ETRAP 2009

ETRAP 2009

Transactions

8 - 12 November 2009 - Lisbon Portugal

SCK•CEN
STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

IAEA
International Atomic Energy Agency
Atoms For Peace

AEN NEA

European Nuclear Society
Rue Belliard 65
1040 Brussels, Belgium
Phone + 32 2 505 30 54
Fax +32 2 502 39 02
E-mail ens@euronuclear.org
Internet www.euronuclear.org

ISBN 978-92-95064-08-9

These transactions contain all contributions submitted by 6 November 2009.

SETTING THE SCENE

EDUCATION AND TRAINING REQUIREMENTS IN THE REVISED EUROPEAN BASIC SAFETY STANDARDS DIRECTIVE

STEFAN MUNDIGL
European Commission DG TREN - H 4 Radiation Protection
Office EUFO 04/4154
L-2920 Luxembourg)

ABSTRACT

The European Commission is currently developing a modified European Basic Safety Standards Directive covering two major objectives: the consolidation of existing European Radiation Protection legislation, and the revision of the European Basic Safety Standards. The consolidation will merge the following five Directives into one single Directive: the Basic Safety Standards Directive, the Medical Exposures Directive, the Public Information Directive, the Outside Workers Directive, and the Directive on the Control of high-activity sealed radioactive sources and orphan sources.

The revision of the European Basic Safety Standards will take account of the latest recommendations by the International Commission on Radiological Protection (ICRP) and shall improve clarity of the requirements where appropriate. It is planned to introduce more binding requirements on natural radiation sources, on criteria for clearance, and on the cooperation between Member States for emergency planning and response, as well as a graded approach for regulatory control. One additional goal is to achieve greater harmonisation between the European BSS and the international BSS.

Following a recommendation from the Article 31 Group of Experts, the current draft of the modified BSS will highlight the importance of education and training by dedicating a specific title to radiation protection education, training and information. This title will include a general requirement on the Member States to ensure the establishment of an adequate legislative and administrative framework for providing appropriate radiation protection education, training and information. In addition, there will be specific requirements on training in the medical field, on information and training of workers in general, of workers potentially exposed to orphan sources, and to emergency workers.

The revised BSS directive will include requirements on the competence of a radiation protection expert (RPE) and of a radiation protection officer (RPO). The concept of a radiation protection expert will replace the current concept of a Qualified Expert (QE) which has been interpreted differently within Europe. These new requirements together with clearer definitions of the concepts RPE and RPO shall support harmonisation in Europe.

1. Legal basis

All competencies with regard to nuclear energy and radiation protection in the European Community are laid down in the Euratom Treaty (1957). Chapter III *Health and Safety* contains provisions which are directly applicable as primary legislation and offers the legal framework for the establishment of European Basic Safety Standards for the health protection of the general public and workers against the dangers arising from ionising radiation. The first basic safety standards date back to 1959, the latest version Council Directive 96/29/Euratom [1] was published in 1996. This principle piece of legislation has

been supplemented by additional binding instruments as well as by non-binding Commission Recommendations and Communications. According to Article 31 of the Euratom Treaty, these basic safety standards shall be worked out by the Commission after is has obtained the opinion of a group of public health experts, called Article 31 Group of Experts.

2. Revision of the Euratom Basic Safety Standards

The European Commission started a process to revise the existing European Basic Safety Standards Directive. At the same time, the Commission undertakes the simplification of its *acquis* of Community legislation by the codification of related acts or by recasting these. The development of modified basic safety standards will therefore comprise the revision of Directive 96/29/Euratom and at the same time the consolidation of existing European Radiation Protection legislation merging the following five Directives into one:

- the Basic Safety Standards Directive (96/29/Euratom) [1],
- the Medical Exposures Directive (97/43/Euratom) [2],
- the Public Information Directive (89/618/Euratom) [3],
- the Outside Workers Directive (90/641/Euratom) [4], and
- the Directive on the Control of high-activity sealed radioactive sources and orphan sources (HASS Directive 2003/122/Euratom) [5].

In addition, it is planned to cover the Commission Recommendation on the protection of the public against indoor radon exposure (90/143/Euratom) [6]. This consolidation will promote the coherence of definitions and requirements in all Directives and the association of specific and general requirements and should lead to a more effective legislation.

The revision of the EURATOM Basic Safety Standards will take account of the latest recommendations by the International Commission on Radiological Protection (ICRP), ICRP Publication 103 [7]. The principles of protection according to ICRP stay very much the same, and will therefore not necessarily require major changes in regulatory requirements, they offer, however, a much more coherent and understandable framework for radiation protection, introducing the concepts of planned, existing and emergency exposure situations, and highlighting the role of optimisation below suitable constraints and allowing for reference levels.

Further to accommodating the new philosophy of ICRP Publication 103, the new Basic Safety Standards will introduce more binding requirements on natural radiation sources, on criteria for exemption and clearance, and on the cooperation between Member States for emergency planning and response. The previsions for regulatory control of planned exposure situations foresee a graded approach commensurate to the magnitude and likelihood of exposures from a practice, and commensurate to the extent by which regulatory control may have an impact on reducing exposures or enhancing safety. Finally, the new BSS shall take account of recent scientific developments, such as the availability of new data on cataracts, and epidemiological findings on radon in dwellings.

In parallel to the revision of the European BSS, the International Atomic Energy Agency together with many other international organisations undertakes the revision of the *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources* [8]. One objective in both revision processes is to achieve a greater harmonisation between the European BSS and the International BSS

The structure of the new Basic Safety Standards Directive was thoroughly revised, firstly to accommodate the incorporation of the other Directives as part of the recast process and secondly, to allow for the modifications proposed by ICRP. The overall structure of the new recast Directive is given in Table 1.

Preamble	
Title I	Subject matter and Scope
Title II	Definitions
Title III	System of Protection
Title IV	Responsibilities for regulatory control
Title V	Requirements for Radiation Protection Education, Training and Information
Title VI	Justification and Regulatory control of planned exposure situations
Title VII	Protection of Workers, Apprentices and Students
Title VIII	Protection of Patients and other individuals submitted to medical exposure
Title IX	Protection of Members of the Public
Title X	Protection of the Environment
Title XI	Final provisions

Tab 1: Overall structure of the new Euratom Basic Safety Standards

Following a recommendation from the Article 31 Group of Experts, the current draft of the modified BSS will highlight the importance of education and training by dedicating a specific title to requirements for radiation protection education, training and information.

3. Education and training in the revision process

In the field of education and training, the 1996 Basic Safety Standards Directive established general requirements for training, experience and recognition of qualified experts. In spite of clarifications given in the Communication concerning the implementation of Directive 96/29, based on different historically grown education and training systems and different interpretation of the definition of the *Qualified Expert*, Member States transposed and implemented education and training arrangements differently. The experience gathered since 1996 with transposition in national legislation (due by May 2000) and with operational implementation demonstrated a need for enhanced harmonisation. In 2002, a survey carried out on behalf of the European Commission on the situation of the radiation protection experts in the Member States identified some difficulties in the implementation of the concept of the *Qualified expert*. In fact different definitions and status of qualified experts were established in Member States and structure and scope of training and education vary within Europe. In 2006, the Commission initiated and financed the European Radiation Protection Training and Education Platform (EUTERP) with the main objective to remove obstacles for the mobility of radiation protection experts within the European Union through harmonisation of criteria and qualifications for and mutual recognition of such experts. During two workshops in 2007 and 2008, EUTERP discussed definitions, core competences and qualifications of the radiation protection expert which shall replace the concept of the qualified expert, and of the additional concept of a radiation protection officer. Clearer definitions and well defined core competences shall facilitate defining the education and training needs of a radiation protection expert and a radiation protection officer.

4. Definition and role of experts and services

In a more general Title IV on *Responsibilities for regulatory control*, the new BSS will define which experts and services are required for the establishment of an efficient radiation protection system. The introduction of precise definitions and of core competences of these experts and services shall facilitate the implementation of these concepts and contribute to enhanced harmonisation within Europe. The new BSS requires from Member States that adequate arrangements are in place to allow for the recognition of

- occupational health services,
- dosimetry services,
- radiation protection experts, and
- medical physics experts.

The occupational health services are meant to perform medical surveillance of workers with regard to their exposure to ionizing radiation and their fitness for the tasks assigned to them. The dosimetry services will assist in the individual monitoring of exposed workers by assessing internal and external doses and by establishing the recorded dose in cooperation with the undertaking and the occupational health service.

The Radiation protection expert shall give competent radiation protection advice on matters related to occupational exposure and public exposure. Within the healthcare environment, the Medical Physics Expert shall act or give specialist advice on matters relating to radiation physics applied to medical exposure. The Medical Physics Expert will in particular be responsible for patient dosimetry.

In addition to the above mentioned experts and services, the new BSS introduces the radiation protection officer as an additional concept. The radiation protection officer shall be designated by an undertaking to oversee the implementation of the radiation protection arrangements of the undertaking. The radiation protection officer needs to be competent in radiation protection matters relevant for a given type of practice. The decision to require the establishment of a radiation protection officer is left with the Member State. Arrangements for the recognition of the radiation protection officer are not required by the BSS.

In order to better define the role of the experts, the new BSS includes detailed requirements specifying the core competences of the radiation protection expert, the medical physics expert, and the radiation protection officer.

5. Requirements on Radiation Protection Education, training and information

Following a recommendation from the Article 31 Group of Experts, the current draft of the modified BSS includes a specific Title V on *Requirements on Radiation Protection Education, training and information*. The objective is to highlight the importance of education and training and to consolidate education and training provisions from all radiation protection directives included in the recast.

Title V contains a requirement on Member States to ensure the establishment of an adequate legislative and administrative framework for providing appropriate radiation protection education, training and information to all individuals with specific competences in radiation protection. Education, training and retraining programmes shall allow for the recognition of radiation protection experts, medical physics experts, occupational health services, and dosimetry services. Title V maintains already existing (more detailed) requirements on information and training of

- exposed workers, apprentices and students,
- workers potentially exposed to orphan sources, and
- emergency workers.

From the Medical Directive [2], the requirements on education, information and training in the field of medical exposure remain. An newly introduced requirement concerns the establishment of mechanisms for the timely dissemination of information on lessons learned from significant events, such as accidents, incidents, near misses, as well as other information on new developments relevant to radiation protection in medical exposure.

6. Next steps

The Group of Experts under Article 31 of the EURATOM Treaty endeavours to finalise the text of the new Directive by Spring 2010. A lot of work remains but the prospects of achieving this goal are good. The text of the Experts and their Opinion will be the basis of a Commission proposal scheduled for 2010. Adoption of the Commission's proposal by the Council may take another few years and, taking into account the time granted for transposition into national legislation, it may not be before 2014 that the requirements become truly effective.

Meanwhile the Commission is closely following the revision of the international Basic Safety Standards. As a result of the decision making rules in the European Union, the EC has so far never formally co-sponsored the international Standards. It is now envisaged to do so, in the same way as for the document laying down the Safety Fundamentals [9]. The aim is to harmonise as far as possible the definitions and requirements, both reflecting the ICRP Recommendations. It should be emphasised, however, that the Euratom Basic Safety Standards and the international Standards will still look very different, on the one hand because the structures are not the same and neither is the amount of detail in existing legislation or requirements that needs to be incorporated; on the other hand because of the legally binding nature of the Euratom Basic Safety Standards, applicable to the 27 Member States of the European Union.

7. References

[1] Council Directive 96/29/Euratom of 13 May 1996, laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation (Official Journal L-159 of 29.06.1996, page 1).

[2] Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure, and repealing Directive 84/466/EURATOM (Official Journal L-180 of 09.07.1997, page 22).

[3] Council Directive 89/618/EURATOM of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency (Official Journal L-357 of 07.12.1989, page 31).

[4] Council Directive 90/641/EURATOM of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas (Official Journal L-349 of 13.12.1990, page 21).

[5] Council Directive 2003/122/EURATOM of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources (Official Journal L346 of 31.12.2003).

[6] Commission Recommendation 90/143/Euratom of 21 February 1990 on the protection of the public against indoor radon exposure (Official Journal L80 of 27.03.1990)

[7] The 2007 Recommendations of ICRP, Annals of the ICRP, Publication 103, International Commission on Radiological Protection, 2008, Elsevier

[8] International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, International Atomic Energy Agency, 21 March 1996, Vienna.

[9] International Atomic Energy Agency, Fundamental Safety Principles, Safety Fundamentals No. SF-1, Vienna (2006)

EDUCATION, TRAINING AND THE EURATOM FRAMEWORK PROGRAMME

ANDRÉ JOUVE, GEORGES VAN GOETHEM
DG-Research, European Commission

ABSTRACT

The maintaining of knowledge implies education and training programmes that ensure not only the instruction of students and trainees but also the transfer of knowledge across generations. This is especially important for research in the Euratom field in the present context of nuclear renaissance.

DG-Research is responsible for the implementation of the Euratom Framework Programme on nuclear research and training. Through these activities, it is striving to promote the integration of national radiation protection research programmes in Europe, including education and training in radiation protection.

These education and training activities supported in the Euratom Programme are helping to establish top-quality teaching modules assembled into masters programmes or higher-level training packages jointly qualified and mutually recognised across the EU. This Euratom approach is entirely in line with the Bologna process.

This paper presents and discusses the various actions in education and training in radiation protection supported by DG- Research.

1. Introduction

Training is a provision of the Euratom Treaty[1] signed at Rome in 1957, chapter 1 article 4, committing the European Commission to facilitate nuclear research and training:

- "The Commission shall be responsible for promoting and facilitating nuclear research in the Member States and for complementing it by carrying out a Community research and training programme".

As was the case at the birth of Euratom, the transmission of knowledge is still imperative in the present context of the evolution of a long-term energy policy in the European Union (EU) and the role nuclear is playing in this policy.

The Directorate-General for Research, Directorate J (Euratom), Unit 2 (fission), implements an annual budget of about 50 Meuros for the scientific and financial support of European research, education and training in the field of nuclear safety and technology, radioactive waste management and radiation protection[2].

An adequate level of expertise and human resources needs to be maintained in all areas of nuclear fission and radiation protection in Europe. Indeed, our current high level of nuclear safety and radiation protection is critically dependant on retaining and recruiting people with the necessary scientific competence and know-how. To guarantee the availability of suitably qualified researchers, engineers and technicians in the long-term, further development of scientific competence and human capacity is necessary. Coordination between educational institutions across the EU is pursued and the training and mobility of students and scientists facilitated.

The Euratom programme supports education and training activities to meet stakeholder needs in areas of reactor systems, radioactive waste management and radiation protection. This helps to provide attractive opportunities for young people wanting to enter the field. In partiular, Euratom fission training schemes are organized in areas where gaps in training provision are perceived.

In the present paper and for the sake of clarity, education and training (E&T) are defined as follows:

- Education is a basic or life-long learning process which encompasses the need to maintain completeness and continuity of competences across generations, involving academic institutions as suppliers and students as customers in a knowledge-driven process;
- training is the learning of a particular skill required to deliver a particular outcome: it is about schooling activities other than regular academic education schemes and essentially an application-driven process, involving industry regulatory bodies as well as training organisations as suppliers, and professionals as customers.

The Euratom approach is naturally in line with the Bologna process[3] (ERASMUS). More specifically, its strategy for nuclear E&T is based on the following four objectives:

- MODULAR COURSES AND COMMON QUALIFICATION APPROACH ensuring top-quality for each module and the development of a coherent framework;
- ONE MUTUAL RECOGNITION SYSTEM ACROSS THE EUROPEAN UNION such as the European Credit Transfer and accumulation System of ERASMUS (ECTS);
- MOBILITY FOR TEACHERS AND STUDENTS ACROSS THE EU in order to broaden the circulation and exchange of ideas and knowledge in nuclear fission;
- FEEDBACK FROM "STAKEHOLDERS", BOTH PUBLIC AND PRIVATE, in order to involve future employers and improve the balance of supply and demand.

2. Euratom research, education and training activities

The provisions of the Euratom treaty for education and training are implemented following 3 main directions[4].

2.1 Imbedded training packages within research projects

A significant part of the support for human resources, mobility and training are implemented by encouraging the embedding of this support within the Networks of Excellence, collaborative Projects and, where appropriate, other actions. The Commission recommends and monitors that 5% of the total project budget is dedicated to these activities. Projects in all areas have therefore developed a comprehensive ‘training and (trans-national) mobility’ package.

This includes:

- the development and delivery of training courses in the subject matter of the project;
- the exchange of research workers, aiming at improving synergies between private and public research organisations at international level.

Training courses are widely announced and open also to non-participating organisations, including, where appropriate, from 3rd countries as an element of international cooperation. A part of the research undertaken in the project is executed by researchers preparing a doctoral thesis or employed on a post-doctoral position. For those projects having recourse

to postgraduate students to perform research the budget dedicated to the transmission of knowledge merely exceeds the recommended threshold of 5%. The use of other funding instruments provided by national and international programmes (e.g. Erasmus Mundus of the Education, Audiovisual and Culture Executive Agency EACEA) is encouraged.

2.2 Euratom Fission Training Schemes (EFTS)

In addition to the above embedded training and mobility activities, dedicated EFTS were engaged in 2008 and 2009 in areas where a shortage of skilled professionals was identified.

An EFTS is aimed at structuring research training and career development across the EU, targeting research workers at post-graduate or equivalent level, e.g. from doctoral students to senior visiting scientists. Its is a long term and ambitious programme, spread over many years and relying on the active participation and contribution of 'future employers', i.e. representatives of system suppliers, energy providers, safety authorities and TSOs, users of ionising radiation in medicine and industry, waste management agencies, etc. It encourages the involvement of young researchers, addresses life-long learning and career development of experienced researchers, maximises transfer of higher-level knowledge and technology with emphasis on multi-disciplinarity, trans-national and inter-sectoral mobility of trainees as well as trainers (e.g. industry-academia partnerships across the EU).

The EC intends to evaluate the training and mobility actions with the help of independent experts at the end of an EFTS period. EFTS should use a systematic approach to higher-level training (e.g. analysis, design, development, implementation and evaluation) and develop best practice guidelines on the basis of the lessons learned.

These EFTS are expected to help develop private-public partnerships recognised as international scientific references, through training schemes and/or doctoral schools, spread over many years and many countries.

They aim at:

- maximising the transfer of higher-level knowledge and technology, addressing young as well as experienced research workers, wherever a coordinated action at EU level will bring added value;
- increasing the attractiveness of nuclear research careers across the EU;
- strengthening links with other Community policies and training networks outside the EU.

2.3 Training, education and the Strategic Research Agendas (SRA)

Research and training are also part of the SRA of SNE-TP (Sustainable Nuclear Energy Technology Platform)[5], MELODI (Multidisciplinary European Low Dose Initiative)[6] and IGD-TP (Implementing Geological Disposal Technology Platform)[7], and are cross-cutting activities of the SET-Plan (Community's Strategic Energy Technology Plan) and associated European Industrial Initiative in sustainable nuclear fission (generation-IV).

As far as radiation protection is concerned and in particular its backbone activity on low dose research, MELODI aims at the sustainable integration or European research on low radiation doses.

This is expected to be achieved through:

- bringing together the programmes of the various funding bodies and research organisations in Europe;
- establishing effective interfaces with stakeholders and the broader scientific and health community in Europe and beyond;

- ensuring the availability of key infrastructures;
- establishing an integrated approach for training and education, including knowledge management.

Expectations from this initiative are high and it may be seen as a model of integration of research and training in radiation protection.

3. Examples of imbedded projects, EFTS and SRA initiatives.

3.1 Examples of projects imbedding E&T and training PhD and post-doctorate students.

CARDIORISK[8]: this 3.8 M€ project is performing radiobiological experiments to investigate the mechanisms involved in the radiation-induced mortality from cardiovascular and cerebrovascular diseases. In its first report to the Commission, this project launched in February 2008 indicates the organisation of a training course attended by 45 participants. Thirty percent of its workforce is composed of Ph.D. and post-doctorate students.

NOTE[9]: similarly to Cardiorisk but with a broader scope, this 12 M€ project investigates through experiments of radiobiology the mechanisms involved in Non Targeted Effects (NOTE) of ionising radiation which are the effects observed in biological tissues after irradiation of other parts of the organism than those in which the effect is observed. In other words, NOTE is studying the vectors of radiation effects requiring a deep understanding of the biological mechanisms. Since its start in September 2006 this project has organised 2 training courses on dedicated topics such as, for example, using mathematical models in radiation biology. Forty participants attended these courses. Together with short term student fellowships and travel grants to international conferences these courses represented 2.5% of the budget at the mid term of the project. In addition to this effort some research in NOTE is performed by PhD and post-doctorate students.

ALPHA-RISK[10]: this 4.4 M€ project is currently ending with significant results on the risk arising from the exposure to radon. This gaseous natural radionuclide, emitter of alpha particles, is the major contributor to the average radiation dose to the European population from all sources. Alpha-risk will help to sustain the pending new European policy on radon. About 16% of Alpha-Risk workforce is composed of PhD and post-doctorate students.

MADEIRA[11] : (Minimizing Activities and Doses by Enhancing Image quality in Radiopharmaceutical Administration) this 3.7 M€ project started in January 2008 aims a reducing doses to patients thanks to improved image quality of new nuclear medicine techniques coupling the measurement of radiopharmaceutical uptake and computed tomography (PET and SPECT). It also is expected to increase the competitiveness of European manufacturers of these machines. Madeira organised so far one training course on radiation physics for nuclear medicine attended by 45 trainees. A similar one is planned for the end of November 2009 on radiation protection in nuclear medicine. In addition to this effort 60% of the research work in MADEIRA is performed by PhD and post-doctorate students.

3.2 Three EFTS will be launched in 2009 and 2 are expected to be launched in 2010

In chronological order, the EFTS already started or about to start are:

Education and training on Geological disposal of radioactive wastes (PETRUSII)[12]

PETRUS II started in January 2009, pursuing the overall objective to enable present and future professionals on radioactive waste management in Europe to follow a training

programme on geological disposal which would be widely recognized across Europe. In addressing the needs of the end-users, access to a combination of formal education, continuous learning and non-formal professional development will be offered and developed within the project.

European Network on Education and Training in Radiation Protection (ENETRAPII)

This project is the subject of a dedicated presentation in this seminar. It started on 1 March 2009 pursuing the overall objective to develop European high-quality "reference standards" and good practices for education and training in radiation protection (RP), specifically with respect to the radiation protection expert (RPE) and the radiation protection officer (RPO). These "standards" will reflect the needs of the RPE and the RPO in all sectors where ionising radiation is applied. The introduction of a radiation protection training passport as a mean to facilitate efficient and transparent European mutual recognition is another ultimate deliverable of this project.

It is envisaged that the outcome of this project will be instrumental for the cooperation between regulators, training providers and customers (nuclear industry, research, non-nuclear industry, etc.) in reaching harmonization of the requirements for, and the education and training of RPEs and RPOs within Europe, and will stimulate building competence and career development in radiation protection to meet the demands of the future.

The European Nuclear Education Network on Nuclear Engineering (ENEN III)

ENEN III started on 1 May 2009 for a period of three years. It associates 19 Partners from 12 EU countries and is coordinated by the ENEN association. The project covers the structuring, organisation, coordination and implementation of training schemes in cooperation with local, national and international training organisations, to provide training to professionals in nuclear organisations and their contractors or subcontractors. The training schemes provide a portfolio of courses, training sessions, seminars and workshops for continuous learning, for upgrading knowledge and developing skills in Nuclear Engineering.

In addition, two more are being negotiated and may be launched next year (NB following information is indicative only):

Cooperation in education In Nuclear Chemistry (CINCH)

The renaissance of nuclear power will require a significant increase of nuclear chemists. The project aims at coordinating education and training in nuclear chemistry in Europe. This EFTS expected to be launched in 2009-2010 will provide a common basis to the fragmented activities in this field and move the education and training in nuclear chemistry to a qualitatively new level. The main target group will be not only the doctoral students and research workers but also the students at the master level. Including these students into the system should increase attractiveness of the studies of nuclear chemistry and thus enlarge the source of highly qualified professionals for the future employers.

Training Schemes on Nuclear Safety Culture (TRANUSAFE)

Nuclear Safety Culture is a topic of paramount importance for all nuclear operators as well as for operators of installations dedicated to radiology and radiotherapy. It also involves regulators and their technical support organisations. The objective of this project is to design, develop and test relevant training schemes on Nuclear Safety Culture with a European dimension, based on a specific evaluation of the training needs. This will be applied to two groups of users: a group composed of actors of the nuclear industry and the other of users of radiation sources for industrial, medical or research purposes. The expected output is the recognition of good practices and behaviours related to the management of safety culture.

3.3 The SRA for radiation protection

Further to the reflections of the High Level and Expert Group (HLEG), whose activities were co-funded by the Euratom programme, European national regulatory bodies for radiation protection, or their technical support organisation (BfS, CEA, IRSN, ISS, STUK), set up the MELODI platform and are intending to progressively integrate their research programmes in the area of low dose. To support this initiative of European integration, the EC included a topic in the Euratom 2009 call for proposals to which a consortia made up of the above organisations, with other partners, successfully responded. The proposal, still under negotiation, foresees the creation of a network of excellence (NOE) for the Low Dose Research towards Multidisciplinary Integration (DOREMI). This NOE will include a strategy for European integration of education and training in radiation protection and in particular in the most critical field of radiation protection research in Europe, that of low dose multidisciplinary science.

The approach being elaborated would include Bologna-compliant courses of MSc, PhD, Post-doctoral programmes as well as focused shorter courses as required that would be accessible by undergraduate students.

The range of subjects covered would be broad and multi-disciplinary, rather than narrowly focused, and cover physics of radiation interactions with tissue, radiobiology - both low dose and high doses, basics in toxicology, epidemiology, probability and risk analysis, radiation risk – occupational, medical, public, and sociology of risk perception.

Conclusion

In all scientific disciplines, education and training form an indivisible package with research. This complementary nature was understood by the promoters of the Euratom Treaty 50 years ago and is still imperative today. In particular, the Euratom 7th Framework Programme is promoting cross-fertilisation between research and training in all areas of the programme. Such actions are essential if the nuclear sector is to fulfil its role in addressing Europe's energy challenge.

Education and training in radiation protection has a wide societal impact, going beyond just energy issues. Indeed, all EU Member States, whether or not using nuclear energy, have to protect citizens from the harmful effects of ionising radiation in compliance with European directives. For both the owner/operator of a radiation source and the regulator, training and education in radiation protection can ensure of a high level of radiation safety in the future, in particular in medical applications. Harmonisation between Member States in this field is also a prerequisite in the area of radiation protection, and this includes guidance, practices, and education and training.

In addition to Euratom Fission Training Schemes, the main contribution of Euratom research to E&T is the imbedded training of Ph.D. and Post-doc students directly participating in FP projects.

Training will also be a key consideration within the strategic research agenda and the bottom-up integration of research and education in radiation protection in Europe pursued within the MELODI platform, and the Euratom FP can serve as a good example to be followed.

References

1 Traité instituant la Communauté Européenne de l'Énergie Atomique (EURATOM)

2 Euratom FP7 Research & Training Projects Volume 1, 2009, EUR 23580 EN

3 http://ec.europa.eu/education/higher-education/doc1290_en.htm

4 Euratom for Nuclear Research and Training Activities1(European Commission C(2008)6800 of 17 November 2008) http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.EuratomDetailsCallPage&call_id=182#infopack

5 http://www.snetp.eu/

6 http://www.hleg.de/

7 http://www.igdtp.eu/

8 http://www.cardiorisk.eu/

9 https://ssl.note-ip.org/index.asp

10 http://www.alpha-risk.org/

11 http://www.madeira-project.eu/

12 http://www.enen-assoc.org/

IRPA'S CONTRIBUTION TO E&T ACTIVITIES FOR RADIATION PROTECTION PROFESSIONALS

E. GALLEGO[1], A. HEFNER[2]
IRPA Executive Council

[1]Nuclear Engineering Department, Universidad Politécnica de Madrid
José Gutiérrez Abascal, 2, E-28006 Madrid – Spain

[2]Head of Radiation Expert Group, Health Physics Division, AIT Austrian Institute of Technology GmbH
A-2444 Seibersdorf - Austria

ABSTRACT

The International Radiation Protection Association (IRPA) promotes excellence in the practice of radiation protection through national and regional Associate Societies for radiation protection professionals. IRPA has recently prepared and E&T Plan structured around three main lines: the cooperation with international and regional organizations dealing with E&T in Radiation Protection; the internal stimulation of E&T by organizing discussion forums during IRPA Congresses; and the stimulation and support to the organization of E&T activities either by IRPA or by its Associate Societies. The main innovations are in the possibility of undertaking common activities by two or more Associate Societies; the promotion of E&T networks sharing language or regional proximity; and the emergence of activities to attract young generations to the profession.

1. Introduction

The International Radiation Protection Association (IRPA) is the international voice of the radiation protection profession. It promotes excellence in the practice of radiation protection through national and regional Associate Societies for radiation protection professionals by providing benchmarks of good practice and enhancing professional competence and networking.

One of the main strategic goals of IRPA is to promote excellence in radiation protection professionals. To reach that objective, IRPA has started the development of guidance documents for use by radiation protection professionals and Associate Societies. The first topic addressed has been stakeholder engagement and currently new guiding documents are being developed on radiation protection culture and on professional qualification.

Education and Training (E&T) is another key to reach professional excellence, and its essential role has been recognized since the beginning of IRPA. However, there is still a wide variation between different countries with regard to E&T methods as well as certification and recognition systems for radiation protection professionals and the desirable harmonization is still to come.

1.1 Radiation Protection Expert

The IRPA Executive Council (EC) has widely discussed on these issues and a position paper [1] was presented at a previous ETRAP Conference six years ago. Since then, an important milestone has been the recognition by the International Labour Organization of Radiation Protection Expert (RPE) within the International Standard Classification of Occupations (ISCO-08; 2263) [2]. RPE is included in the group of occupations covered by the definition of Environmental and occupational health and hygiene professionals.

The IRPA definition of RPE is very relevant in this context. According to IRPA, the RPE is a person:

> having education and/or experience equivalent to a graduate or masters degree from an accredited college or university in radiation protection, radiation safety, biology, chemistry, engineering, physics or a closely related physical or biological science; and
>
> who has acquired competence in radiation protection, by virtue of special studies, training and practical experience. Such special studies and training must have been sufficient in the above sciences to provide the understanding, ability and competency to
>
> anticipate and recognize the interactions of radiation with matter and to understand the effects of radiation on people, animals and the environment;
>
> evaluate, on the basis of training and experience and with the aid of quantitative measurement techniques, the magnitude of radiological factors in terms of their ability to impair human health and well-being and damage to the environment;
>
> develop and implement, on the basis of training and experience, methods to prevent, eliminate, control, or reduce radiation exposure to workers, patients, the public and the environment.

In most countries the competence of radiation protection experts needs to be recognized by the competent authority in order for these professionals to be eligible to undertake certain defined radiation protection responsibilities. The process of recognition may involve formal certification, accreditation, registration, etc.

2. IRPA E&T Plan for 2008-20

Given the differences existing between countries with regard to certification and accreditation and the nature of IRPA as association of national and regional professional societies, the IRPA EC is developing an E&T Plan that aims towards promoting, supporting, providing guidance and networking to the E&T activities organized by the Associate Societies individually or, preferably, in cooperation.

IRPA Societies are not universities and their E&T activities are not intended for an academic diploma but for professional enhancement. These activities generally focus on general Radiation Protection trends and/or on very specialized topics which cannot be covered by other organizations.

Taking these facts into account, the IRPA E&T Plan is structured around three main lines:

- The cooperation with international and regional organizations dealing with E&T in Radiation Protection;
- the internal stimulation of E&T by organizing discussion forums during IRPA Congresses; and
- the stimulation and support of E&T activities organized by the Associate Societies.

2.1 Cooperation with International and Regional Organizations

IRPA is a main stakeholder representing the profession views on E&T needs in radiation protection for both basic levels and continuous professional enhancement. Consequently, IRPA is maintaining cooperation with the IAEA, the European Commission and the American Academy of Health Physics, amongst others.

IAEA is currently implementing a “Strategic Approach to Education and Training in Radiation and Waste Safety”, aimed at establishing sustainable education and training programmes in Member States [3]. In order to advise on policy development, the maintenance of the Agency’s training programme and the monitoring of the long term action plan, IAEA created in 2002 the “Steering Committee on Education and Training in Radiation Protection and Waste Safety” with nominated members representing regional, collaborating training centres, the European Union and Professional organizations (IRPA). As observer in the Steering Committee, IRPA is contributing to the implementation of the IAEA strategic plan on E&T by exchanging information on actual projects and developments with the Associate Societies.

Giving the great opportunity to interact with the main stakeholders on E&T, IRPA representatives are regularly attending the ETRAP (International Conference on Education and Training in Radiological Protection) Conference series, organized by the European Nuclear Society. This participation will hopefully continue in the next editions after ETRAP 2009.

In the European Union, the draft of the modified Basic Safety Standards Directive highlights the importance of education and training by dedicating a specific title to “requirements for radiation protection education, training and information” [4]. The European Radiation Protection Training and Education Platform (EUTERP) has been created with the main objective of removing obstacles for the mobility of radiation protection experts within the EU through harmonisation of criteria and qualifications for and mutual recognition of such experts. The ENETRAP II project (European Network on Education and Training in RAdiological Protection, FP7-EURATOM), which runs in 2009-2012 aims to develop European high-quality "reference standards" and good practices for E&T in radiation protection, specifically with respect to the RPE and the Radiation Protection Officer (RPO) [5]. These networks could have a clear role to recognize RPE from countries that do not have their own recognition system. IRPA has been collaborating in the past with these EU initiatives as observer, and contributed to the development of the definitions of RPE and RPO. Looking to the future, it would be good if IRPA could continue playing an advisory role. The European Associate Societies, which held annual informal meetings, can provide the EU networks with essential feedback from the professional perspective and IRPA can facilitate to establish the adequate mechanisms.

In the United States of America, the American Academy of Health Physics (AAHP) is an organization that advances the profession of Health Physics, encourages the highest standards of ethics and integrity in the practice of Health Physics, enhances communications among Certified Health Physicists (CHP) and provides a means for Active CHPs to participate in the certification program. The AAHP accredited the training activities (refresher courses and seminars) organized as part of the IRPA 12 international congress in 2008 and also assigned credits valid for recertification (continuing education programme) to the participants requesting them. This very positive experience is encouraging and IRPA will try to establish a memorandum of understanding with AAHP for a permanent collaboration.

2.2 Discussion forums at IRPA congresses.

Over the last years it has proved very successful to organise an Associate Societies’ forum at all IRPA regional and international congresses. E&T is regularly scheduled to be one subject for discussion: this is a going on action.

The IRPA EC will check that these discussion meetings on E&T activities are maintained, either embedded or separated from the Associate Societies Forums, as a way to exchange experiences, promote the harmonization of the definition of RPE according to IRPA and encourage the organization of common and new E&T activities as well as to stimulate to an active participation in the actions proposed in the IRPA E&T Plan, which are described in the following paragraph.

2.3 Actions on E&T

IRPA has already a long tradition in organizing Refresher courses at IRPA congresses. These are lectures by specialists in which updated information on a very precise topic is offered. The IRPA 12 Congress included 20 Refresher Courses, and also 3 Seminars in which different topics of a theme were addressed by a team of experts. The E&T Plan looks forward to maintain these activities and to reinforce them by, specifically:

- including Refresher Courses and Seminars within each IRPA Congress (already established in the guidance for IRPA congresses organization);
- implementing an evaluation and follow-up procedure for the Refresher Courses and Seminars, based on questionnaires to be fulfilled by the participants;
- exploring the live Internet transmission of the IRPA 13 Refresher Courses; and
- improving the post-congress accessibility at the IRPA website to texts and presentations from the Refresher Courses and Seminars (including those from IRPA Regional Congresses).

IRPA Associate Societies frequently organize specific training events, such as seminars, short courses and summer (or winter) schools on specialized topics. These activities are somehow unconnected, and there is an intention in the E&T Plan to promote good coordination. First of all, a questionnaire is going to be distributed to have a complete picture. Then, IRPA sponsoring would be granted to those activities which clear and openly look for professional enhancement within the IRPA family. Specific actions that should be undertaken by the organizing societies to get the “IRPA stamp” can be the following (from easier to harder implementation):

- Advertisement and promotion through IRPA and the Associate Societies.
- Availability of grants for young professionals to facilitate their participation (usually to young members of the organizing societies or from developing countries).
- Agreement to share and exchange teaching materials (by, for instance opening of internet spaces at the IRPA website).
- Webcast of lectures and courses previously recorded.
- Interactive participation via live Internet transmission in courses or seminars (“webinars”).

The IRPA E&T Plan also considers other actions, some of them innovative, to stimulate E&T activities at different levels, like the following:

- Promote the creation of “E&T networks” within IRPA, for instance by those societies sharing language (e.g. Latin-American societies together with Spain and Portugal) or belonging to the same region (e.g. European Radiation Protection Young Scientists Exchange Network, with pilot project for schools and universities with participation from OVS, FS, SFRP, NVS, NSRP and SRP), with dedicated spaces in the IRPA website.
- Encourage Associate Societies activities at national or regional scale to attract young generations to the profession: examples are emerging in some countries to engage pre-university and undergraduate students. Awards programmes to individual or collective work in schools or universities could be an effective way.
- Attract young professionals to IRPA Congresses by initiatives like the National and European Awards for young scientists (the IRPA European Societies will give a first award at the IRPA European Regional Congress in Helsinki in 2010).
- Provide backup and establish interaction with International Training Centres or the World Nuclear University.

3. Conclusions

The IRPA E&T Plan 2008-2020 will continue the cooperation with international and regional organizations dealing with E&T in Radiation Protection where IRPA is representing the profession views. The continuous interaction between the Associate Societies to cooperate

in E&T will continue at different levels, in particular at the discussion forums organized during IRPA Congresses. The Plan also aims to stimulate and support the Associate Societies to organize coordinated activities; to share E&T resources; to create E&T networks sharing language or regional proximity; and to organize activities to attract young generations to the profession.

4. References

[1] C. Wernli, D. Cancio and J. Valentin. The role of IRPA in education and training of radiation protection professionals. In Proc. *II International Conference on Radiation Protection Training. Future Strategies*. 17 – 19 September 2003. Madrid (Spain). (ISBN 84-7834-450-0).

[2] International Labour Organization. Updating the International Standard Classification of Occupations (ISCO) Draft ISCO-08 Group Definitions: Occupations in Health. Draft published November 2008.
Available at http://www.ilo.org/public/english/bureau/stat/isco/docs/health.pdf

[3] J. Wheatley and A. Luciani. IAEA Activities in Education and Training in Radiation, Transport and Waste Safety: Current Status and Future Challenges. In Transactions ETRAP, 8-12 November 2009, Lisbon (Portugal). (ISBN 978-92-95064-08-9).

[4] S. Mundigl. Education and Training Requirements in the Revised European Basic Safety Standards Directive. ETRAP, 8-12 November 2009, Lisbon (Portugal). (ISBN 978-92-95064-08-9).

[5] F.S. Draaisma. ENETRAPII: WP5 Develop and Apply Mechanisms for the Evaluation of Training Material, Events and Providers. ETRAP, 8-12 November 2009, Lisbon (Portugal). (ISBN 978-92-95064-08-9).

IAEA ACTIVITIES IN EDUCATION AND TRAINING IN RADIATION, TRANSPORT AND WASTE SAFETY: CURRENT STATUS AND FUTURE CHALLENGES

JOHN WHEATLEY & ANDREA LUCIANI
Regulatory Infrastructure and Transport Safety Section
Division of Radiation, Transport and Waste Safety
Department of Nuclear Safety and Security
International Atomic Energy Agency, Wagramerstrasse 5, A-1400 Vienna, Austria

Abstract

IAEA's education and training activities related to radiation, transport and waste safety follow the resolutions of its General Conference. IAEA is currently implementing a 'Strategic Approach to Education and Training in Radiation and Waste Safety', aimed at establishing sustainable education and training programmes in Member States. This is being achieved through a range of activities that include, inter alia, educational and training courses, train-the-trainers workshops, distance learning, on-the-job training, specialized missions and a 'training tool kit' for Member States to evaluate their needs. All training materials are based on IAEA Safety Standards and are run in accordance with standard syllabi or as part of training packages that are approved by a steering committee.
The paper gives an overview of the mechanisms by which IAEA is enhancing education and training in radiation, transport and waste safety around the world. In addition to describing what has worked well, the paper will indicate what can be improved and what challenges lie ahead.

Introduction

The statute of the International Atomic Energy Agency includes the establishment of, and provision for, the application of safety standards for protection of health, life and property against ionizing radiation. Education and training play a key role in facilitating the application of Safety Standards in IAEA Member States and for strengthening the global radiation safety regime. The education and training activities of IAEA follow the resolutions of the General Conferences and reflect IAEA Safety Standards and guidance [1,2,3]. A "Strategic Approach to Education and Training in Radiation and Waste Safety" (Strategy on Education and Training) was endorsed by the IAEA General Conference in resolution GC(45)/RES/10C in 2001 [4] and aimed to establish sustainable education and training programmes in Member States by 2010. A steering committee advises the IAEA secretariat on the implementation of this strategic plan. The various IAEA mechanisms and activities that are associated with implementation of the strategic plan are described below.

Regional Training Centres

Within the strategic plan, regional training centres (RTCs) play a crucial role in the development of competence at the regional level, and their establishment in all regions is a considered to be a key success. IAEA post graduate education courses in radiation protection and the safety of sources (PGEC), specialized courses and train-the-trainer events have all been run at the regional training centres. The PGEC, in particular, is considered to be a fundamental element in building a strong radiation protection infrastructure within Member States. Overall, the RTC's provide an active interface between IAEA and its Member States and they significantly contribute to helping States to apply the IAEA Safety Standards in all regions.

In order to facilitate networking between IAEA regional training centres, an Inter Centre Network (ICN) was developed, with the objective to:

- facilitate communication and exchange of information between the centres and between the IAEA and the centres;
- disseminate lecture material through the ICN website;
- promote e-learning programmes;
- provide feedback from participants and lecturers on training material to the Steering Committee;
- harmonize training centre management.

Although good in concept, the ICN has not been well utilized due both to technical difficulties with the IT platform and a relatively small group of users. Recognizing that the concept is still valid, ways to improve the network will be considered.

IAEA Training Activities in Radiation Protection

Post-Graduate Educational Course (PGEC)

The post-graduate educational course (PGEC) in radiation protection and safety of radiation sources is a comprehensive and multidisciplinary programme with theoretical and practical training. It is aimed to educate and train young professionals, especially regulators, who may in later years become senior managers. The PGEC is hosted by IAEA Regional Training Centres (RTCs) in Africa (English and French), Europe (English and Russian), Latin America (Spanish), Asia (Arabic and English). The course is supported by IAEA and is run in line with the IAEA Standard Syllabus [5]. Every year over 100 participants benefit from this post graduate course.

Presenter's material in the form of PowerPoint slides have been developed in line with the standard syllabus and are provided to the RTCs. This ensures that the information provided to the students is based on IAEA Safety Standards and this facilities a harmonized approach. Data from the RTCs shows an increasing trend in the use of local lecturers and less reliance on IAEA. This is taken to be a good indicator that the self-sustainability of the RTC's is improving.

Feedback from the students indicates that the content of the syllabus may, in some areas, need to be better balanced as some modules contain a lot of detail to be covered in the allocated time. This matter will be taken into consideration when the syllabus is next reviewed. The PGEC includes an element of project work and feedback shows that this is very beneficial to the students and many continue with their projects when they return home.

Other steps being taken to improve the PGEC include sharing good practices and lessons learned among the regional training centres and the preparation of a 'model' quality manual for RTCs.

Specialized Training Courses (STCs) & Workshops

Short duration specialized training courses are run for one or two weeks in IAEA Member States. They are aimed at participants who already have relevant work experience. Workshops provide participants with the opportunity for in-depth training and exchange of information. Topics covered by such courses and workshops are wide ranging and include, for example, the regulatory framework, occupational protection (external and internal), patient protection (diagnostic radiology, radiotherapy and nuclear medicine), radioactive waste management, transport of radioactive materials,

safety of radioactive sources and safety in industrial applications. The courses are regularly organized at the national and regional level for different target audiences, such as for regulators or radiographers. Each year around 25 such regional training events are organized in various Member States. The training materials have been translated into most official IAEA languages. An ongoing issue has been with respect to the validation of training material prior to being made available for routine use. In practice, the process has been slow and a more efficient process is currently being established.

Training material for Radiation Protection Officers

The Radiation Protection Officer, according to the International Basic Safety Standards, is an individual technically competent in radiation protection matters relevant for a given type of practice who is designated by a registrant or licensee to oversee the application of the relevant requirements of the IAEA Safety Standards. That being the case, it was considered appropriate to increase emphasis on the development of training material for Radiation Protection Officers (RPO), this also being a significant element with regard to the successful implementation of the IAEA strategic plan. The course is divided into compulsory 'core' modules supported by supplementary modules that are specific to the practice (e.g.: industrial radiography).

Other Training Mechanisms

On the Job Training
The objective of on-the-job training (OJT) is to provide individuals with practical experience in a chosen area for a longer duration under the direct supervision of experienced professionals. The duration of the OJT is dictated by the training theme, varying from 1- 3 months. The added value is the opportunity to work in well-developed centers and to learn from peers. The successful completion of PGEC, STC and OJT provides a solid basis for radiation protection professionals.

Distance Learning (DL)
IAEA successfully concluded a `Distance Learning' project in Radiation Protection in the Asia and the Pacific region. The participating countries were Australia (coordinator), Korea, Indonesia, Mongolia, Thailand, The Philippines and New Zealand. This learning method was used both nationally and internationally. Distance learning complements the classroom training and was found to be useful where only small number of people need training or where target population is scattered or live far from national training centers. Distance learning is also good tool for refresher training or as pre-training to prepare an individual to attend a training course. The learning material developed for the distance learning is now being used for providing pre-training for PGEC participants. The objective is to harmonize the level of knowledge in radiation protection of all the PGEC participants coming from different educational backgrounds and with varying levels of experience. The selected participants receive the pre-training material in their home country to prepare themselves for the long duration PGEC. This material has been translated to Arabic, Russian and Spanish. Consideration is being given to converting this material from CD format to a web-based system.

Training the Trainers (TTT)
This training modality is mainly aimed at developing communication skills with a view to building a core of national trainers in radiation protection. The training syllabus includes presentational and communication skills, organization of training events and includes practical exercises. In the TTT training course the participants are familiarized with IAEA developed training material so that it can be used effectively in future training

courses. The TTT training course is designed to be interactive with presentations by the participants. More than 10 such train-the-trainers workshops for radiation protection in medical and industrial applications have been run at the national and regional levels. In addition, the module has been made included on the PGEC. Future work in this area will involve how to evaluate the on-going effectiveness of the potential trainers.

National strategy for building competence in radiation protection

To ensure a comprehensive approach to building competence in radiation protection, States may wish to consider developing a national strategy. Such a strategy can be considered to consist of 4 interlinked phases, where the outcome of one phase is the starting point for the next phase, with the loop being closed by evaluation and feedback, as shown in Fig 1.:

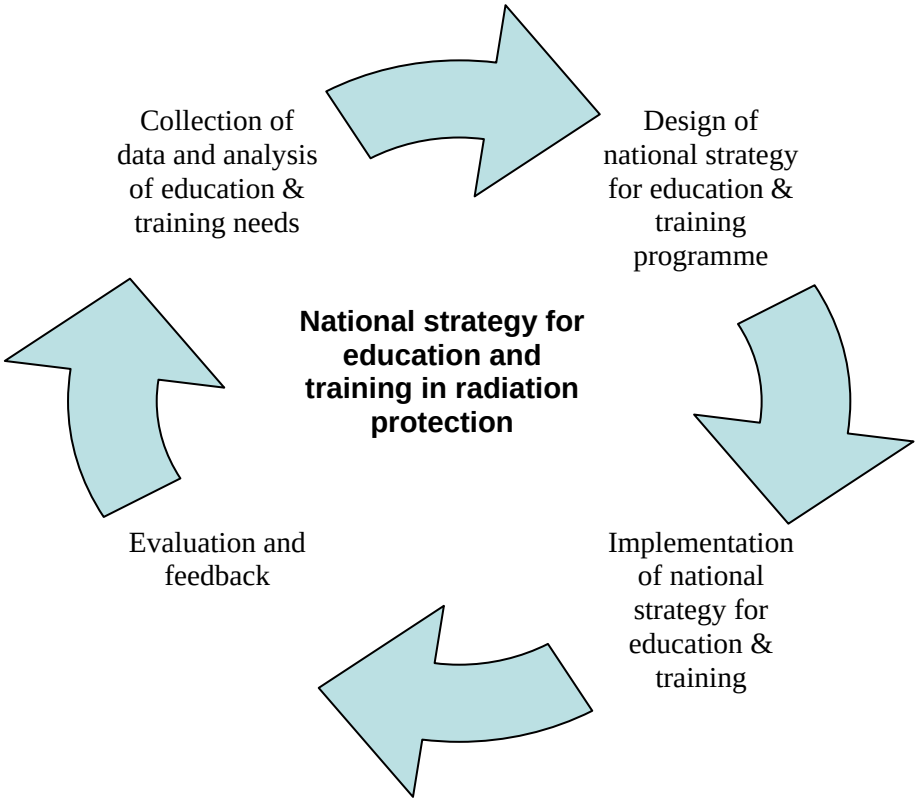

Fig 1. Four phases to establish and maintain a national strategy.

The first step is to collect and analyze information about the current and foreseeable situation for a range of areas, inter alia, regulatory requirements and regulatory infrastructure for education and training in radiation protection, and data on types and numbers of radiation sources and information about the number of adequately trained personnel (including workers, radiation protection officers, staff of the regulatory body, and qualified experts). The output of the analysis should show the identified needs regarding the number of people that need education and training in the various fields of radiation protection. This analysis will enable the national strategy to be designed to meet those needs, for example by identifying the need to increase the number or expertise of training providers. Evaluation and feedback from implementing the plan will help to ensure that strategy remains effective.

IAEA is in the process of developing a ‘Training Tool Kit’, based on IAEA Safety Standards and training material, to specifically help its Member States to develop such a national strategy. IAEA also offer an Education and Training Appraisal (EduTA) mission to Member

States, with the objective of reviewing the national status of provisions for education and training in radiation protection.

The Future

Considerable work has been undertaken in pursuance of the strategic aims for strengthening education and training in radiation protection and the safety of sources, and considerable progress has been made, especially at the regional level. Future work will focus on strengthening education and training at the national level, with the regional training centres playing a key role. The ultimate effectiveness will depend upon the commitment of Member States to develop their own national strategy and sustainable training programmes in radiation protection and safety of sources. By working together more progress can be made towards the realization of a harmonized approach for education and training. These steps are essential ingredients for maintaining high standards of radiation protection and the safety of sources worldwide.

REFERENCES

[1] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANISATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna (1996).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Building Competence in Radiation Protection and the Safe Use of Radiation Sources, IAEA Safety Standards Series No. RS-G-1.4, IAEA, Vienna (2001).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Training in Radiation Protection and the Safe Use of Radiation Sources, Safety Reports Series No. 20, IAEA, Vienna (2001).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY Strategy for the development of a self-sustaining education and training programme in radiation protection and the safe use of radiation sources. IAEA General Conference resolution GC (45)/RES/10C, 2001.

[5] INTERNATIONAL ATOMIC ENERGY AGENCY Postgraduate educational course in radiation protection and then safety of radiation sources – standard syllabus. Training Course Series No.18, Vienna (2002)

European Nuclear Society

Rue Belliard 65, 1040 Brussels, Belgium
Telephone +32 2 505 30 54, Fax + 32 2 502 39 02
etrap2009@euronuclear.org - www.euronuclear.org