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RECENT DEVELOPMENTS IN RECOGNITION AND HARMONIZATION OF REQUIREMENTS

United States Nuclear Regulatory Commission Training Program

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ABSTRACT

The Mission of the United States Nuclear Regulatory Commission (NRC) is to ensure adequate protection of public health and safety, to promote common defense and security, and to protect the environment in the use of nuclear materials in the United States. The ability of the NRC to accomplish its mission is, in part, dependent on the qualifications of its personnel. One aspect of the qualification process involves formal training which is managed by NRC Human Resources Training and Development (HRTD). In this paper we will provide an overview of the training program managed by HRTD for the NRC, including the organizational structure, the subject areas covered, the documents which specify training requirements, how training is provided, the methods used for evaluating effectiveness and a discussion of some of the challenges currently being addressed

1. Introduction

The Nuclear Regulatory Commission (NRC) is an agency of the United States Government with the responsibility to regulate the nation's civilian use of nuclear materials for the protection of public health and safety and the environment. The NRC's regulatory mission covers three main arenas: a) nuclear reactors, b) materials (such as industrial and medical applications) and c) waste (the nuclear fuel cycle, low and high level radioactive waste). The goals of the NRC are Safety and Security as noted in its Strategic Plan which is available along with additional information regarding the NRC at www.nrc.gov

The NRC is divided into several technical offices each of which has responsibility for specific aspects of its mission. The following is a list of some of these offices:

- Office of Nuclear Reactor Regulation (NRR) - responsible for overseeing existing nuclear reactors

- Office of New Reactors (NRO) - responsible for overseeing construction and licensing of the new generation of reactors

- Office of Nuclear Material Safety and Safeguards (NMSS) - responsible for regulation of the nuclear fuel cycle including uranium milling, conversion, enrichment and fuel fabrication. It is also responsible for the safe storage, transportation and disposal of high-level radioactive waste and spent nuclear fuel; and the transportation of radioactive materials.

- Office of Federal and State Materials and Environmental Management Programs (FSME) - responsible for overseeing both the Federal and State regulation of radioactive material. States which have entered into an agreement with the NRC assume regulatory responsibility within their borders for all nuclear materials except for reactors and federal installations. Currently, of the 50 States, 37 are Agreement States. More information about the Agreement State Program including training issues may be found at: http://nrc-stp.ornl.gov/ .

The NRC Headquarters (HQ) building is located in Rockville, Maryland; however, there are also four Regional Offices:

Region I - King of Prussia, Pennsylvania (near Philadelphia)
Region II - Atlanta, Georgia
Region III - Lisle, Illinois (near Chicago)
Region IV - Arlington, Texas (near Dallas)

While the headquarters offices are responsible for establishing regulatory policy, the regional offices implement the NRC's regulations by conducting inspections. In the case of medical and industrial applications, the Regions issue licenses for the possession and use of radioactive material and then inspect those licensees to ensure that they are in compliance with their license commitments and the regulations, and, that they are protecting the public, radiation workers and the environment

2. Training

To accomplish its mission, the NRC requires a highly competent technical workforce possessing the knowledge and skills to implement the regulations and protect public health and safety.

The responsibility for insuring the qualification of the staff to perform their duties rests with the Human Resources Training and Development (HRTD) which is a division within the Office of Human Resources (HR).

2.1 HRTD

The director of HRTD is the Chief Learning Officer (CLO) who has responsibility for all NRC training activities.

HRTD is divided into five training branches:

- Professional Development and Policy Branch (PDPB) - responsible for training in areas such as familiarity with computer software, leadership and management and other similar non-technical skills training.

- Regulatory Fundamentals Training Branch (RFTB) - responsible for generic reactor technology training, Site Access Training (also known as General Employee Training) and other reactor support training primarily for HQ personnel.

- Reactor Technology Training Branch (RTTB(B)) - responsible for advanced technical training in boiling water reactor (BWR) technology.

- Reactor Technology Training Branch (RTTB(P)) - responsible for advanced technical training in pressurized water reactor (PWR) technology.

- Specialized Technical Training Branch (STTB) - responsible for a wide variety of technical training including radiological safety of medical and industrial applications, risk assessment, security, licensing and inspection, root cause analysis, codes and standards, engineering support and essentially any other subject not directly related to reactor technology.

2.2 Training Facilities

The first two branches listed above are located in the Professional Development Center (PDC) in Bethesda, Maryland near the NRC HQ facility. The remaining three are located at the Technical Training Center (TTC) in Chattanooga, Tennessee (Figure 1) which is a remote facility not adjacent to any NRC Office or Region. This permits students to concentrate on their training activities with minimal distractions.

Figure 1 - Technical Training Center, Chattanooga, Tennessee

The TTC facility includes six classrooms with a capacity of 18 to 44 students and four full scope control room simulators representing the four vendors of nuclear plants in the United States (Figure 2).

Figure 2 - Nuclear Reactor Control Room Simulator

Also available are classroom training aids including reactor components, medical and industrial devices, radiation detection instruments and similar items for hands-on activities (Figure 3).

Figure 3 - Materials Training Aids

2.3 Training Courses

The technical training courses are given a 3 digit numerical designation preceded by a letter which represents the subject area (e.g., F-XXX). The letters are explained in Table 1. The numbers in parentheses indicate the total number of course offered in that subject area:

E - engineering support (13)	P - probabilistic risk assessment (22)
F - fuel cycle (8)	R - reactor technology (45)
G - regulatory skills (19)	S - safeguards and security (13)
H - health physics/radiation safety (26)	

Table 1 - Training Course Subject Areas

2.4 Course Catalogue

Unfortunately, the entire NRC training catalogue is currently available only on the NRC internal website. However, a subset of the catalogue focussing on the areas of responsibility of the Agreement States (medical and industrial applications and regulatory skills) may be viewed at: https://ilearnnrc.plateau.com/plateau/user/portal.do?siteID=ExternalCatalog . Additional information regarding NRC training courses may be obtained by contacting the Office of International Programs (OIP) at http://www.nrc.gov/about-nrc/ip/contact-ip.html .

Anyone interested in attending NRC sponsored training courses should contact OIP. Seats in our courses are available at no cost on a “space available” basis.

A few examples of the training courses provided by STTB are listed in Table 2. Unless otherwise specified, all courses are five days or less in duration.

NOTE: Courses with an “S” following the course number (e.g., F-102S) indicates a self study course.

E Courses	
E-115 - Medium Voltage Circuit Breakers	E-117 - Concrete Technology & Codes
F Courses	
F-102S - General Health Physics Practices for Fuel Cycle Facilities	F-206S - Fire Protection for Fuel Cycle Facilities
G Courses	
G-108 - Inspection Procedures	G-205 - Root Cause/Incident Investigation
H Courses	
H-122 - Basic Health Physics (2 weeks)	H-314 - Safety Aspects of Well Logging
H-305 - Safety Aspects of Industrial Radiography	H-313 - Brachytherapy, Gamma Knife and Emerging Technologies
P Courses	
P-200 - System Modelling Techniques	P-203 Human Reliability Assessment
R Courses	
R-105 - Nuclear Technology for Security	
S Courses	
S-201 - NRC Materials Control & Security Systems & Principles	S-503 - Advanced Intrusion Detection Systems

Table 2 - Sample Courses

2.5 Location

All reactor technology courses are taught by NRC staff at the TTC or PDC. However, the training courses offered by STTB are presented by various groups in various locations. Many of the courses such as medical, radiography and irradiator courses are presented by contractors who possess the expertise, equipment and facilities to provide hands-on activities as well as classroom lectures. For example, MDS Nordion Inc in Laval, Quebec, Canada has been the source for Irradiator Technology training.

Some health physics and regulatory skills courses are presented by STTB staff while others, like the Licensing and Inspection courses, are presented by experienced license reviewers and inspectors from the NRC Regions.

2.6 Qualification Programs

The NRC has established Qualification Programs for most of its technical staff. These programs provide detailed, step-by step processes to insure that individuals are qualified prior to being permitted to perform inspections or other significant activities unsupervised. These qualification programs are contained in Inspection Manual Chapters (IMC) which may be viewed at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/ . The following are the primary technical qualification programs:

IMC 1245 - Qualification Program for Operating Reactor Programs
IMC 1246 - Formal Qualification Programs in the Nuclear Material Safety and Safeguards Program Area
IMC1247 - Qualification Program for Fuel Facility Inspectors in the Nuclear Material Safety and Safeguards Program Area
IMC1252 - Construction Inspector Training and Qualification Program

3. Current Issues

3.1 Course Evaluations

Evaluating the effectiveness of training is an important consideration. In general the goal is to determine: the reaction to the training (student post-course evaluations), the learning achieved (exam results), the impact on behaviour (application of the learning during work assignments) and the results (such as a measured increase in productivity or efficiency).

The NRC currently uses the overall assessment of the course as a metric to determine success. There are five possible outcomes: Unsatisfactory, Marginal, Satisfactory, Good or Excellent. Success is achieved if 95% of the composite ratings for the year are satisfactory or better. In 2008, of 2,394 evaluations, 98.6% were satisfactory or better.

The questions on the evaluation forms have traditionally concentrated on the course content. Space is also provided for any additional comments. However, recently, there has been a directive to include specific questions relating to the performance of the instructors. Assessment of an instructor's knowledge and performance has traditionally been the responsibility of the individual's supervisor. It remains to be seen whether these additional questions will provide added value to the evaluation process.

3.2 Student Behaviour

A Working Group has been formed to establish a set of "Rules of Behaviour" for students. This resulted from instances where students attended training with inappropriate attire, used cell phones and PDAs during class and in recognition that electronic devices may be used to store reference material which could be used during examinations. Students must be made aware of any rules and those rules must be clearly defined.

Recognizing the difficulty in recruiting experienced professionals, the NRC is actively recruiting new university graduates in science and engineering disciplines to develop qualified staff in-house. Some of these "behaviour" issues may simply be a manifestation of cross-generational influences since many of these new hires are young, technologically advanced and come directly from university with no industry work experience.

4. Conclusion

The Nuclear Regulatory Commission's training program is a good one but it is not perfect. The newly appointed Chief Learning Officer has established a vision for the organization that will assist in our goal of continuous improvement. To achieve this vision it is important that:

- We know what knowledge and skills (competencies) the NRC workforce needs in order to effectively execute its mission and strategic goals.
- We know what the gap is between the level of knowledge and competencies our workforce currently possesses and what it needs.
- Our courses and other learning interventions are directly aligned to the needed knowledge and competencies.
- We are using the right (efficient and effective) modes of learning intervention delivery and capitalizing on the potential that technology offers.
- Our learning interventions are of known effectiveness in closing competency gaps and in improving accomplishment of mission and strategic goals.
- We are identifying, capturing, and making accessible the high-value and high-risk knowledge that already exists within our workforce.

We have much to learn from others who may have already addressed these issues and we are willing to share with others whatever information we can for our mutual benefit.

ENETRAPII: WP5
DEVELOP AND APPLY MECHANISMS FOR THE EVALUATION OF TRAINING MATERIAL, EVENTS AND PROVIDERS

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ABSTRACT

To maintain a high level of competency in Europe regarding radiation protection and to facilitate harmonisation and (mutual) recognition of Radiation Protection Experts (RPEs) and Officers (RPOs) quality assurance and quality control might play an important role. The ENETRAPII project (FP7-EURATOM) aims at developing European high-quality 'reference standards' and good practices for education and training in radiation protection. In work package 5 (WP5) the quality issue is addressed. Therefore WP5 deals with the development and application of mechanisms for the evaluation of training material, training events and training providers by means of a transparent and objective methodology. The results can be used by regulatory authorities to benchmark their national radiation protection training programme and will be communicated to other networks, e.g. EUTERP.

This paper provides a more detailed overview of the work in progress within ENETRAPII-WP5, regarding the quality aspects of education and training in radiation protection.

1. Introduction

The FP7 European Network for Education and Training in Radiation Protection II (ENETRAPII) project is a specific tool for EURATOM policy for E&T implementation in the radiation protection field and towards a mutual recognition of professional qualifications. The project will last three years.
Today's challenge in the field of radiation protection involves measures to make the work in radiation protection more attractive for young people and to provide attractive career opportunities, and the support of young students and professionals in their need to gain and maintain high level knowledge in radiation protection. These objectives can be reached by the development and implementation of a high-quality European standard for initial education and continuous professional development for Radiation Protection Experts (RPEs) and Radiation Protection Officers (RPOs).

For the purposes of this project the Radiation Protection Expert can be defined as :
"An individual having the knowledge, training and experience needed to give radiation protection advice in order to ensure effective protection of individuals, whose capacity to act is recognized by the competent authorities."
and the Radiation Protection Officer as:
"An individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the requirement of the Standards and whose capacity to act is recognized by the competent authorities".
These are the definitions as proposed in Item 4.5 Draft European Basic Safety Standards Directive - version 8 May 2009.

To reach high-quality European standards for initial education and continuous professional development, there has to be agreement between the European countries concerning the duties and responsibilities of both RPEs and the RPOs. These standards are developed in Work Packages 3 and 4 (WP3 and WP4) of the ENETRAPII project.

When these standards are known, each country will be able to access and benchmark its own education and training against the European standards. It will also be possible for a country to benchmark an RPE or RPO, educated and trained in another country, to their own national standard. Shortcomings become clear of education and training materials, events and providers, when it is possible to compare education levels and national standards to the European standard. Therefore one of the cornerstone work packages in ENETRAPII is work package 5 (WP5), entitled: *Develop and apply mechanisms for the evaluation of training material, events and providers*.

2. WP5 Objective, description of work and deliverables

The main objective of WP5 is:

To develop a mechanism for the comparison, through a transparent and objective methodology, of training materials, courses and training providers, which can be used by regulatory authorities to evaluate their national radiation protection training programme for compliance with the European Radiation Protection Training Scheme (ERPTS).

To reach this objective of WP5, the next items will be addressed:

1. Organisation of a kick-off meeting and subsequent WP5 meetings
2. Defining a detailed work programme for WP5 and subsequent division of tasks.
3. Identification of the elements that are essential for the comparison of training materials.

4. Identification of the elements that are essential for the comparison of training courses, including exercises, On-the-Job-Training, Work Experience, examinations, etc.
5. Defining the range of detail for course elements that is sufficient for compliance with the ERPTS.
6. Identification of the criteria and indicators that are essential for the comparison and evaluation of training providers.
7. Setting up and apply a quality assurance protocol for the comparison of training materials, courses and providers on the basis of the above-mentioned elements.
8. Reporting to the Steering Committee.

All items are drawn up in more detail in the next chapter.

The next deliverables will be produced. The items mentioned above will be input for the deliverables.

- WD5.1 Methodology and quality assurance protocol for comparison and evaluation of training material
- WD5.2 Methodology and quality assurance protocol for comparison and of training events
- WD5.3 Methodology and quality assurance protocol for comparison and evaluation of training providers
- WD5.4 Application of the defined mechanisms to some examples of training material, providers and events

The WP5 leader is NRG (The Netherlands). The work package partners are CEA/INSTN (France), FZK-FTU (Germany), ENEA (Italy), HPA-CRCE (United Kingdom), ENEN (European), ITN (Portugal) and UPB (Romania).

3. Detailed work programme

The work package will be split up in four parts, related to the four deliverables. The research for the first three items (WD5.1 to WD5.3) will be carried out parallel. When all methodologies and protocols are finished, they can be applied to some examples of training materials, training events and training providers.

The first two years are going to be used for a survey to existing and new comparison methods and protocols (WP5) and a definition of the European standards (WP3 and WP4). In the first year an inventory takes place towards of the comparison methods currently applied in the WP5-partners countries. The preferred comparison methods will be worked out in more detail during the following year, after which it can be used for the comparison with the new European standard (WP3 and WP4) during the last year.

3.1 Organisation of a kick-off meeting and subsequent WP5 meetings

The kick-off meeting of WP5 is scheduled for November 2009. Preferably the kick-off meetings of the different work packages in the ENETRAPII project will be combined.

Two subsequent meetings of the WP5 participants are foreseen. It is tried for financial reasons to couple the WP5 meetings to other ENETRAPII events.
The first one will take place when the inventory to existing comparison methodologies is finished (12 months after the kick-off meeting of WP5). Its goal is to decide on a comparison method or methods that is (are) going to be used in WP5 for the training material, training providers and training events.
The second meeting is foreseen when the comparison method(s) is (are) worked out in detail at the end of the second year (24 months after the kick-off meeting of WP5).

3.2 Defining a detailed work programme for WP5 and subsequent division of tasks

The work programme for WP5 will be an adapted version of this paper. The tasks will be divided amongst the partners at the kick-off meeting.

3.3 Identification of the elements that are essential for the comparison of training materials

WP5 will start with an inventory of topics, items and subjects that need to be addressed in the education and training of the RPE and RPOs. These main subjects need to be subdivided in a reference table to come to a methodology of comparison. With this reference table each country can compare its own training and education methods with that of the European Standard (WP4 and WP4).

The inventory starts with the subjects addressed in the syllabus EG133 (EG Basic Syllabus 98/C133/03), the IAEA syllabus (IAEA Basic Syllabus PGEC), the European Master's degree in Radiation Protection syllabus – EMRP - (result of WP8 ENETRAP), the existing tables of subjects for education and training in radiation protection and similar tables used in different countries.

3.4 Identification of the elements that are essential for the comparison of training courses, including exercises, practical works, On-the-Job-Training, Work Experience, examinations, etc.

For comparison of the training courses an inventory will be carried out amongst WP5 partners about the number of hours spent on the identified elements. These hours have to be classified as class hours (theoretical, problem solving, examination), practical hours, on the job training and work experience, etc. The results of this inventory will be used to determine a reference standard.

3.5 Defining the range of detail for course elements that is sufficient for compliance with the ERPTS

The range of detail will be based on the European standards, determined by ENETRAPII WP3 and WP4. The subdivision, mentioned earlier and the range of detail of the European standards will result in a reference table, which indicates the detail of the subjects that need to be addressed in education and training for RPEs and RPOs. This also holds for the elements needed for course comparison and for event comparison.

3.6 Identification of the elements that are essential for the comparison of training providers

For the comparison of training providers an inventory will be carried out about the elements of quality assurance. This inventory will take into account requirements by regulations and international standards, e.g. ISO 17024 and topics addressed by stakeholders. The WP5 partners will be asked to collect the topics of the stakeholders as input to obtain a list of demands for training providers

3.7 Setting up and apply a quality assurance protocol for the comparison of training materials, courses and providers on the basis of the above-mentioned elements

Discussed and selected comparison methods will be joined to create in a protocol. The usefulness of this protocol will be verified by applying it to some training materials, courses and providers.

3.8 Reporting to the Steering Committee

The WP5 leader (NRG) will report to the steering committee about the progress at each SC meeting. The progress reports will be based in the input of the WP5 leader and the WP5 partners. A progress reports will be sent to the SC after 12 months, 24 months and 36 months.

HARMONIZATION OF NATIONAL AND REGIONAL EDUCATION AND TRAINING IN RADIATION PROTECTION IN CASE OF BELARUS

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ABSTRACT

The approaches to train specialists in radiation protection in the region of Former soviet Union countries and possible pathways to harmonise nuclear and non-nuclear education and training in radiation safety, justification of needs, appropriate education and training curricula, optimization of list and curricula of post-graduate and re-training courses within the framework of international co-operation between European Union and Former Soviet Union countries are considered. The main goal of this report is to draw attention of the European Union countries on new possibilities for co-operation and to develop proposals for getting started in this way.

1. Historical background

Training in radiation protection In Former Soviet Union (FSU) was concentrated in several huge Russian centres like Moscow, Leningrad (Saint Petersburg now) and their affiliations mostly situated in some settlements secret at that time like Obninsk, Sarov, Krasnoyarsk-16 etc. The radiation protection was "parked" in 3 main brunches: nuclear technologies, medicine and military applications. Environmental issues of radiation protection where not separate from nuclear technologies and their military applications and, as the result, were outcasts of political decisions.
Relating to Belarus at times of the FSU one can mention some experience in training on nuclear physics, radiochemistry and radiation chemistry (Belarus State University) for nuclear research institute of the National Academy of Sciences and the Research Institute of Nuclear Problems of Belarus State University with minor distribution to institutions and enterprises using ionising radiation sources. Small amount of medical doctors involved in use of medical applications of ionizing radiation was being trained in Minsk medical institute in that time. No engineers for medical applications were trained at all. All of them had come into the brunch from nuclear physics and general engineering. Re-training in the field was almost absent but some professional updating and refreshing was carried out within the ministries that were responsible for use of radiation sources. There were separate regulatory bodies for industrial and medical applications that attracted specialists from the practices with refreshing and enhancing their knowledge in central training institutions of FSU in Moscow, Leningrad, Obninsk, etc. That is why there was the lack of local specialists in radiation protection at the moment of Chernobyl accident in Belarus. The same situation, may be, a little bit better was at that time in Ukraine and the west districts of Russia affected by Chernobyl releases.
The situation was worse in other FSU republic: Armenia, Azerbaijan, Baltic countries, Georgia, Moldova, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan. The training was almost absent at all levels except, may be, small amount of people in several local universities like in Armenia having nuclear power plant (NPP) at that moment. It was habitual, like training specialists for Ignalina NPP in Lithuania, to give basic general training at the first 2-3 years in national universities and to deliver than for completing education in Moscow and Obninsk.
As result, after the disintegration of the Soviet Union there were no sustainable education and training in radiation protection in all FSU countries except Russia, and, may be, only

Ukraine was close to the sustainability in the field but political processes and lack of national funds prevented at that time to form the system quickly. Because of mostly political reasons the possibility to continue education and training specialists in radiation protection for national needs of FSU countries in Russia has been lost in the beginning of 1990th.

2. Why Belarus, why ISEU?

Belarus has become as the centre of counteraction to these centrifugal effects in FSU mostly suddenly (figuratively saying, like a ‘strange attractor’) but there were several strong reasons to that.

After 6 years spent from Chernobyl, in 1992 the International Sakharov College on Radioecology was created. The project was launched due to proposal of the 1st memorial Andrey Sakharov Congress held in Moscow in 1991 that had advised to create such kinds of higher institutions as internationally co-operating bodies to assist to alleviating the environmental and medical consequences of Chernobyl in 3 countries: Belarus, Russia and Ukraine. To facilitate the international co-operation and to promote to the dissemination of international experience and approaches the congress had proposed to establish an International Advisory Committee in each institution. It was the only Government of Belarus that has created the institution of such kind with the International Advisory Committee (the first head, Prof. Richard Wilson, Harvard University, USA) after huge organizational work done by Alexander Lutsko, the first rector of the College that soon, in 1995, had become the International Radioecology Institute and than the International Sakharov Environmental University (ISEU) in 1998. Being focused at the first time on only radiological consequences of Chernobyl accident the institution has steadily expanded its efforts to education and training for all fields embracing by radiation protection.

Still Prof. Alexander Lutsko (he suddenly died in 1997) had drown attention of the ISEU staff onto efforts of the International Atomic Energy Agency (IAEA) to promote education and training in radiation protection. The 1st for ISEU national technical co-operation project with IAEA was implemented in 1999-2000. At the same time the Educational committee of the Community of Independent States (CIS) created after disintegration of the Soviet Union had taken the decision to establish the Standing commission on training in radioecology, radiobiology and radiation safety of several CIS countries (firstly, Belarus Kazakhstan, Moldova, Russia and Ukraine). This outcome had happened also due to the initiative of Alexander Lutsko, continued by the second ISEU rector, Prof. Alexander Milyutin and current rector Prof. Semyon Kundas. The work of the commission goes slowly because of lack of funds issuing by CIS for that but it has established officially the co-operation in training in radiation protection among CIS countries at the regional level.

The co-operation with IAEA has resulted in establishing the regional Post-Graduate Course (PGEC) on radiation protection and safety of radiation sources on the base of ISEU in Russian language for FSU and mostly Eastern-European countries which specialists use Russian in their professional work. There were 116 specialists trained at PGEC in ISEU, Minsk, since 2001. Graduates are awarded by Belarus national diploma on re-training within the speciality “Radiation protection and safety of radiation sources” established since 2006 in full accordance with the IAEA PGEC Syllabus. ISEU has got the licence from the Ministry of Education of Belarus to award participants by such diploma.

The strong technical support of IAEA brought the international content and approach to education and training in radiation protection in Belarus and operation of the CIS Standing commission had provided the basis for the ISEU to pretend to be a regional training centre in radiation protection. At the same time Belarus Parliament Standing commission on alleviation of Chernobyl consequences had advised in 2005 to direct ISEU efforts in training not only onto Chernobyl problems but also to all radiation protection issues for Belarus and to convert the speciality “Radioecology” from pure environmental to more engineering mode. It was partially realizing within the specialization “Radiology” introduced into the speciality “Radioecology” in 2001 but real sufficient changes in the national education and training has started in Belarus only in last 2 years.

In September 2008 training specialists on new for Belarus speciality "Nuclear and Radiation Safety" had started in ISEU. There was some preliminarily work done in 2 years before to create the education and training in the field including radiation safety in non-nuclear sector. The experience of Russia, Ukraine and also France, Great Britain and, to some extent, United States were also taken into account. It would be impossible without the 'Nuclear Renaissance' being come to Belarus just after the end in 2008 of moratorium on to build NPP taken by Belarus Parliament many years ago. The decision of Belarus leadership to install NPP in Belarus, sufficient organising efforts and financial contribution from the Government of Belarus has opened the new era in ISEU activities in radiation protection.
As it was in the Soviet Union and is continuing in CIS now the nuclear brunch is the locomotive of education and training in radiation protection at all. Training specialists on safe use of different radiation sources is the specialization now in the speciality "Nuclear and radiation safety". It is essential to emphasize, that education and training in non-nuclear radiation protection has the opportunity to obey solid material resources in this case. At the same time, permanent growth of uses of radiation sources in medicine and industry, rapid aging the staff turn the attention of profile Ministries of Belarus (the Ministry of Health, first of all) to the capabilities of ISEU developing in the last years due to contribution of the IAEA and national nuclear programme.

3. New opportunities

Recent progress in co-operation between CIS countries and especially in rather new European-Asian Economical Society (EAES), comprised Belarus, Kazakhstan, Kyrgyzstan, Russia and Uzbekistan, established the Council for co-operation in the peaceful use of atomic energy, provides new possibilities in the European and the World co-operation. Thus, The Council has launched the International Nuclear Innovation Consortium (INIC) united higher educational institutions involved in the nuclear field in EAES countries.The 1st meeting was held in the Moscow Engineering Physical Institute (MEPhI) as the head of INIC in May, 2008. In May, 2009 Russian President, Dmitri Medvedev has signed the bill to establish the Federal Nuclear University uniting all the former MEPhI affiliations like the Obninsk Institute of Atomic Energy and also some faculties and parts of other institutions, including Ural Polytechnic University, Tomsk Technical University and other institutions strong in nuclear field under the MEPhI umbrella. In combination with activities at the regional level it opens new opportunities in the international co-operation in education and training in radiation protection at all. And the role of ISEU in this case can be to focus efforts of the regional community to harmonize their approaches in education and training in the field between each other and with the European Union to have the firm basis for the sustainability and equality of approaches to radiation protection.
The experience gained since 1991 in FSU countries shows that it would be wasting time and efforts if the harmonization would be started from the equalization of organization of academic life like involving into Bologna Process. Despite of the evident progress in that (for instance, Russia and Kazakhstan had strongly joined to the process) it takes some time to concord all points of view at national levels. For instance, Bologna process has not been started in Belarus yet. But there are specific features of our internal regulations established by the Ministry of education that can de considered very close to European two level higher education. It seems that harmonization can be carried out now within the following directions not strongly connected to the Bologna policy:

- harmonization of professional requirements to graduates;
- creating comparison table of equal qualifications and positions in radiation protection in different countries;
- enforcing exchange between counterparts by information on education and training in radiation protection;
- establishing the permanent exchange by training methodologies including distance learning and e-learning;
- promotion to fellowships and scientific visits of the staff of different universities to exchange the findings and to learn at the place;

- accumulation of the database of the best practices in education and training in radiation protection.

The final aim is to reach the mutual recognition of professional qualifications in different states. This work is doing within the European Union. There is the good moment to join the harmonization process going now in the Eastern part of the Europe and the Middle Asia to the European Union approach.

4. Towards organizing the process

The big renovation of professional requirements to the specialists in radiation protection is started in the Russian Federation within the more wide process of establishing up-to-date requirements collected in so called ‘professiongrams’. Introducing into some of them one may reveal the good comprehension to that is proposed by IAEA and is being processed within the European Union (EU). There is only a need to adjust the requirements and to create the comparison table of equal professions.

Then, there will be an opportunity to derive the appropriate content of education and training from the professiograms harmonized and developed and to standardize it. The content must be fitted to be provided by different ways of the organization of training habitual to different countries. The main goal in this part is to reach the same message to be conveyed.

To assure that the process is going on concordance with appropriate international approach the quality assurance programme is to be established in each country being a counterpart in this co-operation. Standards of ISO-9000 series provide the firm basis for that. It should be mentioned that almost all Kazakh universities are passed through this processes of validation. Approximately the 3rd part of Russian universities are also accredited in the way if ISO 9000. This is the turn for Belarus. Recently, Belarus Rector Council and the Ministry of Education have taken the decision to bring national quality assurance programme of education and training in compliance with ISO-9000 series. Special working plan to implement this decision is adopted. It seems that despite of sometimes critical differences between national approaches to organization of education and training the internationally assumed procedure of quality assurance can be the key to open the doors.

It should be added that the Ministry of Education of the Republic of Belarus has ordered to Belarus universities to develop new syllabi for 2 year Master Courses versus existing 1 year ones. At the same time the Minister of Education urge universities to develop the Master courses curricula to be able to provide training in English. It means, that these curricula must be in total accordance with similar curricula providing by European universities.

To reach these goals establishing of close co-operation of EU and CIS universities providing education and training in radiation protection is desirable. It can be done within several international programmes like a regional project for IAEA and/or a TEMPUS project. There can be not one to cover particular topics in radiation protection of mutual interests of counterparts.

5. Main RP education and training stream in ISEU

Harmonization has to be start from the comparison of approach in the education and training content at the same levels of education. In this way one should taken into account details of existing curriculum in nuclear and radiation safety in ISEU.

The first level curriculum for training of specialists in nuclear and radiation safety being implemented now in ISEU is based mainly on the combination of MEPhI’s academic plans for correspondent specialities and the ISEU experience on training in radioecology. The major ruling idea was to provide to students a sound basic knowledge in:

- higher mathematics with probability theory and statistics (2 years, 32 credits);
- general physics (2,5 years, 31.5 credits);
- chemistry (2 years, 16.5 credits);
- basic life and environmental science (2 years, 13.5 credits) with basic environmental practice (2 weeks);
- basic computer science (1.5 years, 9 credits).

It is supposed to provide a firm platform for professional and special subjects that occupy the 47% of the curriculum. They can be split into the following groups:

- *special phys-math* subjects including physics of a nucleus and ionizing radiation, radiation detection and measurement, etc.(21,6%);
- *special phys-chem* subjects as radiochemistry, radiation chemistry, radioactive waste management (5,1%);
- *special biomedical* subjects as biological effects of ionizing radiation and basic radioecology (3,2%);
- *general engineering* subjects including theoretical mechanics, basic radioelectronics, basic design, material science etc. (22,7%);
- *special engineering* subjects including radiation shielding, nuclear reactors, reliability and risk management, metrology, etc. (12,5%)
- *specific economics and law* issues (8%)
- *special interdisciplinary subjects* including dosimetry, general and radiation safety, basics of radiation monitoring, safety for cases of planned and existing exposure, emergency response, etc (15,9%).

There is the specific point of ISEU curricula that all students are trained deeply in foreign languages (English is mandatory – 688 hours, second foreign language – 456 hours with options for French, German. Spanish). It should assist to a future specialist not only to read and write but to communicate in the field of his/her professional interests and also be able to take a part in international co-operation.

The duration of training at the 1st level is 5.5 years now. It includes 17 weeks of practice at radiation objects and defending the diploma project or work.

Training at the Master course in nuclear and radiation safety (2nd level of higher education) is 1 year now. We consider the possibility to expand it to 2 years with specific training in radiation protection issues related to uses of ionizing radiation.

Re-training and professional updating is going in ISEU now within the line established by IAEA. But there is big need for the country to join all the activities in the field under this umbrella.

We also keep in mind the growing demand of medical physicists. Their education and training does not exist in Belarus now. We need substantial assistance from well experienced EU bodies in establishing that.

6. What can be of interest for EU from this co-operation

There can be many of contributions to be in benefit to European universities from possible co-operation programme. It would be desirable if the project would comprise not only well experienced universities especially from new EU countries but new ones that are aimed to develop some particular radiation protection profile, for instance, in medical physics or industrial applications. It would involve them in the main flow and will provide an opportunity to get additional assistance from EU and other international bodies in the benefit to harmonization of training approach and capabilities

CIS universities can share with their EU counterparts by their findings in training materials, organization and technical support of knowledge evaluation including distance methods and some webwise tools, etc. Sound experience of MEPhI and other institutions in Russia uniting into Federal Nuclear University can be of special interest for many of EU universities.

It seems that implementing the projects the counterparts might find many peculiarities that would be fruitful for their development. ISEU, particularly is looking for co-operation in education and training for medical applications of ionizing radiation.

Professional Qualification in Radiological Protection:
Update on the Portuguese Needs

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Abstract
A recently published decree-law (*Dec.-Lei nº 227/2008 de 25 Novembro*) introduces three levels of professional qualification in radiological protection: the Qualified Expert (QE) equivalent to the RPE, the Qualified Technician (QT) equivalent to the RPO and the Operator Technician (OT) equivalent to the RW. The law enumerates roles and duties for each of them, outlines specific training programmes and addresses pre-requisites to be fulfilled by candidates applying for the professional qualification.
Information on the contents of the decree-law will be given, and a detailed assessment of the training effort required in Portugal will me made taking into account the number and geographical distribution of equipment using ionizing radiation sources.

1. Introduction
Central aspects of Radiological Protection (RP), namely, RP of professionals exposed to ionizing radiations and that of patients submitted to radiological diagnostic and also to therapeutic involving ionizing radiations have been given particular attention at European level. The EU Directives 96/29 and 97/43 of Euratom that specifically address these matters had been partially transposed to the legal Portuguese framework for some time now, but only recently a long waited for law on qualifications and training of professionals was finally published
The decree-law (*Dec.-Lei nº 227/2008 de 25 Novembro*) introduces different levels of professional qualification in radiological protection, enumerating the roles and duties for each of them, outlines specific training programmes and addresses pre-requisites to be fulfilled by candidates applying for the professional qualification. In addition it addresses requirements to be fulfilled by training entities, and designates a supervising body. In spite of this, the present situation in what RP is concerned is still negatively conditioned by the fact that is not yet mandatory for an industrial installation using radiation based equipment to incorporate in its staff a Qualified Expert in radiation protection.
This may explain why the Portuguese medium and higher education institutions have paid little attention to the field of RP. However, there is an increasing awareness of the need to correct the situation. Reflecting this concern, the Instituto Superior Técnico (IST) of the Technical University of Lisbon offered a master course in Radiation Protection that were lectured, in collaboration with the Instituto Tecnológico e Nuclear (ITN), and offers presently the second edition of a professional specialization course in RP, again lectured in collaboration with ITN. Other initiatives along this line are under way, involving other institutions of the Portuguese higher education tree.
At a different level, training courses for professionals dealing with ionizing radiations (industrial equipment operators, radiologists and other health professionals), Civil Protection officials, army personnel and firemen, have been organized and lectured manly by ITN, most of them under request. These are typically one week or less courses, for which no specific academic preparation of the trainees is required. As for the use of ionizing radiation in medical practices, current legislation imposes that all practices must be performed under the responsibility of a physician with specific knowledge of RP. Furthermore the teams that operate the equipments must include a specialist in medical physics. It is, however, to be noted that the specialized training programme of the physicians is not clearly defined, and the same somewhat applies to the training programmes of the specialists in medical physics.
The recently published legislation gives important guidelines and opens the opportunity for an effective intervention aiming at the improvement of the overall situation of RP in the country. This paper addresses briefly essential aspects of the legislation and estimates the training effort required in the coming years.

2. The new legislative package
The recent legislation defines the following three levels of qualification of professionals of radiation protection: Qualified Expert (QE), Qualified Technician QT), Operator Technician (OT). For each of them it defines the

duties/functions, the specific training (duration, basic syllabus), the pre-qualification required to access training, and the conditions for the renewal of certificates.

In what concerns duties, the QE has the role to provide comprehensive, professional advice to the employer on a wide range of radiation protection matters. The QE will establish the radiation protection and safety programme in accordance with the relevant national requirements. He/her is expected to supervise radiation protection and safety within a facility, and where appropriate, coordinate the activities of the QTs working at the same facility (institution), within the framework of RP. We note that once qualified as an expert, the professional can work both in the health sector and the industry sector, irrespective of the on-the-job component of the training which is carried out in a specific field.
The activity of the QT is practice oriented, his (hers) primary function being to guarantee the application of the relevant legislative requirements and ensure that the work is carried out safely in compliance with the established RP programme. The specific duties of the QT will somehow depend on the nature of the practice.
The OT operates equipment under supervision.
Table 1 presents for the different qualification levels, background required for candidates to access ET programmes, the duration of the ET programme and the kind of evaluation of the candidates.

	QE	**QT**	**OT**
Background required to access the ET level	**University degree** in Physics; Technological Physics; Physical Engineering or Biomedical Engineering University degree in other areas through CV analysis	Those mentioned for LEVEL 1 plus: Chemistry; Engineering; Medicine; Dental Medicine or Veterinarian Medicine	High school:
Duration	**300** h in class (50% practical) + (on-the-job training – 6 months)	**100** h in class (50% practical)	**12** hours
Programme	IAEA and EU syllabus (apart from the training, there is no distinction between the ET programme of a health or a industry QE or QT)		Fitting the working environment
Evaluation	**Final exam** + **analysis of a detailed report** produced during the 6 months on-the-job training	Final exam	

Table 1. *ET training for the different qualifications in RP.*

The law states that the General Directorate of Health (DGS), which acts under the Health Ministry, is the competent body to recognize the scientific and technical competence of ET entities, to approve specific training programmes and to certify the professional qualification of professionals. The higher education institutions and ITN are recognized as competent entities in this field. All remaining entities need to seek approval from the DGS to become RP training providers enabling applicants to become qualified. Furthermore, all ET programmes will have to be approved by the DGS.
Once approved in the ET course, the candidate gets a certificate of professional qualification that has to be renewed every three years. Renewal depends on a favourable assessment of a detailed report of the three year activity, and the candidate should include proof of the attendance of refreshment courses, although they are more mandatory to achieve renewal.
For those professionals that are already in the field, the legal diploma considers equivalence schemes for them to be considered as qualified experts or technicians. In these cases the qualification certificate is issued following a positive evaluation of the curriculum of the candidate, provided the following pre-requisites are met:

	QE Level	QT Level
Education	University Degree in Physics; Physical Engineering, Technological Physics; Technological Chemistry or Biomedical Engineering	University Degree in Physics; Chemistry; Engineering; Medicine or other Health Sciences Degree Or Bach in the same subjects
Experience performing technical duties in the area	5 years	3 years

Table 2. *Pre-requisites for professionals in the field to apply for the two top level qualifications in RP.*

In this respect it is to be stressed that the choice of the legislator was to attribute automatically the qualification of QE to all medical physicists in activity.

All together, full implementation of this diploma requires an important training effort, particularly in the industry sector, especially if and when complementary legislation is issued imposing that all operation of equipment that uses ionizing radiation sources must have the supervision of certified qualified professionals.

3. Estimated personnel needs

The number of qualified experts in RP depends on the number and complexity of the equipments being operated. Table 3 presents the most recent data concerning all licensed equipment in Portugal, gathered by the General-Directorate of Health. Data is given for five administrative regions of continental Portugal: Alentejo, Algarve, Lisboa e Vale do Tejo, Centro, Norte and the autonomous regions of Madeira and Açores. The data is grouped into 12 categories for the sake of comparison with data from 2005. The cathegories are: CT scanner, Veterinary x-ray units, Dental x-ray units, Conventional x-ray units, Orthopantomograph units, Nuclear Medicine (gamma cameras), Mammography, Radioisotope laboratory, Bone densitometry, Brachytherapy, External radiotherapy (linear accelerators and cobalt units) and radiological industrial applications (gammagraphy and radiography units, density meters, level meters, thickness meters,).

Equipment	Alentejo		Algarve		Lisboa e vale do Tejo		Centro		Norte		Madeira e Açores		Total
	2005	2009	2005	2009	2005	2009	2005	2009	2005	2009	2005	2009	2009
CT scanner	10	10	9	12	51	83	15	28	55	111	NA	5	**249**
Veterinarinary X-ray	6	10	0	15	24	64	6	21	45	91	NA	1	**202**
Dental X-ray	30	30	37	42	419	490	91	93	317	377	NA	105	**1137**
Conventional X-ray	19	4	26	47	189	126	58	47	140	168	NA	18	**383**
Orthopantomography	6	9	6	21	87	148	30	48	79	146	NA	22	**394**
Nuclear Medicine	0	0	1	1	9	13	7	6	14	11	NA	1	**32**
Mammography	14	11	11	14	84	107	23	39	92	140	NA	7	**318**
Bone densitometry	10	11	6	13	76	106	25	41	68	116	NA	3	**290**
Brachytherapy	0	2	0	1	14	24	4	4	8	7	NA	3	**41**
Ext. radiotherapy	0	2	1	1	11	20	3	3	3	9	NA	3	**38**
Industry	6	48	9	47	181	346	66	94	103	256	NA	38	**829**
Radioisotope lab.	2	2	2	3	22	48	9	7	8	25	NA	3	**88**
Heavy ions cyclotron								1		1			**2**

Table 3. *Licensed equipment in Portugal. (Source: Directorate-General of Health)*

It is noticeable the increase in the number of licensed equipment particularly in the industry sector, reflecting both and increase in use of equipment making use of ionizing radiation, and the effectiveness of the action of the DGS.

Fig 1 presents graphically the data from 2009. It is noticeable that the equipment density is higher closer to the coast and in particular near to Lisbon and Oporto. This distribution, that is very similar to that of 2005, can be easily correlated with the population density map of the country. The southern and in-land regions have a much lower equipment (and population) density.

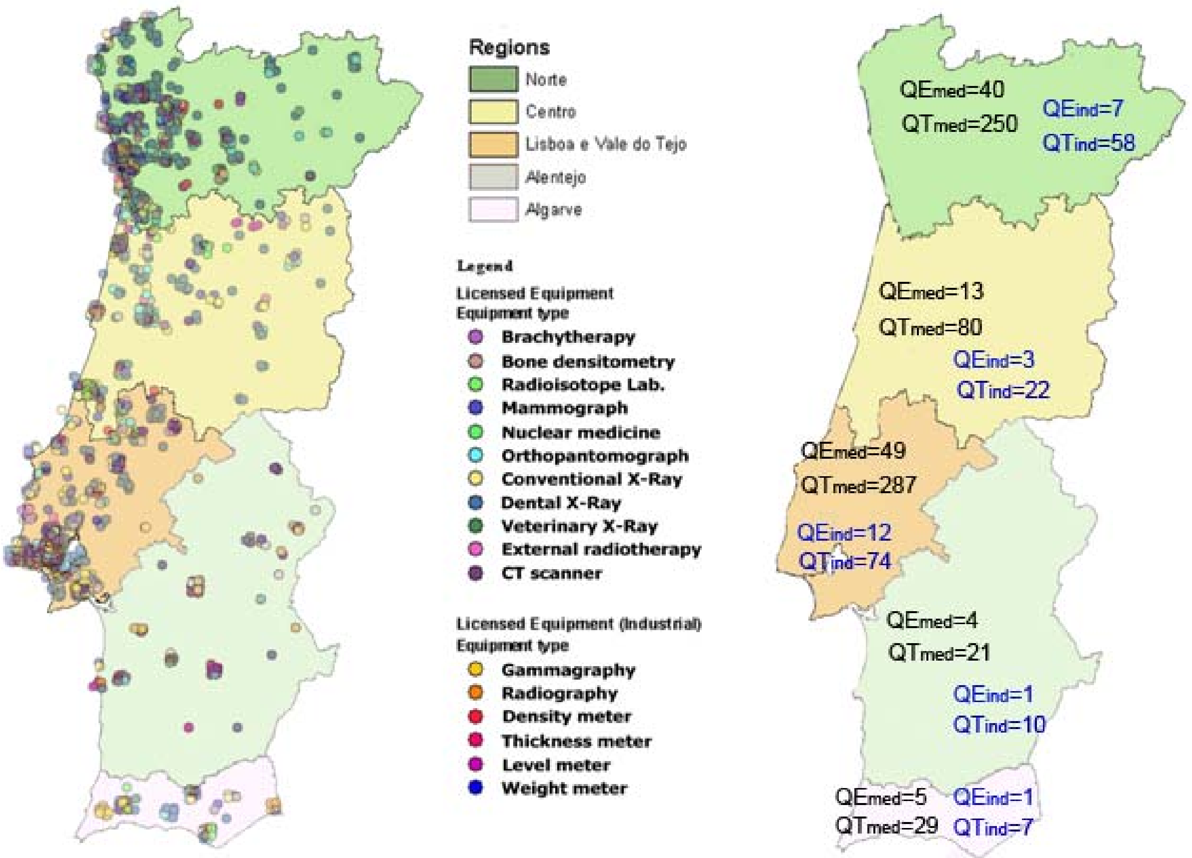

Fig 1. *Equipment distribution and corresponding estimated personnel needs.*
(Source: Directorate-General of Health, 2009)

In order to make an estimate of the personnel needs in the country we multiplied the data included in table 1 by a factor of 1.2, on the basis that: (*i*) facilities are still undergoing licensing; (*ii*) new facilities are scheduled to be installed; (*iii*) some licenses have expired and are seeking renewal. Using this data and assuming that the reference personnel/equipment ratios presented in table 4 are applicable, it is possible to make a rough estimate of the personnel needs for each type of equipment.

Equipment	QE	QT
Linear accelerator	0.37	2
Conventional x-ray	0.03	0,2
Brachytherapy	0.18	1
Gamma camera	0.2	2

Table 4. *Personnel needs for each type of equipment on a radiotherapy service*
(adapted from tables I and II from Annex II of Decree-Law nº 180/2002 of August 8th)

Some assumptions were made for the remaining equipment, namely, that CT scanners, bone densitometers and veterinary x-ray units have the same personnel needs as conventional x-ray units. For dental x-ray and orthopantomograph units, it was assumed that 1 QE/QT would be able to monitor 40 facilities. For radioisotope laboratories, it was assumed that they have the same personnel needs as those of nuclear medicine units. For industrial applications it was assumed that 1 QE could handle 20 facilities of high radiological risk, and 1 QE could supervise 40 facilities of low radiological risk. Numbers of QT were adjusted taking into consideration the distribution of the number of equipment per installation.

Results from these estimates for continental Portugal are presented in table 5 and graphically in Fig 1.

Region	QE (Medical)	QT (Medical)	QE (Industry)	QT (Industry)
Alentejo	4	21	1	10
Algarve	5	29	1	7
LVT	49	287	12	74
Centro	13	80	3	22
Norte	40	250	7	58
Total	111	667	24	178

Table 5. *Estimated personnel needs for each administrative region*

Under the assumptions made, the numbers presented in table 5 provide an estimate on the number of qualified experts and technicians required in the country. The numbers should be considered round numbers since, on one hand, we are in presence of a dynamic situation, and on the other, there are already in the market many very qualified professionals whose qualification can be recognized through the equivalence scheme mentioned in the recently published legislation. This is particularly so for professionals working in the medical field. However, the training effort required to upgrade the present situation to an adequate level is still considerable, especially for industry applications of ionizing radiation.

4. Conclusions

We have outlined essential aspects of recently published legislation addressing ET in radiation protection, and made an estimate of the number of higher qualification professionals required in the country. Although the real numbers and the true impact of the present legislation can only be known and felt upon publication of complementary legislation defining the number of professionals per installation/equipment, and making mandatory that all installation should hire those professionals, a rough estimate of the training effort was made. Training providers should take good notice of what was published and launch training programmes in compliance with what is required for qualification. One final note to state that something that clearly is required is to strengthen the DGS team that is in charge of dealing with these matters.

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