



This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287.



EJP-CONCERT

European Joint Programme for the Integration of Radiation Protection Research

H2020 – 662287

D7.16 Final report on the coordination and collaboration on E&T policy and strategy in radiation protection related themes

Vocational training for experts foreseen in the new Euratom BSS directive

Lead Author: Tom Clarijs

Affiliation: SCK•CEN

With contributions from: Michèle Coeck

Reviewer(s): Vere Smyth and
CONCERT coordination team

Work package / Task	WP 7	T 7.4
Deliverable nature:	Report	
Dissemination level: (Confidentiality)	Public	
Contractual delivery date:	Month 60	
Actual delivery date:	Month 58	
Version:	1	
Total number of pages:	20	
Keywords:	BSS, vocational training, E&T	
Approved by the coordinator:	Month 58	
Submitted to EC by the coordinator:	Month 58	

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Abstract

This report focusses on the specific tasks related to coordination and collaboration on E&T policy and strategy (task 7.4) within WP7 (education and training). During this reporting period, CONCERT in general and WP7 tasks in particular were systematically mentioned at several E&T related meetings. In addition, a dedicated E&T session was organized at the fourth edition of the RPW event (held in Stockholm) and support was provided to a side meeting at the same conference, addressing the initiatives for the Young Generation.

Next, with respect to task 7.4.2 this deliverable also summarises the needs for vocational training for professionals in radiation protection as identified in the European Basic Safety Standard (BSS). It describes the current availability of E&T guidance and initiatives for these professionals. The training courses developed within CONCERT are investigated to be pooled into consistent professional learning pathways in line with the training plans of radiation protection organizations.

Gaps and remaining issues are stated as a need to translate research outcomes in concrete education and training programmes, and the lack of vocational E&T initiatives are identified for various professionals in radiation protection.

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LIST OF ABBREVIATIONS

ALLIANCE	(European) Radioecology Alliance
ANNETTE	Advanced Networking for Nuclear Education and Training and Transfer of Expertise
BSS	Council Directive 2013/59/Euratom (laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation)
CINCH	Cooperation in Education and Training in Nuclear Chemistry
CIRSE	Cardiovascular and Interventional Radiological Society of Europe
CORONA	Establishment of a Regional Centre of Competence for VVER Technology and Nuclear Applications
CONCERT	European Joint Programme for the Integration of Radiation Protection Research
CONFIDENCE	COping with uNcertainties For Improved modelling and DEcision making in Nuclear emergenCiEs
CPD	Continuous Professional Development
EANM	European Association of Nuclear Medicine
EC	European Commission
ECTS	European Credit Transfer System
ECVET	European Credit system for Vocational Education and Training
EFOMP	European Federation of Organisations for Medical Physicists
EFRS	European Federation of Radiographers Societies
EFTS	European Fission Training Schemes
EJP	European Joint Programme
ELINDER	The European Learning Initiatives for Nuclear Decommissioning and Environmental Remediation
ENEN	European Nuclear Engineering Network Training Schemes
ENETRAP	European Network on Education and Training in RAdiological Protection
ENGAGE	ENhancinG stAkeholder participation in the GovernancE of radiological risks for improved radiation protection and informed decision-making
EURADOS	European Radiation Dosimetry Group
EUTERP	European Training and Education in Radiation Protection Foundation
ESR	European Society of Radiology
ESTRO	European Society for Radiotherapy and Oncology
ESVS	European Society for Vascular Surgery
E&T	Education and Training
GENTLE	Graduate and Executive Nuclear Training and Lifelong Education
KSC	Knowledge, Skills and Competences
LDLensRad	Towards a full mechanistic understanding of low dose radiation induced cataracts
LEU-TRACK	The Role of Extracellular Vesicles in Modulating the Risk of Low Dose Radiation-induced Leukaemia
LO	Learning Outcome
MELODI	Multidisciplinary European Low Dose Initiative
MEDRAPET	Medical Radiation Protection Education and Training
MPE	Medical Physics Expert
NEPTUNO	The Nuclear European Platform of Training and University Organisations
NERIS	Nuclear and radiological Emergency management and Rehabilitation strategies Information
NUSHARE	Sharing Nuclear Safety Culture Competence
PETRUS	Programme for Education, Training and Research on Underground Storage
PODIUM	Personal Online Dosimetry Using computational Methods
SEPARATE	Systemic Effects of Partial-body Exposure to Low Radiation Doses
SHAMISEN-SINGS	Stakeholder involvement in generating science after nuclear emergencies
TERRITORIES	To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations
TRASNUSAFE	Project for training schemes on nuclear safety culture
VERIDIC	Validation and Estimation of Radiation skIn Dose in Interventional Cardiology

1 INTRODUCTION – Coordination and collaboration on E&T policy and strategy

Task 7.4 (Coordination and collaboration on E&T policy and strategy) within CONCERT WP7 (Education and training) focuses in subtask 7.4.1 on the coordination and collaboration on E&T matters in a broad context. It ensures the inclusion of the interests and requirements of E&T Working Groups of all radiation protection research platforms involved in the EJP (MELODI, ALLIANCE, NERIS and EURADOS, and medical radiation groups), in the planning and execution of the other tasks in this work package. In addition, an active programme of dialogue with other interest groups and stakeholders in order to take account of common policies, resources, and funding streams is set in place.

In subtask 7.4.2, vocational training for experts foreseen in the new Euratom BSS directive is investigated. To be consistent with evolving safety standards and the Directive 2013/59/Euratom (Basic Safety Standards) in particular, as well as the EU policy and strategy in E&T, training and retraining of staff concerned with radiation protection in organizations using or controlling the use of ionizing radiation needs to be set in place according to up to date standards and knowledge in the field. [1] In this subtask the training courses developed within CONCERT are investigated to be pooled into consistent professional learning pathways in line with the training plans of radiation protection organizations.

1.1 Specific tasks related to 4.2.1 carried out during the last year of the project

The initiative was taken to promote E&T at the ERPW2019 in Stockholm (14-18 October 2019). In dialogue with the conference organisers we managed to introduce E&T topics in the call for abstracts (for the first time in the series of the RPW events). A 1-hour plenary E&T session was programmed in the middle of the conference to allow attention to this topic without competition from other topic areas. In this session, time was provided for some scientific presentations highlighting recent E&T initiatives related to the CONCERT research agenda. One presentation was specifically selected to provide a historical overview of E&T support in the radiation protection research areas from the EURATOM projects and to address the concern for continuation of the E&T initiatives in the future, given the fact that the CONCERT project will end.

Another presentation provided a report from the 2019 EUTERP workshop addressing the needs and opportunities for E&T training of professionals in radiation protection. Reference was made to the regulatory requirements for E&T in radiation protection for various professionals, which is also discussed further in this document.

These last two presentations served as an input for the discussion with the audience, specifically targeting the researchers, the research platforms and the European Commission.

The programme of the plenary E&T session is provided below:

- Introduction of the plenary E&T session - Tom Clarijs
- Creation of video tutorials describing cytogenetic assays for dose exposure assessment - Cecile Herate
- Education and Preparedness for Radiation Emergency Medicine at Hiroshima University Graduate School of Health Sciences, Japan - Toshiya Nakamura
- Education and training to support radiation protection research: the contribution from EURATOM projects - Vere Smyth
- Optimization of training in radiation protection, report of the 8th EUTERP workshop - JE Stewart and Tom Clarijs
- Discussion

The topic of discussion was '*Where are we heading with E&T in the future for RP research*'.

A major concern was that, due to the ending of the CONCERT project, multiple training courses as well as international mobility of researchers could not be continued in the future because of lack of financial support. Opinions were asked from the RP research platforms, as well as the representative of the European Commission. It was clear that, although structural funding will be not available for a period, most research platforms endorsed explicitly the idea to attribute limited funding for mobility travel. According to the research platforms, it seemed also that the specific training courses organized so far in specific domains could continue to be organized in the future.

In order to keep an overview of the available funding for E&T support within the domains of radiation protection research (including the research platforms), and to optimize the effective use of the 5% funding that must go to E&T in EURATOM RTD programmes, the E&T actions should be preferentially coordinated by an umbrella structure such as the CONCERT E&T WG or the MELODI E&T WG. This would ensure a close collaboration between the radiation protection research platforms and avoid duplication of work.

Brief discussions were also started with the organisers of the next ERPW which will be organized from September 28 to October 2, 2020 in Estoril, Portugal, to include the topic on E&T in the conference programme.

On the last day of the conference, a Young Scientists meeting was initiated by the CONCERT E&T working group, together with the partners of the COST project proposal RAPKEYS, the board of [SWERAYS](#) (Swedish Radiation Research Association for Young Scientists) and the (remainder of) EURAYS (European Radiation Research Association for Young Scientists). The purpose was to discuss actions targeting the young generation of researchers in the domain of radiation protection. The meeting was attended by about 25 young enthusiastic scientists from different backgrounds.

Again, a brief overview was provided on E&T support from previous EURATOM RTD programmes, with a focus on the benefits for young scientists. Also, SWERAYS presented their organization and the history of EURAYS was briefly discussed. Networking ideas were proposed for early stage career scientists in radiation protection research, and as concrete action points it was concluded that (1) an effort will be made to gather a large pool of contacts interested in the potential actions for the young generation, (2) a proposal will be drafted of actions which will be sent to the European research platforms, including the aim to make connections to existing initiatives such as the IRPA Young Generation etc. With this, an attempt to revive the EURAYS platform was established.

2 NEEDS FOR VOCATIONAL TRAINING

To be consistent with evolving safety standards and the Directive 2013/59/Euratom (Basic Safety Standards - BSS) as well as the EU policy and strategy in E&T, training and retraining of staff concerned with radiation protection in organizations (including research organizations) using or controlling the use of ionizing radiation needs to be set in place according to up to date standards and knowledge in the field. In subtask 7.4.2* it was investigated whether the training courses developed within CONCERT could be pooled into learning pathways for organisations and professionals requiring specific competences in radiation protection. Since education and training in radiation protection is mainly driven by international recommendations translated to regulatory requirements in radiation

protection, the analysis will focus on these requirements and related European funded projects which enabled their implementation.

(*this activity deviates from the originally foreseen task 7.4.2 which was finally not performed by ENSTTI as foreseen.)

2.1 Categories of professionals working with ionising radiation according to 2013/59/Euratom

According to Chapter IV of the Council Directive 2013/59/Euratom (laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, EU BSS) the following career profiles must be properly educated, trained and informed:

- A. radiation protection experts (RPE)
- B. radiation protection officers (RPO)
- C. medical physics experts (MPE)
- D. practitioners in the field of medical exposure
- E. the individuals involved in the practical aspects of medical radiological procedures
- F. occupational health services
- G. dosimetry services
- H. exposed workers
- I. workers potentially exposed to orphan sources
- J. emergency workers

ANNEX I: Relevant articles of the Council Directive 2013/59/EURATOM summarizes the main requirements for radiation protection education, training and information.

General information about the defined tasks can be found on Chapter IX of the EU BSS, see Article 82 for the Radiation Protection Expert (RPE), Article 83 for the Medical Physic Expert (MPE) and Article 84 for the Radiation Protection Officer (RPO).

2.2 Learning pathways and training plans of radiation protection professionals

Due to the specific tasks and responsibilities of certain professionals in radiation protection, as set by the EU BSS, various projects have been set up over the recent years to meet the demand for guidance on a harmonized approach for E&T for these professionals. Most of these projects were organised in the framework of the Euratom Fission Training activities under the umbrella of the Euratom Fission Training Schemes (EFTS).

Specific guidance documents resulted from these projects, meeting the direct demands of various career profiles. Moreover, each of these guidance documents are in line with the format and terminology of the European Qualifications Framework for Lifelong Learning, including the ECVET and ECTS standards.

2.2.1 RPE and RPO: ENETRAP I, II and III projects

The ENETRAP projects promoted a common European radiation protection culture based on the harmonisation of E&T to enable the mobility of workers and students throughout the European countries. In this project series, some specific documents have been delivered about the career profiles

of RPEs and RPOs. This led to the introduction of the new definitions for RPE and RPO in the current EU BSS, and multiple guidance reports on

- The requirements and methodology for the recognition of RPEs, including mutual recognition
- Reference standards for RPE training, including a reference training scheme for RPE
- The implementation of the E&T requirements for RPE and RPO

All guidance documents from the ENETRAP projects can be found on the website of the EUTERP Foundation, which provides a sustainable platform for the availability and continuation of the work performed in the ENETRAP projects: www.euterp.eu.

Pilot training programmes were set up for specific training modules in the proposed reference training scheme, in collaboration with other projects and/or networks. For example, a specific training module in medical radiation protection was set up in collaboration with EFOMP (European Federation of Organisations for Medical Physicists), and a specific training module in geological disposal of radioactive waste was set up in collaboration with the PETRUS project (Programme for Education, Training and Research on Underground Storage).

2.2.2 MPE: MPE project and EUTEMPE-RX

The MPE project (Guidelines on Medical Physics Expert) drafted the requirements that a Medical Physicist should fulfil in order to be recognized as a Medical Physics Expert by the relevant Competent Authorities. This led to the publication of the European Commission Radiation Protection Report 174 “Guidelines on Medical Physics Expert”. [2] This document includes a qualification framework for the MPE, defined in EQF learning outcomes defined in knowledge, skills and competences (KSC). The guidance document RP174 states detailed requirements for initial and continuing training.

The objective of the EUTEMPE-RX project (EUropean Training and Education for Medical Physics Experts in Radiology) was to provide education and training so that medical physicists in diagnostic and interventional radiology can reach the highest level, namely EQF level 8. This would then give them all the knowledge skills and competences needed to work at the best healthcare for patients. Specific training courses were set up to meet these demands.

2.2.3 Medical professionals

The European Commission Radiation Protection Report 175 “Guidelines on radiation protection education and training of medical professionals in the European Union” describes core and specific learning outcomes in KSC for the medical professionals (i.e. the practitioners in the field of medical exposure as well as the individuals involved in the practical aspects of medical radiological procedures, as mentioned above in the categories under 2.1). This document was developed in the MEDRAPET project led by the European Society for Radiology, but with the input of and endorsement by the major European (medical) professional societies in the area (ESR, EFOMP, EFRS, EANM, ESTRO, CIRSE, EUTERP, ESVS), which should provide strong support for its future implementation in everyday practice.

The guidance document RP175 states detailed requirements for initial and continuing training.

2.2.4 The nuclear fuel cycle

Education and training related to various aspects in the nuclear fuel cycle is widely addressed in various E&T projects such as:

- NEPTUNO (academic education in nuclear engineering and associated fields)
- the ENEN project series (nuclear engineering)
- the CINCH project series (nuclear chemistry)
- the PETRUS project series (geological disposal of radioactive waste)
- ELINDER (nuclear decommissioning and environmental remediation)
- TRASNUSAFE (nuclear safety culture)
- NUSHARE (nuclear safety culture)
- the CORONA project series (VVER technology and nuclear applications)
- GENTLE (nuclear energy)
- ANNETTE (advanced networking between domains of nuclear fission technology including safety, security and safeguards, nuclear fusion, radioactive waste and disposal, radiation protection)
- ENEN+ (attract, retain and develop new nuclear talents beyond academic curricula in the domains of nuclear reactor engineering and safety, waste management and geological disposal, radiation protection and medical applications)

These projects do not target specifically profiles which are identified in the EU BSS, but radiation protection experts (RPE) and nuclear workers could benefit from these activities.

2.2.5 Other radiation protection professionals

No dedicated European E&T project addressed the implementation of the E&T requirements as set in the EU BSS for the following professionals in radiation protection:

- occupational health services
- dosimetry services
- exposed workers
- workers potentially exposed to orphan sources
- emergency workers

For some of these professional profiles, specific courses have been offered by the various platforms such as NERIS (mainly targeting emergency workers) and EURADOS (mainly targeting dosimetry services).

3 TRAINING COURSES DEVELOPED IN THE FRAMEWORK OF CONCERT

The following projects resulted from the CONCERT calls:

- CONFIDENCE
- LDLensRad
- TERRITORIES
- ENGAGE
- LEU-TRACK
- PODIUM
- SEPARATE
- VERIDIC
- SHAMISEN-SINGS

Currently, the E&T activities of these projects mainly concentrate on dissemination of the project results via presentations, workshops, round tables during various scientific meetings, and the involvement of students in the research.

The E&T activities of CONFIDENCE comprise guidance on the use of uncertainty information by decision makers at the various levels within the decision-making process, derivation and application of 'process' based models to predict radionuclide activity concentrations in foodstuffs, and building of capabilities, trust and confidence in radiation protection issues. These training courses are mainly aimed at radiation protection experts, but also students and young researchers in the domain.

TERRITORIES created an online blog and a website, where scientific presentations are offered to professionals in radiation protection, as well as an inventory of available training courses in this domain. Furthermore, the TERRITORIES website is directly linked to the Radioecology Exchange Education and Training Platform (E&T Platform), as one of the primary European platforms for knowledge exchange and information dissemination related to protecting humans and the environment from radiation. Rich scientific content is delivered through links to e-learning modules and web-based training courses, complementary to the blog. In addition to the E&T resources, 4 TERRITORIES workshops were organized as dissemination activities.

The E&T activities of PODIUM consist of dissemination actions to maximize the impact of the development of an online dosimetry application based on computer simulations. The objective is to stimulate the optimal application of the ALARA principle in workplace planning, as well as the education of workers.

The project SHAMISEN-SINGS organised various communication and outreach activities which even went beyond the scientific community with the main aim to enhance citizen participation in preparedness for and recovery from a radiation accident through novel tools.

With the exception of the CONFIDENCE and PODIUM projects, no E&T activities were specifically planned addressing professional profiles identified in the EU BSS.

4 TRAINING COURSES SUPPORTED BY CONCERT

The EJP-CONCERT project actioned an annual call for courses in the topics of interest of the participating radiation protection research platforms for the purpose of extending the expertise of the research community and attracting new students into the topic areas. These courses were not primarily concerned with practical operational radiation protection, but they were potentially of interest and benefit to radiation protection professionals in providing the background science that underpins the principles of radiation protection.

The list of training courses supported through the calls follows. The potential target audience of RP professionals is indicated by using the categories as mentioned in the EU BSS.

- A. radiation protection experts (RPE)
- B. radiation protection officers (RPO)
- C. medical physics experts (MPE)
- D. practitioners in the field of medical exposure
- E. the individuals involved in the practical aspects of medical radiological procedures
- F. occupational health services
- G. dosimetry services
- H. exposed workers
- I. workers potentially exposed to orphan sources
- J. emergency workers

Date	Topic and location of the training course	Potential target audience
18-29 April 2016	InterRad - Interdisciplinary Radiation Research BfS, Neuherberg, Germany	A, M, D, O
11-22 April 2016	Cellular effects of low doses and low dose rates with focus on molecular radiation carcinogenesis Stockholm University, Sweden	A, C, D, F
25 - 29 April 2016	Preparedness and response for nuclear and radiological emergencies. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F, G, J
27 April – 12 May 2016	Radiation-induced effects with particular emphasis on genetics, developmental biology, teratology, cognition as well as space-related health issues. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F
23 May – 3 June 2016	Modelling radiation effects from initial events: Learning modelling approaches and techniques in radiation biophysics and radiobiology research, from basic mechanisms to applications University of Pavia, Italy	A, C, D, F
6-10 June 2016	Emergency and recovery preparedness, and response NCRRP, Sofia, Bulgaria	A, D, E, F, G, J
20 June – 1 July 2016	Molecular Mechanisms of Radiation Carcinogenesis HMGU, Neuherberg, Germany	A, D, F
4 – 8 July 2016	Uncertainty analysis for low dose research Centre for Research in Environmental Epidemiology (CREAL) Barcelona Spain	A, F
8 - 19 August 2016	Summer School in Radiobiology. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, D, F
9 – 27 Jan 2017	Radiation Epidemiology and Dosimetry – How to Quantify Radiation Risk HMGU, Neuherberg, Germany	A, D, F, G

6 – 10 Feb 2017	Radiation Protection: Basics and Applications Forschungszentrum Jülich, Germany	A, F, G, J
6 – 17 Mar 2017	Assessment of long-term radiological risks from environmental releases: modelling and measurements TUD, Riso, Denmark	A, G
6 - 17 Mar 2017	Radiation-induced effects with particular emphasis on genetics, development, teratology, cognition, cancer, and space-related health issues. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F
20 – 24 Mar 2017	Preparedness and response for nuclear and radiological emergencies SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F, G, J
24 – 28 Apr 2017	Emergency and recovery preparedness, and response NCRP, Sofia, Bulgaria	A, D, E, F, G, J
24 Apr – 5 May 2017	Cellular effects of ionising radiation – introduction to radiation biology Stockholm University, Sweden	A, F, G
27 March – 7 April 2017	ADORE: Application of cytogenetic and EPR/OSL techniques for biological dosimetry and physical retrospective dosimetry BfS, Munich, Germany	A, G
22 May – 2 Jun 2017	Modelling radiation effects from initial events University of Pavia, Italy	A, C, D, F
6 – 16 June 2017	Assessing risk to humans and the environment NMBU, Oslo, Norway	A
19 – 23 June 2017	‘Late Phase’ Nuclear Accident Preparedness and Management RIR, Gomel, Belarus	A, F, G, J
19 - 23 June 2017	EURADOS-CONCERT School on uncertainty analysis processes for retrospective dosimetry and associated research IRSN, Paris, France	A, F, G
3 – 7 July 2017	Uncertainty analysis in low dose radiation epidemiology CREAL, Barcelona, Spain	A, F
16 – 25 Aug 2017	Summer School in Radiobiology. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, D, F
27 Nov – 8 Dec 2017	Molecular Mechanisms of Radiation Carcinogenesis. Helmholtz Center Munich Institute for Radiation Biology, Germany	A, D, F
5 – 9 Feb 2018	Emergency and recovery preparedness and response. National Center of Radiobiology and Radiation Protection, Bulgaria	A, D, E, F, G, J
19 – 23 Feb 2018	Radiation Protection: Basics and Applications. Forschungszentrum Jülich, Germany	A, F, G, J
5 – 16 Mar 2018	Assessment of long-term radiological risks from environmental releases: modelling and measurements. Technical University of Denmark	A, G
12 – 16 Mar 2018	EURADOS Training course on Application of Monte Carlo Methods for Dosimetry of Ionizing Radiation. Karlsruhe Institute of Technology, Germany	A, G
12 – 23 Mar 2018	Radiation-induced effects with particular emphasis on genetics, development, teratology, cognition, cancer as well as space-related health issues. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F
19 – 23 Mar 2018	Monitoring and dose assessment for internal exposures. National Center of Radiobiology and Radiation Protection, Bulgaria	A, F, G

16 – 20 Apr 2018	Preparedness and response for nuclear and radiological emergencies. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F, G, J
16 – 27 Apr 2018	InterRad - Interdisciplinary Radiation Research. Bundesamt für Strahlenschutz, Germany	A, F
23 Apr – 4 May 2018	Cellular effects of ionising radiation – introduction to radiation biology Acronym: CELOD, Stockholm University, Sweden	A, F, G
28 May – 8 Jun 2018	Modelling radiation effects from initial physical events. University of Pavia, Italy	A, C, D, F
11 – 29 Jun 2018	NORM (Naturally Occurring Radioactive Material) in work and natural environment: identification, exposure assessment and decision making process. Central Mining Institute, Katowice, Poland	A, G
25 Jun – 6 Jul 2018	Space Summer School (space radiation, medicine and life sciences). SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A
13 – 24 Aug 2018	Summer School in Radiobiology. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, D, F
21 Jan – 1 Feb 2019	Radiation epidemiology, dosimetry and radiation protection concepts of ICRP. Helmholtz Center, Munich Institute for Radiation Protection, Germany	A, D, F, G
11 - 22 Feb 2019	Radiation-induced effects with particular emphasis on genetics, development, teratology, cognition, cancer as well as space-related health issues. SCK•CEN (Belgian Nuclear Research Centre), Mol, Belgium	A, F
18 – 22 Feb 2019	Emergency and recovery preparedness and response. National Center of Radiobiology and Radiation Protection, Bulgaria	A, D, E, F, G, J
11 – 15 March 2019	Radiation Protection: Basics and Applications. Forschungszentrum Jülich, Germany	A, F, G, J
15 – 19 Apr 2019	EURADOS-CONCERT School on uncertainty in biological, physical, and internal dosimetry following a single exposure. Institut de radioprotection et de sûreté nucléaire (IRSN), France	A, F, G
29 April - 10 May 2019	Cellular effects of ionising radiation – introduction to radiation biology Acronym: CELOD, Stockholm University, Sweden	A, F, G
27 May - 7 June 2019	Modelling radiation effects from initial physical events. University of Pavia, Italy	A, C, D, F
23 Apr – 3 May 2019	Assessment of long-term radiological risks from environmental releases. Technical University of Denmark, Risø Campus, Denmark	A, G
19 May- 2 Jun 2019	Measurement techniques used in monitoring of naturally occurring radionuclides. Central Mining Institute, Katowice, Poland	A, G
24 Jun – 5 Jul 2019	ADORE - Application of cytogenetic and EPR/OSL techniques for biological dosimetry and physical retrospective dosimetry. Bundesamt für Strahlenschutz, Germany	A, G
12 – 23 August 2019	Summer School in Radiobiology. SCK•CEN (Belgian Nuclear Research Centre), Belgium	A, D, F
7– 17 January 2020	Radiation epidemiology, dosimetry and radiation protection concepts of ICRP. Helmholtz Center, Munich Institute for Radiation Protection, Germany	A, D, F, G
20 – 31 January 2020	InterRad – Interdisciplinary Radiation Research. Bundesamt für Strahlenschutz, Germany	A, F

24 – 28 February 2020	Emergency and recovery preparedness and response. National Center of Radiobiology and Radiation Protection, Bulgaria	A, D, E, F, G, J
15 – 29 March 2020	Monitoring strategies applied in NORM involving industries – evaluation of occupational exposure and environmental impact. Central Mining Institute, Katowice, Poland	A, G
16 – 27 March 2020	Radiation-induced effects with particular emphasis on genetics, development, teratology, cognition, cancer as well as space-related health issues. SCK•CEN (Belgian Nuclear Research Centre), Belgium	A, F
09 – 13 March 2020	Radiation Protection: Basics and Applications. Forschungszentrum Jülich, Germany	A, F, G, J
20 – 30 April 2020	Cellular effects of ionising radiation – introduction to radiation biology Acronym: CELOD, Stockholm University, Sweden	A, F, G
20 April – 1 May 2020	Assessment of long-term radiological risks from environmental releases. Technical University of Denmark, Risø Campus, Denmark	A, G
18 – 29 May 2020	Modelling radiation effects from initial physical events. University of Pavia, Italy	A, C, D, F

Some professional profiles identified in the EU BSS need a high level of initial training in radiation protection issues, and need to maintain their knowledge, skills and competences at all levels for the correct implementation of the tasks listed in the EU BSS.

For example: radiation protection experts (category A) and occupational health physicians (category F) need to keep their knowledge up-to-date with the latest insights in the various domains of radiation protection, such as radiobiology, dosimetry and emergency preparedness. This is why, often, these profiles are indicated as a potential target audience in various training courses supported by CONCERT.

5 GAPS AND REMAINING ISSUES

5.1 Knowledge transfer of research outcomes in education and training programmes

New insights in radiation protection issues can influence and change the practical implementation of the basic fundamentals of radiation protection, such as the justification of exposures, the optimisation according to the ALARA principle and the dose limitation and constraints.

Therefore, it is of paramount importance that the new findings in research are correctly communicated in terms of impact on the radiation protection system and its practical implementation. Although various professional profiles identified in the EU BSS need to keep their KSC up-to-date in various radiation protection fields, they should be able to practically implement the new insights in radiation protection research in their daily work. The majority of training courses supported by CONCERT are not specifically addressing this target audience, and the training content is not adapted to the training needs of these professionals. However, there is an added value in making the current CONCERT courses more widely available beyond the traditional CONCERT target community.

The majority of the training courses supported by CONCERT are aimed at students. Although these students can take one of the professional roles identified by the EU BSS in their future career, a solid learning pathway should be used for each of these roles. Where possible, the training courses supported by CONCERT could be more visibly embedded in the initial training programme of the professionals in radiation protection.

Dissemination activities in research projects can go further than the organisation of topical workshops and specialised articles and presentations, and could involve a more active approach to integrate new insights in the initial and continuing training programmes offered by higher educational institutes and vocational training providers. The initial and continuing training programmes can greatly benefit from the research performed in various radiation protection domains, and must be made more accessible to the professional profiles identified in the EU BSS.

This can be done by e.g. integrating basic refresher courses during research conferences; increasing the accessibility of academic training courses to professionals; providing online E&T packages ready-to-use; outreach activities to teachers in various radiation protection domains, actively involving the national and international professional organisations representing these profiles, etc.

5.2 Lack of vocational E&T initiatives for various professionals in radiation protection

The Euratom Work Programme NFRP7-2015 by the European Commission, under which CONCERT is carried out, envisaged that projects would address the need for research and innovation required to support the successful transposition and implementation of the revised European Basic Safety Standards (BSS). It was not the intention of CONCERT to act as a provider of vocational training for professionals as defined in the new Euratom BSS. Nevertheless, E&T initiatives on a vocational level are certainly needed to meet the requirements of the BSS. The ones listed above can already serve this goal [4]. In addition, dedicated courses for this target group are needed and radiation protection research platforms are ideally placed to feed these courses with the latest scientific findings.

Besides the existing European guidance on E&T for RPEs, RPOs, MPEs and medical professionals, no specific E&T guidance documents exist (yet) on the implementation of the E&T requirements as set in the EU BSS for the following professionals in radiation protection:

- occupational health services
- dosimetry services
- emergency workers

Specific training programmes and E&T guidance could be developed targeting these professional profiles, using the most recent findings in radiation protection research.

The learning pathways which are currently proposed for these professional profiles are not limited to a broad scientific basis delivered by academic education, but necessitate mainly vocational education and training initiatives.

5.3 The biggest group is not reached by current E&T initiatives: workers

Exposed workers and workers potentially exposed to sources of ionising radiation need to be informed and trained about the health risks, radiation protection procedures, precautions etc. which all have a scientific basis.

This information and training is provided in a very diverse way (in-house or outsourced, face-to-face or online,...), and potentially contains outdated information. New scientific insights should be incorporated in the basic information and training content, and this content could be updated on a regular basis for (continuous professional development) CPD purposes. Low-level training material should be made available from current and future projects in radiation protection, summarizing the newest scientific insights to make sure that the provided information is up-to-date with today's scientific insights.

6 REFERENCES

- [1] Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:013:0001:0073:EN:PDF>
- [2] European Commission Radiation Protection Report 174 “Guidelines on Medical Physics Expert”. <https://ec.europa.eu/energy/sites/ener/files/documents/174.pdf>
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7 ANNEX I: Relevant articles of the Council Directive 2013/59/EURATOM

Chapter IV “Requirements for radiation protection education, training and information”

Article 14

General responsibilities for the education, training and provision of information

1. Member States shall establish an adequate legislative and administrative framework ensuring the provision of appropriate radiation protection education, training and information to all individuals whose tasks require specific competences in radiation protection. The provision of training and information shall be repeated at appropriate intervals and documented.
2. Member States shall ensure that arrangements are made for the establishment of education, training and retraining to allow the recognition of radiation protection experts and medical physics experts, as well as occupational health services and dosimetry services, in relation to the type of practice.
3. Member States may make arrangements for the establishment of education, training and retraining to allow the recognition of radiation protection officers, if such recognition is provided for in national legislation.

Article 15

Training of exposed workers and information provided to them

1. Member States shall require the undertaking to inform exposed workers on:
 - (a) the radiation health risks involved in their work;
 - (b) the general radiation protection procedures and precautions to be taken;
 - (c) the radiation protection procedures and precautions connected with the operational and working conditions of both the practice in general and each type of workstation or work to which they may be assigned;
 - (d) the relevant parts of the emergency response plans and procedures;
 - (e) the importance of complying with the technical, medical and administrative requirements.

In the case of outside workers, their employer shall ensure that the information required in points (a), (b) and (e) is provided.

2. Member States shall require the undertaking or, in case of outside workers, the employer, to inform exposed workers on the importance of making an early declaration of pregnancy in view of the risks of exposure for the unborn child.
3. Member States shall require the undertaking or, in case of outside workers, the employer, to inform exposed workers on the importance of announcing the intention to breast-feed an infant in view of the risks of exposure for a breast-fed infant after intake of radionuclides or bodily contamination.

4. Member States shall require that the undertaking or, in case of outside workers, the employer, provides appropriate radiation protection training and information programmes for exposed workers.

5. In addition to the information and training in the field of radiation protection as specified in paragraphs 1, 2, 3 and 4, Member States shall require that the undertaking responsible for high-activity sealed sources shall ensure that such training includes specific requirements for the safe management and control of high-activity sealed sources with a view to preparing the relevant workers adequately for any events affecting the radiation protection. The information and training shall place particular emphasis on the necessary safety requirements and shall contain specific information on the possible consequences of the loss of adequate control of high-activity sealed sources.

Article 16

Information and training of workers potentially exposed to orphan sources

1. Member States shall ensure that the management of installations where orphan sources are most likely to be found or processed, including large metal scrap yards and major metal scrap recycling installations, and in significant nodal transit points, are informed of the possibility that they may be confronted with a source.

2. Member States shall encourage the management of installations referred to in paragraph 1 to ensure that where workers in their installation may be confronted with a source, they are:

- (a) advised and trained in the visual detection of sources and their containers;
- (b) informed of basic facts about ionising radiation and its effects;
- (c) informed of and trained in the actions to be taken on site in the event of the detection or suspected detection of a source.

Article 17

Prior information and training for emergency workers

1. Member States shall ensure that emergency workers who are identified in an emergency response plan or management system are given adequate and regularly updated information on the health risks their intervention might involve and on the precautionary measures to be taken in such an event. This information shall take into account the range of potential emergencies and the type of intervention.

2. As soon as an emergency occurs, the information referred to in paragraph 1 shall be supplemented appropriately, having regard to the specific circumstances.

3. Member States shall ensure that the undertaking or the organisation responsible for the protection of emergency workers provides to emergency workers referred to in paragraph 1 appropriate training as provided for in the emergency management system set out in Article 97. Where appropriate, this training shall include practical exercises.

4. Member States shall ensure that, in addition to the emergency response training referred to in paragraph 3, the undertaking or the organisation responsible for the protection of emergency workers provides these workers with appropriate radiation protection training and information.

*Article 18***Education, information and training in the field of medical exposure**

1. Member States shall ensure that practitioners and the individuals involved in the practical aspects of medical radiological procedures have adequate education, information and theoretical and practical training for the purpose of medical radiological practices, as well as relevant competence in radiation protection.

For this purpose Member States shall ensure that appropriate curricula are established and shall recognise the corresponding diplomas, certificates or formal qualifications.

2. Individuals undergoing relevant training programmes may participate in practical aspects of medical radiological procedures as set out in Article 57(2).

3. Member States shall ensure that continuing education and training after qualification is provided and, in the special case of the clinical use of new techniques, training is provided on these techniques and the relevant radiation protection requirements.

4. Member States shall encourage the introduction of a course on radiation protection in the basic curriculum of medical and dental schools.