation measures to provide safety and security conditions in the workplace, by giving access to adequate protection equipment and training initiatives targeted at teaching workers to understand and deal with risks of exposure and safety measures for managing the risks.
Actually, workplace environmental conditions are becoming more and more important, because these conditions influence worker's health and wellbeing, what ultimately effect worker's happiness and job satisfaction. Happy workers are six times more energized, twice as productive, take only 1/10$^{th}$ of the sick-leaves, and intend to stay twice as long in the organizations as compared to unhappy workers.
Considering the organizations' radon prevention for the whole sample 19% said that their organizations do not perform radon prevention, being the most concerned firms the ones form Bulgaria and Portugal. For 74% of the respondents, workplaces denote an appropriate ventilation level, being the most representative the ones from Portugal and Spain. 73% of respondents consider working under an adequate workplace temperature as well as 66% of them who feel to work under proper humidity conditions, being also Portuguese and Spanish workers the ones who are more satisfied with these conditions. For 66% of the sample, respondents said that they have enough safety equipment and regular maintenance (with particular importance for the Portuguese and Italian). 15% of the sample stated that they are exposed to extreme heat or cold at the workplace, with particular incidence for the Greek and Cypriot workers.
Results from an OLS regression applied to 2 groups of respondents, a group of satisfied workers and another with unsatisfied employees denote that a workplace with an adequate ventilation system affects positively on the workers happiness for the ones who are satisfied with their working conditions. On the opposite, for the same typology of workers, the inexistence of preventive measures concerning the presence of radon in the workplace and the exposure to extreme temperatures influences negatively on the happiness of employees. For the unsatisfied workers' group, the workplace temperature and the existence of safety equipment impact in a positive manner on the workers' feeling of happiness. Notwithstanding, the high levels of humidity at the workplace as well as the lack of safety training concerning exposure to radon affect in a negative way the happiness of workers.

## System for educating Radiation Protection in the Czech Republic

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**Abstract**

Radiation Protection as an interdisciplinary subject involving physics, engineering, interaction of ionizing radiation with matter, last but not least modelling of radiation transport by the Monte Carlo method and medicine has become increasingly important in connection with the development and implementation of new sophisticated methods and technologies utilizing ionising radiation in nuclear energy, application of ionizing radiation in industry and science and medicine.

In accordance with new legislation reflecting the relevant EC directives, the Czech Technical University has innovated the master degree programmes related to the use of ionizing radiation. In the Czech Republic nine faculties, Czech universities, associated with CENEN (Czech Nuclear Education Network) are involved in nuclear education. An important role is played in this association by the West Bohemian University in Plzen, in a place where a significant part of the Czech nuclear industry is concentrated.
CENEN works closely with European partners in the ENEN (European Nuclear Education Network), an organization that aims to harmonize access to nuclear education in Europe, to integrate a European education system in the field of nuclear safety and radiation protection, and to achieve better cooperation between academic resources and national and international capacities. The general objectives of the ENEN Association are defined as follows:

- to develop a more harmonized approach for education in the nuclear sciences and nuclear engineering in Europe;
- to integrate European education and training in nuclear safety and radiation protection; and
- to achieve better co-operation and sharing of academic resources and capabilities at the national and international level.

The CENEN objectives are aligned with the ENEN objectives.

Special attention is paid to radiation protection during teaching of medical physics.
Of particular importance is radiation protection in medicine, in the teaching of Medical physics is that it is the largest controllable radiation source in the world. Medical uses of radiation constitute more than 99 % on radiation exposure to the world´s population from man-made sources. Two Universities in the Czech Republic has prepared a master degree programmes in medical physics, the Czech Technical University in Prague and Masaryk University in Brno. These programs are organized in cooperation with partner institutions, including departments of radiotherapy, nuclear medicine and radio diagnostics in hospitals. This project is important with respect to general problems of health care treated by the new legislation, and is directly linked to the future fields of interest of the national professional organization of medical physicists, which plays an important role in the preparation of teaching both in the Master's program and in the further specialization and postgraduate education of radiological physicists. Teaching materials on radiation protection of both patients and staff, e.g. Radiation Dose Management in Computed Tomography or Safety and Quality in Radiotherapy, https://www.iaea.org/resources/rpop/resources/online-training, prepared by the IAEA, are used in teaching.

Radiation protection teaching is not only in Master's and Doctoral Studies, but the university organizes specialized courses to deepen the education. Courses are mainly organized for industry, research and government officials. Such a typical course organized at Faculty of Nuclear Sciences and Physical Engineering, TU in Prague is two-year, four-semester course, each semester contains several weeks of teaching. In nuclear-related courses, the subject of radiation protection along with subjects such as nuclear physics, ionizing radiation interactions with matter, dosimetry, detectors, modeling of Monte Carlo radiation transport, and legislation are a very important part of such a course.

According to the valid legislation in the Czech Republic, a worker wishing to acquire special professional competence for activities of particular significance from the point of view of radiation protection must have a special course containing a summary of the most important knowledge of the field and the corresponding legislation. Radiation protection is an integral part of these courses.
The faculty also organizes courses for students of foreign universities. Within the framework of the CHERNE cooperation (CHERNE is an open European academic network for **C**ooperation in **H**igher **E**ducation on **R**adiological and **N**uclear **E**ngineering and Radiation Protection, https://www.upv.es/cherne/) within the framework of the ERASMUS program and the follow-up projects, the two weeks courses are held every year at the partner universities.

Radiation protection belongs to the program of these courses Radiation protection is the subject of the ATHENS courses organized by ATHENS Network and are held at the faculty each year. ATHENS Network (Advanced Technology Higher Education Network /Socrates) is made up of 14 European technological universities and nine Paris Tech Graduate Schools of Engineering, http://athensnetwork.eu/.

# Training on software for shielding and organ dose calculations in the X-ray diagnostic

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**Abstract**

The principle of optimization of radiation protection is defined as the source-related process to keep the magnitude of individual doses, the number of people exposed, and the likelihood of potential exposure as low as reasonably achievable below the appropriate dose constraints. To decrease radiation exposure risks, any medical radiation exposure must be justified and the examinations which use ionizing radiation must be optimized.
Diagnostic x-ray procedures cause the major contribution to man's exposure to ionizing radiation from artificial sources. The purpose of radiation shielding is to limit radiation exposures to employees and members of the public, to an acceptable level and to ensure the doses to the patients and to their organs as low as possible without reducing the benefit of the necessary diagnostic examination. Medical exposure is the only category in which large reductions in average dose are possible, and it is therefore highly desirable to reduce applications of medical radiation.
The determination of the thickness of primary and secondary barriers is based on National Council on Radiation Protection and Measurements recommendations. In this work both Report n. 49 (NCRP 49, 1976) and the Report n. 147 (NCRP Report 147, 2004) have been used as a standard guideline for shielding of radiographic rooms while the ICRP n. 34 (ICRP34 1982) has been used as protection patient procedures.
In order to obtain accurate shielding thicknesses in diagnostic x-ray facilities and the doses to organs or to the total body of the patient during a diagnostic examination, a homemade 2D software, based on the Java language, has been developed. This software allows to load a planimetry (as a jpeg file) and to draw and the relevant structural items (walls, windows, doors, apertures), representing the radiological room and the surrounding ones. The radioactive sources can also be located and their main physical parameters set. The computation is in real time performed following the mouse position over the planimetry image.
The program computes the shielding barrier values by using different materials, different dose constraints for the people and for workers respectively as well as different factors relative to the radioprotection parameters and the organ doses of the patient for eight most representative organs relatively to the principal diagnostic examinations.
The software can be a useful tool for the radioprotectionists, qualified expert and healthy physics expert to obtain a good optimization radiation protection training. The importance of delivering effective radiation protection education and training to workers and other stakeholder
The first tests on the computed results are as expected and presented. Further tests to check more combinations of barriers, sources and computing methodology are planned.

# The Programs of Training in Radiation Protection and the Safe Use of Radiation Sources in China

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**Abstract**

The programs of training in radiation protection and the safe use of radiation sources in China have been implemented since 2007. There are eight national training centers in China, three centers for northern China, two for eastern China, each one for northwestern, southwestern and southern China respectively; besides, there is one provincial training center in each province. The training course has three parts. One is Regulatory framework for radiation protection and the safe use of radiation sources. Second part is the fundamental of ionization radiation protection and safety. Third part is for industrial application or medical application. There are three levels of training courses for categories of persons engaged in different practices. Basic level is for workers or beginner. Secondary level is for qualified operators, radiation protection officers or regulators. Advanced level is for qualified experts or regulators. The duration of training courses is 40 hours for basic level, 72 hours for secondary level and 160 hours for advanced level respectively. The duration of retraining courses is 25 hours. Persons will obtain a certificate of competency issued by National Nuclear Safety Administration of China, if they pass the training examination. All qualified staff should have the certificate, and retrain very two year. Based on the statistics in 2016, there were 126991 radioactive sources and 151,054 irradiation installation installations used in China. The average radiological accidents in China was about 6.2 accidents for 10,000 radiation sources (radioactive sources or irradiation installations) per year from 1988 to 1998, decreased to about 2 accidents for 10, 000 radiation sources per year from 2004 to 2016 and significantly decreased to about 0.72 accidents for 10,000 radiation sources per year from 2012 to 2016. It implied that regulation on the safe use of radiation sources was very effective, and the programs of training in radiation protection and the safe use of radiation sources had a significant contributory in China.

## EUTERP Foundation Activities

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**Abstract**

The European Training and Education in Radiation Protection Foundation (EUTERP), was set up as a legal entity nearly 9 years ago, previously being an initiative of the European Commission. The objectives of the Foundation are:

- to encourage and support harmonization of education and training requirements for Radiation Protection Experts (RPEs), Radiation Protection Officers (RPOs) and radiation workers (RW), facilitating the mobility of these professionals;
- to promote the integration of radiation protection education and training systems into general vocational training and education infrastructures; and
- to act as a central focus for the sharing of information on training events, standards, developments, and all other related information.

EUTERP's vision is to be recognized by stakeholders as a focus for identifying and sharing good practice in radiation protection training and for accessing information on opportunities and available resources. Accessibility is facilitated through:

- the website www.euterp.eu;
- the publication of newsletters;
- the organization of workshops - the latest being "Optimizing Radiation Protection Training" in Malta, April 2019.

Through being an active partner in the, now completed, ENETRAP III 7FP project together with several Associates, EUTERP contributed to the formulation of guidance on the competences of, and the underpinning education and training for, the RPE and RPO, reflecting the requirements of Council Directive 2013/59/EURATOM. In close collaboration with the association of the Heads of European Radiological protection Competent Authorities (HERCA), EUTERP continues to strive towards a common understanding and approach in education and training of RPEs and RPOs whilst respecting the differences that exist in the different European Member States.

Another important outcome of the ENETRAP projects is that EUTERP has developed a comprehensive database for courses, and opportunities for posts and studentships, in radiation protection throughout Europe. The database, while being open access to everyone, is currently limited to information provided by EUTERP Associates. EUTERP is currently developing a strategy whereby other organizations may also become involved. Populating this database and maintaining it while developing user strategies will be a major focus for EUTERP in the implementation of its vision.

To facilitate information exchange and understanding, particularly for the younger generation of professionals, EUTERP is currently developing a strategy for its use of social media. As part of this process, EUTERP is considering modifying its present logo to adapt it to modern media. A competition is being held to collect ideas.

EUTERP welcomes collaboration with other international organizations and already works with EFOMP and CERN, both of whom are Associates. EUTERP has observer status with HERCA and the European ALARA Network (EAN) and is developing future liaison with the Nuclear Energy Agency's Committee on Radiological Protection and Public Health (CRPPH), the International Radiation Protection Association (IRPA), the International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP).

## European Federation of Organisations for Medical Physics: the mission and the pillars to advance Medical Physics in Europe

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### Abstract

The European Federation of Organisations for Medical Physics (EFOMP) has as a mission the harmonisation and advancement of Medical Physics both in its professional and scientific expression throughout Europe as well as the systematic exchange of professional and scientific information, by the formulation of common policies, by proposing guidelines, by publishing protocols and by promoting education and training programmes. To support this mission 6 main activities will be strengthened in the next years.
The European Journal of Medical Physics – EJMP, one of the most respected publications in the field of Medical Physics, reached an Impact Factor of 2.24 in 2017 and dramatically increased the number of issues and the number of published papers. Being published by Elsevier on behalf of EFOMP and AIFM (Italy), EJMP is the official journal of the IAPM (Ireland), SFPM (France), CAMP (Czech Republic), HAMP (Greece) and lists among the supporting societies 28 National Member Organisations. The objective is to double the number of the societies for which EJMP is the official journal and to explore potential synergies with other European publications in the field of Medical Physics.

The EMP News, published quarterly, aim to draw attention to the activity of young medical physicists all over Europe, via presentation of their work but also attract advertisers from the world of industry via publication of technological innovations. EFOMP publications along with the EFOMP website and social media offer another opportunity to reach colleagues and the general public, to facilitate the exchange of knowledge and enhance the organisation's image.
The EFOMP Examination Board (EEB) has been established to facilitate the harmonization of Medical Physics education and training standards throughout Europe. The EEB introduced the European Diploma of Medical Physics and the European Attestation Certificate to those Medical Physicists that have reached the Medical Physics Expert level. The EEB examinations are designed to assess the knowledge, skills and competences requisite for the delivery of high standard Medical Physics services.

EFOMP's European School for Medical Physics Expert (ESMPE) has been established to promote education and training programmes for medical physicists in Europe. The ESMPE organises events specifically targeted towards Medical Physicists who are already Medical Physics Experts or would like to achieve MPE status. These events are open to all Medical Physicists and they are accredited by an independent body (the European Board of Accreditation for Medical Physics) to ensure that they are at the required educational level, i.e., Level 8 of the European Qualifications Framework. The attendance is limited to 80 places to guarantee the possibility of individual interaction between lectures and attendees. A distinctive trait of the school is to provide subsidized fees for participants coming from low/middle income European countries. EFOMP school material is accessible to the course participants via the EFOMP e-learning website platform.

The European Congress of Medical Physics (ECMP) hosted by EFOMP National Member Organisations (NMOs) connects Medical Physicists in Europe and beyond and bridges knowledge across specialities. The first congress was held in Athens in 2016, the second in Copenhagen in 2018 and involved world leading scientists and healthcare professionals. The success of this initiative will set the stage for the future development of a congress made by medical physicists and directed at medical physicists, working in the different subspecialties. The objective for this is to have the participation of more than one thousand medical physicists in Torino in 2020, which will make the ECMP the most attended international congress in Medical Physics in Europe.

The nature of the EFOMP as a federation of NMOs is a great asset for the organisation since it allows EFOMP to be recognized at an International level as the unique representative of all the existing European National Medical Physics Societies. The plan in the coming years is to have EFOMP - NMOs leadership meetings with all the 34 NMOs to discuss their needs, how EFOMP could be useful for them and identify the common strategies to increase the visibility, relevance and weight of EFOMP at the European level. At the same time, the possibility of creating some form of individual membership in the EFOMP has to be taken into consideration.

The EFOMP publications and communications, the examinations, the school, the congress and the closer contact between the EFOMP and the National Member Organisations boards will increase the role and the prestige of the medical physics profession in the medical world in Europe and therefore in each national member state.