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ENETRAP-II



WD7.1 Accompanying text for at least one module of the RPE or the RPO training scheme (DRAFT)^o

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ENETRAP II: EUROPEAN NETWORK ON EDUCATION AND TRAINING IN RADIOLOGICAL PROTECTION.

1 INTRODUCTION

Euratom BSS are Guidelines of the Council of the European Union dated 13th May 1996 to stipulate the **basic safety standards for the protection of labor and the population against the hazards of ionizing radiation.**

COUNCIL DIRECTIVE 96/29/EURATOM, 13 May 1996 lays down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation.

The basic standards of 13th May 1996 are geared to the new scientific findings in radiological protection contained in the ICRP Publication 60.

The member states of the EU were obliged to enact the required national legal and administrative regulations to implement the Euratom basic standard by 13th May 2000.

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 revision of the European Basic Safety Standards will take account of the latest recommendations by the International Commission on Radiological Protection (ICRP) and will improve clarity of the requirements where appropriate.

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 harmonization in Europe.

For the purposes of this project, the Radiation Protection Expert can be defined as:

“A person having the knowledge, training and experience needed to give radiation protection advice in order to ensure effective protection of individuals”

and the Radiation Protection Officer as:

“An individual technically competent in radiation protection matters relevant for a given type of practice who is given the role of overseeing the application of relevant radiation protection standards in the workplace”.

With particular respect to the RPE a methodology for mutual recognition on the basis of available EU instruments, such as the European Qualification Framework (EQF) and/or the Directive 2005/36/EC is also seen as enhancing the profile of such professionals.

2 OBJECTIVES

The overall objective of this project is to develop European high-quality "reference standards" and good practices for education and training (E&T) in radiation protection (RP), specifically with respect to the RPE and the RPO. These "standards" will reflect the needs of the RPE and the RPO in all sectors where ionizing radiation is applied (nuclear industry, medical sector, research, non-nuclear industry). The introduction of a radiation protection training passport as a means to facilitate efficient and transparent European mutual recognition is another ultimate deliverable of this project.

With respect to the RPE the overall objective is to be achieved by addressing both education and training requirements. In the field of education this project deals with high-level initial programs, mainly followed by students and/or young professionals. It is foreseen to analyze the European Master in Radiation Protection course, which started in September 2008. This Master is organized by the consortium of universities as established in the ENETRAP 6FP. Broadening of the consortium and quality analysis of the providers and the content of the modules can be performed according to, primarily, the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ENQA) and, secondly, to the ENEN standards.

In the field of RPE training the ultimate goal is the development of a European mutual recognition system for RPEs. Hereto, the ENETRAP Training Scheme initiated as part of the ENETRAP 6FP will be used as a basis for the development of a European Radiation Protection Training Scheme (ERPTS), which includes all the necessary requirements for a competent RPE. In addition, mechanisms will be established for the evaluation of training courses and training providers. These actions will contribute to facilitate mutual recognition and enhanced mobility of these professionals across the European Union.

With respect to the RPO role the desired end-point is an agreed standard for radiation protection training that is recognized across Europe. Data and information obtained from the ENETRAP 6FP will be used to develop the reference standard for radiation protection training necessary to support the effective and competent undertaking of the role.

Furthermore, attention is given to the encouragement of young, early-stage researchers. In order to meet future needs, it is necessary to attract more young people by awakening their interest in radiation applications and radiation protection already during their schooldays, and later on during their out-of-school education (university or vocational education and training). Radiation protection experts and officers work more and more on a European level. It is therefore important to bring together all the national initiatives at a European level: tomorrow's leaders must have an international perspective and must know their counterparts in other countries.

It is envisaged that the outcome of this project will be instrumental for the cooperation between regulators, training providers and customers (nuclear industry, medical sector, research and non-nuclear industry) 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.

3 WORKING PACKAGES

The specific objectives of the project are trying to be reached through the working packages:

WP1 Co-ordination of the project

WP2 Define requirements and methodology for recognition of RPEs

WP3 Define requirements for RPO competencies and establish guidance for appropriate RPO training

WP4 Establish the reference standard for RPE training

WP5 Development and apply mechanisms for the evaluation of training material, events and providers

WP6 Create a database of training events and training providers (including OJT) conforming to the agreed standard

WP7 Develop some course material examples (text book, e-learning modules, ...)

WP8 Organise pilot sessions, test proposed methodologies and monitor the training scheme effectiveness

WP9 Introduction of the training passport and mutual recognition system of RPEs

WP10 Collaboration for building new innovative generations of specialists in radiation protection

This intermediate deliverable only concerns the WP7 and more precisely the WP7.1 that is the writing of the textbook correspond the training scheme of RPE.

4 WORK PACKAGE 7: DEVELOPMENT OF SOME COURSE MATERIAL EXAMPLES (TEXT BOOK, E-LEARNING MODULES, ...)

5 GENERAL DESCRIPTION.

In order to provide examples of standardized training material, meeting the requirements of the ERPTS, WP7 will foresee in European text books for several modules of the ERPTS. These textbooks are foreseen to be written in English. Since a lot of texts already exist in different countries (and thus different languages), the main work will involve the structuring of this material according to the developments of WP2, 3 and 4, and the translation into English.

6 OBJECTIVES

Based on the requirements defined for RPE and RPO training, the training material of same modules will be developed. This material can be in the form of text books.

7 DELIVERABLES AND TIMING

WD7.1 Accompanying text for at least one module of the RPE or the RPO training scheme.

WD7.2 Development of modern learning tools (e-learning) for the RPE or RPO training.

An extension of the project ENETRAP II has been obtained until the end of 2012 and the new table is as follows:

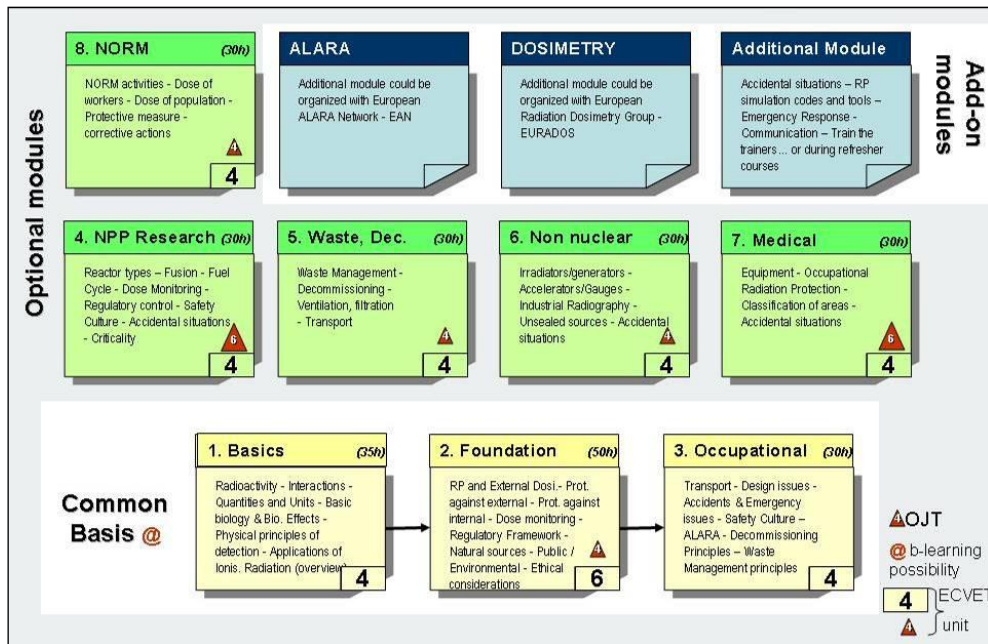


Fig. 1.: The RPE training scheme

The structure of this training programme is based on 3 types of modules:

- Common basis modules
- Specialised modules
- Optional modules

In order to bring this new approach to the future European RPE training, learning objectives for each module/lecture have to be properly formulated.

8.1.2 The relevant text book

The training resources provided by ENETRAP II members were identified and collected. The resources were transmitted by our partners in different languages. We did research on web sites according to different criteria. A table recording relevant text books has been established. Then, selected text books corresponding to the ENETRAP training scheme: according to the table of content were selected

During the 3rd Steering Committee at Grenoble in France in March 2010, it was decided to choose the book **“PCR Personne compétente en radioprotection. Principes de radioprotection-réglementation”** written by C. Jimonet and H. Métivier in 2009 and published by EDP Sciences ; because of its diversity of activities based on exercises with corrections, frames named “to learn more” and its embedded high pedagogical approach.

8.1.3 The common basis/ module 1: Basics

To the question: how many modules of ENETRAP II training scheme are we going to publish? 1, 2 or 3? At the beginning of our analysis, we have thought to publish about the first 3 modules. Now, we have decided to be less ambitious and **only publish the first module**, for 2 main reasons. The EDP book only represents 1/2 of the three modules. In this case, 1/2 would be a translation, 1/2 a writing; it would be too long to

be published before the end of the project. Secondly, for three modules, the cost of translation would be too high. The other advantage of this choice is that, in the future, the other modules could be written by the other European partners.

Module one represents the first part of the "common basis" and deals with physics related to ionizing radiations.

We have decided to translate 5 chapters of the French selected PCR book.

- 1 Radioactivité
- 2 Interactions rayonnements-matière
- 4 Effets biologiques des rayonnements
- 5 Détection des rayonnements ionisants
- 6 Principales utilisations des sources de rayonnements ionisants

To correlate with the 6 chapters of module 1 of ENETRAP II, a new one has been written:

- 3 Dosimetry: quantities and units

9 TASKS DEVELOPED AFTER THE LAST DELIVERABLE (MARCH 2011)

9.1 Degree of relevance of content

At this step, it is necessary to compare the contents of this relevant book with the common basis of ENETRAP II training scheme requirements (outcome of WP4). The work involves the structuring of this text according to WP4 and its translation into English.

It is important to emphasize that to have complete resources which correspond to the European Radiation Protection Training Scheme (ERPTS), the contents not dealt with the text-book, will be in the complementary cyber book.

According to WP5, NRG has developed a table for the comparison of training material. According to reference WP7 –RPE text book, we fill in the table using the grades proposed by NRG. These grades are chosen to determine which course covers which topic to what extended.

Grades:

- 1 Global, quantitative. Familiar with the subject
- 2 Important subjects covered, quantitative. To be able to work with the subject
- 3 Detailed, quantitative. Good knowledge of the subject and able to work with it

With this methodology, we have compared the grades between the French PCR textbook and the future RPE textbook and cyber book. For the main topics the grades are the same but when a difference exists, the contents of the topic is completed by the authors. Here are the comparative tables of the 6 chapters (PCR/RPE):

	PCR Book	RPE textbook and cyberbook
<u>Radioactivity and nuclear physics</u>		
Composition of matter	2	2
Proton-Neutron ratio, ionisation, excitation	3	3
Alpha decay		3
<i>Beta minus decay</i>		
- Energy spectrum β -emitter	3	3
Beta plus decay and electron capture	3	3
Electronic shell rearrangement	3	3
- Consequence of a vacancy	3	3
- Amount of energy available	1	3
- Consequence of the electron capture	3	3
Gamma emission and internal conversion	3	3
Evolution of the activity	3	3
- Exponential law	3	3
- Decay chain with two isotopes	3	3
- Decay chain with n isotopes	1	3
- Activity law	3	3
- Activity, special activity and mass activity	3	3
Producing radionuclides by nuclear reaction	1	2
-Cross section	1	3
- Production of artificial radioactive substances	1	2
- Nuclear fission, fission products	2	2
Nuclide Chart	2	3
- Decay schemes and mother - daughter relation	1	2

	PCR Book	RPE textbook and cyberbook
<u>Interaction of radiation with matter</u>		
Directly ionising radiations	3	3
<i>Heavy charged particles</i>		
- Range	3	3
- Nuclear reactions, cross section	3	3
<i>Light charged particles</i>		
- Ionising capacity, LET, stopping power	3	3
- Range	3	3
- Bremsstrahlung	3	3
- LET	3	3
- Case of the positrons	3	3
- Application: principle of the X ray tube	3	3
Non directly ionising radiations	3	3
<i>Electromagnetic radiations</i>		
- Energy dependent effect	3	3
- Attenuation coefficients, half-value layer	3	3
- General principle of building: build up factor coefficients	3	3
<i>Neutrons</i>		
- Kind of neutrons	1	2

	PCR Book	RPE textbook and cyberbook
<u>Dosimetry</u>		
Physical and dosimetric quantities	1	3
- Radiometric description of radiation field	1	3
- Particle- and energy fluency and density	1	3
- Electron equilibrium	1	3
- Kerma	1	3
- Dosimetric quantities	2	3
- Relationships between radiometric and dosimetric quantities	1	3
- Calculation of absorbed dose	2	3
- Inverse-square law	3	3
Radiation protection dosimetry	3	3
- Need for protection quantities		3
- New approach in ICRP 103, 60, ICRU 51 and EC directives	2	3
- Collective dose	2	3
- Neutron dosimetry	1	1
- Accident dosimetry	1	1

	PCR Book	RPE textbook and cyberbook
<u>Biological effects of radiations</u>		
Basic biology	2	2
Cellular and molecular effects	3	3
- Factors influencing biological effects: radiation conditions, tissue features and ambient factors	3	3
- Dose-effect relations	3	3
- Somatic/genetic - early/late - stochastic/deterministic effects	3	3
Deterministic effects	3	3
Stochastic effects	3	3
Early effects after global or partial irradiation	3	3
Exposure of pregnant woman and foetus	2	2
Epidemiology	1	2
- Risk assessment	3	3

	PCR Book	RPE textbook and cyberbook
<u>Physical principles of detection</u>		
General principle of detection	3	3
- Measurement of chain, efficiency, dead-time, detection threshold, background and noise	3	3
- Uncertainty of a measurement	3	3
Ionisation of gas	3	3
Luminescence phenomenon	3	3
Ionisation into solids	3	3
Physical and chemical phenomenon	2	2
Detector functioning	2	3
Bragg-Gray principle	1	2
Whole body counters	1	3

	PCR Book	RPE textbook and cyberbook
<u>Applications of ionising radiation</u>		
Natural sources of ionising radiation	1	1
Medical applications of ionising radiations	1	1
Industrial applications of ionising radiations	1	1

The scale of grades (1 to 3) associated with the contents has achieved this detailed analysis for the first module of ENETRAP II training scheme. The conclusion is that with these five chapters of the PCR book, 6/10 of the content is already written and must be translated; 4/10 more has to be written. To have the level which corresponds to the European Radiation Protection Training Scheme (ERPTS), writing is more important than we can imagine at the beginning of the project and thus it took more time.

Once more, to have sufficient grades which correspond to ERPTS, the missing parts not dealt with the text-book, will be in the complementary cyber book.

The complementary of the textbook and the cyber book provides a variety of pedagogical approach and a flexibility of particular interest.

9.2 Textbook Edition – Deal

We deal with the private publisher “EDP Sciences”, and the contract has been signed since December 2011.

After, a lot of negotiations, the project is now balanced with the participation of

- **ENETRAP II**
- **INSTN**
- **and EDP Sciences**

The logo of the European Commission will be printed on the first page of the textbook.

Initially, the text was written in French, by ten French radiation protection experts. Then, the text was translated by a specialist of this kind of topic.

Writing the first five chapters is now complete and they are being translated. Writing of the last is in progress and will be completed in February 2012. A first English manuscript will be printed at the end of the spring.

9.3 Title of the textbook

A title for this textbook, “**European Radiation Protection- Basis**”, has been put forward. We wanted to avoid, the word “Radiation Protection Expert” writing in the title. In fact, the book may be of interest the RPE but also the RPO. The title of the textbook should not be restrictive to a specific function. It can interest all the radiation protection community.

9.4 Table of Contents of the textbook

The table of Contents is now finalized. It has been completely written in French in detail and the 6 chapters are now finished. It remains to translate them. It corresponds to the training scheme of the module1 of ENETRAP II. It is in annexe 1.

9.5 Contents

The most important point for this second intermediate deliverable WD7.2 is that all the first five of the six chapters are completely written:

- 1 Radioactivity and nuclear physics
- 2 Interaction of radiation with matter
- 3 Dosimetry: quantities and units
- 4 Biological effects of radiation
- 5 Physical principles of detection

The different authors have always worked with the objective to write with a very progressive approach for the learner. They wrote each topic step by step with a lot of examples, a lot of exercises, to evaluate whether the topic has been understood.

Writing in French for these 5 chapters is finished and the translation in English is still in progress.

It remains to complete and to modify the last chapter:

- 6 Applications of ionizing radiation (overview)

About this chapter: the data in the PCR book is French (number of scanners, number of Positron Emission Tomography, average value of exposures...). For the European Radiation Protection Training Scheme ERPTS, and particularly for this chapter it is necessary to introduce European data. It will be an important work to complete the last chapter.

10 REMAINING TASKS

To conclude, writing and translating the textbook should be finished by spring 2012. It will remain to complete it with new exercises, new illustrations and new iconography.

For each activity, in the WP4, they define the Learning Outcomes that will be broken down into Learning Outcomes related to Knowledge (KLO), Learning Outcomes related to Skills and finally Learning Outcomes associated to Attitudes that will be owned by the RPE. It remains to link the contents of the textbook and the associated Learning Outcomes.

11 ANNEXE 1

Table of contents in French

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Radioactivity and nuclear physics

Hugues Bruchet, Marc Ammerich, Hervé Viguier

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Interaction of ionising radiation with matter

Philippe Massiot, Hugues Bruchet,

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2. INTERACTION DES PARTICULES CHARGEES AVEC LA MATIERE

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 2.2.1 Ionisation et excitation

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5.FAITES LE POINT.....

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Hervé Viguier, Alain Vivier

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Christine Jimonet, Henri Metivier

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7 LES GRANDS PRINCIPES DE LA CIPR

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Physical principles of detection

Jean-Christophe Bodineau, Marc Ammerich, Jean-Claude Moreau, Abdel-Mjid Nourredine

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- 5.3.1.5 Application d'un rendement de mesure pour déterminer l'activité d'un radionucléide
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CHAPITER 6

Overview of applications of ionising radiation

Cécile Etard

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6.3.5 Utilisations de radionucléides en sources non scellées dans l'industrie et la recherche

6.3.5.1 Applications des sources non scellées dans l'industrie

6.3.5.2 Applications des sources non scellées dans la recherche biologique et médicale

6.4 – INDUSTRIE NUCLÉAIRE CIVILE.....

6.4.1 Combustible nucléaire

6.4.2 L'extraction du minerai d'uranium

6.4.3 La fabrication du combustible nucléaire

6.4.3.1 La concentration et le raffinage de l'uranium

4.3.2 L'enrichissement de l'uranium

4.3.3 Les assemblages de combustible

6.4.4 Réacteur nucléaire, de type « Réacteur à Eau sous Pression » **Erreur !**

Signet non défini.

6.4.4.1 Principe de fonctionnement

4.4.2 Les radionucléides présents dans un réacteur

6.4.5 Le traitement du combustible nucléaire