

Education and training activities of ENEA – Radiation Protection Institute: national needs of education to harmonisation and harmonisation of training

Andrea Luciani⁽¹⁾, Elena Fantuzzi⁽¹⁾, Paolo Battisti⁽¹⁾, Massimo Calamosca⁽¹⁾, Carlo-Maria Castellani⁽¹⁾, Gianfranco Gualdrini⁽¹⁾, Silvia Penzo⁽¹⁾, Sandro Sandri⁽²⁾

⁽¹⁾*ENEA - Radiation Protection Institute, Bologna, Italy*

⁽²⁾*ENEA - Radiation Protection Institute, Roma, Italy*

Abstract

ENEA, the Italian National Agency for New Technologies, Energy and the Environment is a public research institution operating in the fields of energy, the environment and new technologies to support competitiveness and sustainable development. Education and training activities are explicitly stated in the ENEA mission. The Radiation Protection Institute (IRP) of ENEA has been taking care of training in the field of radiation protection and dosimetry of ionising radiation since several years. The main fields in which IRP provides education and training derive from the specific traditional areas of research and duties of radiation protection of the Institute within ENEA. They are:

- 1) Methods and techniques for external and internal dosimetry of ionising radiation (scholarships and training stages for student and scientists at its facilities);
- 2) Dissemination of European and International methodologies and approaches used in the radiation protection field with the aim of harmonization of knowledge within Europe and within the country itself (in relation to the long-time collaborations with national and international organisations aimed at the development of methodologies as ISO, EURADOS, etc.);
- 3) Training of qualified experts, in compliance with the national legislation and within an international framework aimed at the harmonisation of skills, competence and knowledge of throughout Europe (ERPC courses, ENETRAP project).

1. Introduction

ENEA conducts scientific research and technology development activities that draw on a wide range of expertise, advanced facilities and tools located at its centres, operating in support of ENEA's programmes and the Nation's productive system. In its ten Research Centres, located throughout the country, ENEA is mainly called upon to promote and carry out basic and applied research and innovation technology activities, also through prototypes and product industrialization, to disseminate and transfer technologies, encouraging their use in productive and social sectors, to provide both public and private bodies and enterprises with high-tech services, studies, tests and evaluations..

The sectors involving the use of ionizing radiations, both in the nuclear and non-nuclear domain, as well as in the medical and research areas, are traditionally part of the activities of ENEA. The Radiation Protection Institute (IRP) provides ENEA with the services of occupational, public and environmental radiation protection according to the national legislation. For this purposes the Institute:

- Gives advice by means of its Qualified Experts to fulfil law obligation;
- Operates laboratories for the calibration of survey monitors (secondary laboratory in the national calibration system), the individual monitoring of the internal contamination (whole body counters, alpha, gamma and ICP-mass spectrometry), the personal monitoring for external exposure (track and thermo-luminescence dosimetry services) and radon concentration evaluation service;
- Assures the environmental surveillance for the ENEA research reactors;
- Runs computing activities of support (e.g. numerical simulations of radiation transport in every aforementioned field).

In addition to the activities carried out to fulfil the law obligation for ENEA, the Institute is in charge of:

- Research and development in radiation protection: biokinetic modelling for internal dosimetry, radiation transport calculations, solid state dosimeters, radiation protection methodologies for advanced nuclear facilities (nuclear fusion);
- Qualification of measurement techniques and methodologies, by contributing to national (UNI: Italian National Standardization Body) and international (ISO: International Organization for

Standardization) standards development, harmonization of dose evaluation procedures (e.g. EU-funded project IDEAS [1] and the Italian intercomparison on internal dose assessment [2]).

Education and training activities are explicitly stated in the ENEA mission. The Institute has been taking care of training in the field of radiation protection and dosimetry of ionising radiation since several years. No group or structure within the Institute is expressively dedicated and focussed on education and training, as formation activities are generally organised and carried out by the same personnel (researchers, qualified experts) engaged in the aforementioned institutional activities. This has allowed implementing into formation programmes the latest developments in the radiation protection field. In recent years, the Institute has been more and more engaged in harmonisation actions, both by elaborating and drafting standard procedures, and by organizing intercomparison exercises. Therefore, efforts are particularly made to provide students and personnel under training with updated standardized methodologies or with agreed procedures (proposed in the frame of *ad hoc* intercomparison exercises), when international and national standards are not available. On the other hand the need of harmonised approaches for education and training in radiation protection is increasingly needed. In this frame the Institute is acting at both international level (e.g. the project ENETRAP [3], for assuring the mobility of workers), and at national level (for assuring completeness and appropriateness of the formation programmes according to the national syllabus [4]).

The education to standardised methodologies and the harmonisation of the training path is one of the chief traits of the education and training activities of the Institute, in respect to other national centres (universities, hospitals, public and private institutions, professional associations) running courses and trainings in radiation protection.

2. Education to harmonised and standardised methodologies

Harmonised and standardised procedures are disseminated mainly in the frame of intercomparison projects. Training courses are organised for discussing and identifying deviations of the results provided by the participants from the reference value and availability and applicability of standard methodologies are verified.

One of the most recent examples is the Italian intercomparison exercise on internal dose assessment (VALDOSE) organised in 2001 [2]. It was promoted by the Institute after the coming into force in the Italian law [4] of the EURATOM 96/29 Directive [5]. The intercomparison exercise was addressed to the Italian experts in internal dosimetry and to the qualified expert to provide the participants with the opportunity of checking the quality of their internal dose assessment methods and to identify problems to focus on for the harmonization of results considering the Italian law needs.

Five case studies of occupational exposure related to the Italian situation were proposed. The radioisotopes were: ^{60}Co , ^{89}Sr , ^{125}I , ^{131}I , and ^{222}Rn + material containing natural radionuclides (^{238}U - ^{235}U - ^{232}Th). A case scenario describing the overall information available for each single case study was set up and sent to the participants. The general scheme proposed in the 3rd European Intercomparison Exercise [6] was adopted for the presentation of the case scenarios. At the end of October 2001 a workshop was held with all nineteen participants to discuss the results and to provide a general guidance for the assessment of the intake and internal dose aimed at harmonizing the approaches used by the experts in internal dosimetry operating in Italy. Wide diffusion of the results and recommendations of the VALDOSE intercomparison has been performed by ENEA-IRP via the main Italian radiation protection associations. This guidance was aimed at making up for lack of national law, guidelines and norms from recognised institutions (nuclear regulatory body, standardisation body, governmental agencies, etc.).

Another important example of education to harmonised methodologies was carried out in the field of radiation transport calculations using the Monte Carlo method. This computational approach has become a basic tool in radiation protection dosimetry, e.g. to link measurable quantities (like kerma or fluence) and to assure the quality of measurements. Therefore a specific field oriented expertise is necessary to avoid occasional usage of complex computer codes that can easily lead to pitfalls and modelling severe errors. The European Dosimetry Group EURADOS with its Working Group 4 (numerical dosimetry) organized in collaboration with ERPET (European Radiation Protection Education and Training) and ENEA-Radiation Protection Institute a Training Course on the Use of MCNP [7], in Radiation Protection and Dosimetry (Bologna 1996) [8]. The course was replicated at the Imperial College (London 1998). The training course, that lasted for 3 days and a half and could rely on the availability of more than 20 PC workstations, consisted of a series of tutorial lectures

proffered by renowned scientist from various Laboratories in Europe and the USA (PTB, IRSN, NEA-DB, ENEA, INFN and LANL). At the beginning they presented an exhaustive panorama on the fundamentals of radiation transport. A central part of the lectures was devoted to the state of the art of the MCNP code, e.g. its variance reduction and electron transport algorithms and a comparison of MCNP with other internationally used codes focused on the high energy domain. The second backbone of the Course was the training sessions at the computer in which progressively complex problems were proposed to the participants. The problems were at the beginning characterized by a very simple geometry description of the studied objects (slab and cylindrical phantoms), extending the complexity to model a complex radiation sources transportation flask and a detailed anthropomorphic analytical phantom. The Training Course, attended by about 50 scientists from Europe and outside, was concluded with a round table with questions and answers on the usage of the code.

A further later initiative was a step forward in the philosophy of a quality assured usage of computer codes and was addressed to an international intercomparison on the usage of computational codes in radiation dosimetry. The Intercomparison, that included training quality feedback between problem authors and participants, was concluded with a Workshop held in Bologna in July 2003 [9].

The Italian Association for Radiation Protection (IRPA affiliate) has organized courses in the radiation protection field since 1984. For this purpose it created the Advanced School for Radiation Protection "Carlo Polvani" and, up today, has organized 41 courses focussed on specific topics. In 2004 the school, in collaboration with the Institute, organized the course "Individual internal dosimetry: methodologies, skills, practice", addressed to post-graduated students, qualified experts and other professionals with limited expertise in internal dose assessment. The programme of the course, the local organization, the subject of the lectures were proposed by the Institute. The practical activities were performed in the Institute laboratories at the ENEA Research Centre in Casaccia (Rome) where the course took place. The course lasted one week and was structured in theoretical lectures, practical exercises in the laboratory with individual monitoring equipments (whole body counters, alpha- and mass-spectrometers for urine samples) and classroom exercises with software tools for assessing the committed internal dose. The course was officially recognized by the Ministry of Health as part of the National Programme for the "Continuing medical education" (CME). The thirty participants took a final examination to verify their level of learning and awarded CME accreditation points. The course was the occasion to continue the harmonisation actions on internal dose assessment carried out with the VALDOSE intercomparison [2]. The lectures provided the attendees with the last developments from the EU-funded project IDEAS [1], participated by the Institute together with seven European institutions and aimed at developing European guidelines for internal dose estimation.

3. Harmonised approaches to education and training

In the last years the Institute has carried out activities aimed at developing harmonised programmes of education and training as well.

At international level the Institute started its actions in this field by participating to the organization of the European Radiation Protection Course (ERPC) with ten institutions from seven European countries (Belgium: SCK-CEN, France: DGSNR, INSTN, Germany: BFS, Italy: ENEA, ANPA, Spain: CIEMAT, CSN, The Netherlands: NRG, United Kingdom: University of Surrey) under the general coordination of INSTN (France). The main objective of the ERPC was to train at high level, in nuclear, medical or industrial applications, the experts in charge of radiation protection, radiological risk assessment, installations inspections (regulatory bodies), workplace and environmental monitoring, accident management. The content of the course was in accordance with European requirements for the qualified experts education and training [5, 11].

The course was based on 15 weeks of lectures and training with lecturers from several European countries. It was structured in four modules with a final examination at the end of each module, with a certificate awarded by the participants that have successfully passed the examination. It lasted four years (2000 - 2003) and was attended by twenty-five attendees from four European countries, plus several attendees sponsored by the International Atomic Energy Agency (IAEA). In 2003 the course was stopped: the lack of an official recognition of the certificate issued by the course in the European countries was one of the main reason of the limited number of attendees that, together with the significant costs of the organization, made the course no longer financially feasible by the INSTN,

The ERPC was a valuable experience aimed at providing European future radiation protection experts with common competencies and skills and it was intended to be a first attempt for a mutual recognition

of qualified expert. In fact, the wide variety of approaches to education and training of the qualified expert across the European Union is a barrier to the mutual recognition and, in part, is contributing to a perceived shortage in expertise in radiation protection and safety. On the base of this experience the Institute is today participating to the ENETRAP project [3]. The overall aim of ENETRAP is to determine mechanisms that in the longer term will facilitate better integration of education and training activities (with a view to mutual recognition across the EU) and to ensure the ongoing provision of the necessary competence and expertise at the level of the qualified expert. Detailed description of the project is given in a specific presentation at the same congress of this work [10].

At national level the Institute organizes the on-the-job trainings (OJT) required by the national legislation [4] to sit the examination for qualified expert. The qualification is recognised by the Ministry of Welfare. In Italy three levels of expertise are set for the qualified expert (for different levels of complexity of the facilities and relating radiation protection issues) and 120 days of OJT are required for each level. The Institute, due to its presence in the ENEA centres where a large variety of facilities using ionizing radiation are present, is able to organize OJT for all the level of expertise.

The national legislation gives also a basic syllabus for the qualified expert, based on the topics addressed by European Commission's syllabus [11]. During the training, Institute's qualified experts provide the students also with theoretical knowledge on radiation protection based on this syllabus.

4. Contributions to other education and training activities

The Institute carries out education and training activities in radiation protection in the frame of courses organized by several other Italian institutions. These activities are less oriented to provide knowledge on standardized methodologies or to develop harmonised education programmes, as they have to comply with the specific objectives of the organizers of the courses. Lectures are given in courses organised by the Advanced School for Radiation Protection "Carlo Polvani of the Italian Association for Radiation Protection, professional associations (e.g. Italian Association of Medical Physics), the Post-Graduate Specialisation School on Health Physics of the University of Bologna, the European School of Advanced Studies on Nuclear and Ionizing Radiation Technology of the University of Pavia (organised in partnership with the IAEA).

In recent time the Institute is testing also the possibility of providing education programmes in radiation protection by using web and on-line utilities. ENEA is running distance learning programmes about several topics of interest for professionals, public administrators and students. In this frame the Institute has created a distance learning programme about radon ("Radon: a neighbour to know") from the basic knowledge, aimed at providing general information, to most specific items as measurements techniques, legislation, risk assessment, mitigation actions [12].

References

- [1] General Guidelines for the estimation of committed dose from incorporation monitoring data. EU Project in the 5th Framework Programme. Contract No FIKR-CT2001-00160. <http://www.ideas-workshop.de>
- [2] C.M. Castellani, A. Luciani. Italian intercomparison exercise on internal dose assessment. *Rad. Prot. Dosim.* 105 (1-4): 443-446, 2003.
- [3] European Network for Education and Training in RAdiological Protection. EU Project in the 6th Framework Programme. Contract No 516529. <http://www.sckcen.be/enetrapp>
- [4] Attuazione delle direttive 89/618/Euratom, 90/641/Euratom, 92/3/Euratom e 96/29/Euratom in materia di radiazioni ionizzanti. D. Lgs. 17 marzo 1995 n. 230 (in Italian).
- [5] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. *Official Journal of the European Communities L 159 Volume 39, 29 June 1996.*
- [6] Doerfel H., A. Andradi, M.R. Bailey, A. Birchall, C.-M. Castellani, C. Hurtgen, N. Jarvis, L. Johansson, B. LeGuen, G. Tarroni. Third European Intercomparison Exercise on Internal Dose Assessment. Report FZKA 6457, Forschungszentrum Karlsruhe, April 2000.
- [7] Briesmeister J F (Ed.) MCNPTM - A General Monte Carlo N-Particle Transport Code, Version 4C Los Alamos National Laboratory Report LA-13709-M Manual, 2000.
- [8] G. Gualdrini and L. Casalini (Editors). Use of MCNP in Radiation Protection and Dosimetry. Proceedings of a Training Course (EC, ERPET, EURADOS, ENEA and OECD-NEA) Bologna 13-16 May 1996, ENEA Report ISBN 88-8286-000-1, 1998.

- [9] Gualdrini, G. and Ferrari, P. (editors) Intercomparison on the usage of Computational Codes in Radiation Dosimetry, Proceedings of QUADOS Workshop (Bologna Italy July 14-16 2003) ENEA-Rome ISBN 88-8286-114-7, 2004.
- [10] M. Coeck, C. Etard, S. Möbius, A. Schmitt-Hannig, A. Luciani, J. Van der Steen, M. Marco, J. Stewart, P. Scalliet, J. Balosso, R. Thompson. The Establishment of a European Network on Education and Training in Radiological Protection "ENETRAP ETRAP2005 "International Conference on Education and Training in Radiological Protection", 23-25 November 2005 in Brussels, Belgium
- [11] Commission Communication C133/03. Official Journal of the European Communities L-133, 30 April 1998,
- [12] S. Penzo, L. Gazzotti, M. Calamosca. "Il radon: un vicino da conoscere". Distance Learning course (in Italian). <http://odl.casaccia.enea.it>

Corresponding Author:

Andrea Luciani
ENEA
Via Dei Colli 16
40136 Bologna
Italy
T: +39 051 6098262
F: +39 051 6098003
e-mail: luciani@bologna.enea.it