**Description of the main S & T results/foregrounds**

In order to achieve the ENETRAP II objectives mentioned earlier, the project defined the following work 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 of 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

In the following paragraphs, a summary of the achievements is given. More details of the work performed in ENETRAP II can be found in the different reports delivered.

Work Package 1: Coordination of the project
Regarding the coordination of the project, as foreseen in Annex I, the Coordinator took several actions.
-    Immediately after the start of the project, a Consortium Agreement was set up and signed by all parties.
-    A Steering Committee (SC), consisting of a representative of each partner, was set up. In total, eight SC meetings were held during the total duration of the project. They were prepared and chaired by the Coordinator, afterwards also the minutes of the meeting were prepared by the Coordinator. During SC meetings, the overall progress of the project was discussed, and necessary actions were discussed and taken in order to meet the pre-set goals. In addition, the project actions were adapted to the new standards and guidelines in the education and training community, for example the introduction of the ECVET principles.
-    An Advisory Board (AB) was set up, with representatives of relevant stakeholders with regard to the aim of the project. The AB consisted of representatives of HERCA, EUTERP, Art. 31 Group of Experts, EC DG ENERGY, IRPA, IAEA, EFOMP, ECVET. The AB met three times during the total duration of the project. The main task of the AB was to reflect and advice on the project actions and results.
-    The project results were disseminated by the partners through participation to several national and international workshops and conferences. In addition, a dedicated ENETRAP II session was embedded in the EUTERP workshop of 2011.
-    A website was set up (www.sckcen.be/enetrap2), and updated on a regular basis during the project. The website consists of a public and private part, the latter being used by the members of the Steering Committee to exchange information and files. Currently, the public part contains the final version of the main deliverables of ENETRAP II.

Work Package 2: Define the requirements and methodology for the recognition of Radiation Protection Experts (RPE)

The primary focus of the ENETRAP II project has been the development of European reference standards for E&T in radiation protection, however, the status conferred by that training, for example that of RPE (as defined in the current draft of the revised European Basic Safety Standards) has also been considered.

The requirements for formal recognition of RPEs and development of proposed methodologies for recognition on both national and international, i.e. mutual recognition between Member States have been addressed within WP2. The specific outcomes of this work can be summarized as follows:

*Criteria for RPE Recognition*

Criteria for RPE Recognition were developed following consultation with relevant Stakeholder groups, that is Regulators/Regulatory Bodies, Radiation Protection Professional Bodies and Training Providers. In this consultation exercise proposals for the core criteria for recognition were presented in a discussion document and identified contacts were asked to agree/disagree and to give their views. The broad matters addressed were:
- the aspects to be considered in the recognition process
- the criteria (within those aspects) to be satisfied, and
- the essential components of a recognition scheme.

The detail of the responses from the consultation exercise included in the first report from WP2 (March 2010) as are the resulting proposed criteria for RPE competence: criteria are specified for background education, knowledge/understanding of topics in a reference syllabus, knowledge of operational radiation protection, ability to develop and provide advice and required experience. A proposal for the operation of national schemes for RPE Recognition is also included in the first report.

*Mutual Recognition*

A general concept for the mutual recognition of professional qualifications exists within the EU. This is aimed primarily at those who are qualified to practice their profession in one Member State and wish to have that qualification recognized in another in order to practice the same profession there. This concept is clearly applicable to RPEs within the EU.
Building on the work done during the first phase of WP2, key requirements for recognition of RPEs on an international (Member States) basis was developed and guidance as to how the process of mutual recognition could work in practice was drafted. In developing the criteria for mutual recognition each of the 5 core components for initial RPE Recognition was considered on the basis of whether or not the component was *transferable,* i.e. not impacted by the country in which the RPE might wish to work. In all cases the outcome was "yes", although it became clear that some minor additional components such as knowledge of the legislation in the new country and confirmation of fluency in the language in which the RPE might have to provide advice should be required.

Full details are provided in the Final Report of WP2.

Work Package 3: Requirements for Radiation Protection Officers

The concept of RPO is being used since many years, but was only recently taken up in the draft of the revised Euratom Basic Safety Standards (Euratom BSS), based on the advice of EUTERP and the ENETRAP 6FP Consortium. Depending on the complexity of the radiation application and the associated radiation protection tasks, RPOs, as defined in the draft Euratom BSS, need appropriate training in radiation protection and a certain level of work experience tailored to the specific needs to fulfil particular radiation protection tasks.

It is therefore essential, on the European level, (i) to define the required competences for RPO according to their area of work and specific radiation protection tasks, and (ii) to propose references for content and mechanisms for delivery of RPO training.

In order to define requirements for RPO competencies, the role of RPO has been considered on the European level. It should be noted that, other than the issues of general competency and suitability, there is no prescription on the European or international level of the "specification" of the individual acting as RPO. The appropriate route to gaining the level of competence required to become an RPO will be a combination of training plus relevant experience in the appropriate area of work.

In this WP, the main areas of RPO work are considered and examples of appropriate training contents are given, divided into professional categories or competence groups, covering the following areas:
- handling of radioactive materials and practices on installations producing ionising radiation (incl. accelerators and cyclotrons)
- medicine, dentistry
- operation of x-ray equipment (technical, medical (without patients), veterinary medicine)
- RPO in nuclear power plants/research reactors

The European Qualifications Framework (EQF) and the European Credit system for Vocational Education and Training (ECVET) are considered as useful tools in building competence of RPO within Europe. Examples of knowledge, skills and competence elements for various EQF levels are given which may be further developed to fit existing RPO training activities.

Full details are provided in the WP3 reports WD 3.1 (Requirements for RPO competencies), and WD 3.2 (Establishment of European guidance on the content and mechanisms for delivery of RPO training), available on the ENETRAP II website.

Work Package 4: Establishment of the reference standards for RPE training

The work proposed in WP4 of ENETRAP II is the development of the European reference training scheme for the Radiation Protection Expert. During the development of this work, and due to evolution in the European context of Vocational Education and Training (VET), we also sought to incorporate the ECVET approach (European Credit for Vocational Education and Training) and established learning outcomes (LO) associated to competences.

The reference training scheme is based on the preliminary ENETRAP training scheme developed at the end of the ENETRAP 6FP project. This training scheme was set up on the basis of already developed "model" courses like the PGEC (IAEA) and the Saclay-based ERPC, and was agreed upon by the main stakeholders in RP E&T via the EUTERP workshops. Within ENETRAP II, we have further developed the reference training scheme to the model that is presented below, consisting of a core unit to be followed by all RPE, and specialized units, to be attended depending on the working environment of the RPE. The list of specialized units should be seen as non-exhaustive. This dynamic list of specialized training modules is still expanding, and is being further developed with for example organisations such as EURADOS and EAN.
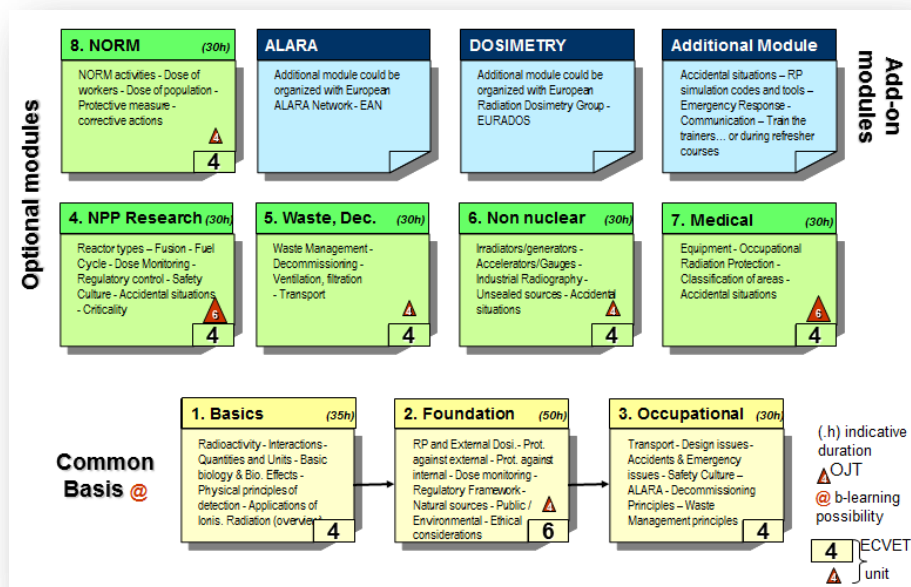
*Figure: European reference training scheme for the Radiation Protection Expert*

In addition, learning outcomes are defined. For the modules 1, 2, 3, 4, 5 and 7, in total 413 LO's (166 associated to knowledge, 156 associated to skills and 91 associated to attitudes) were defined. These were selected on the basis of the experience of the partner institutions, and also through interviews with leading radiation protection experts from industry, the medical sector and training providers external to the project Consortium.

Facing the large number of competences and LO's, we also developed a prototype of a tool that can serve as management system for nuclear competences (currently developed in MS Access). However, the need for a specialized tool remains. This tool allows for adding, deleting, duplicating and moving competences and/or LO's and aims at introducing a common language regarding LO's, facilitating a common methodology and the same level of detail in the whole of the nuclear E&T projects (in radiation protection, waste management, nuclear engineering, safety culture, …). In this way, we also hope to reduce the difficulties and complexity currently perceived in implementing ECVET in nuclear.

Full details regarding the European reference training scheme for RPE, and the accompanying Learning Outcomes, are provided in the final report of this work package: "WD 4.2.: Define requirements and methodology for recognition of RPEs", available on the project website.

Work Package 5: Develop and apply mechanisms for the evaluation of training material, events and providers

Within the ENETRAP II project we also aimed at facilitating the evaluation of training material and events, so that each provider can compare his material or event to the European reference radiation protection training scheme  (ERPTS), developed in WP4. Furthermore WP5 has developed a few quality criteria that can be used as a European quality standard for training providers. If a training provider fulfils all these quality criteria he equals the European quality standard.

*Evaluation of training material and training events*

The evaluation of training material (WD 5.1) and events (WD 5.2) is based on the evaluation of learning outcomes in three different categories: knowledge, skills and competences.

The provider who wants to compare his training material or event with the ERPTS starts with writing down the learning outcomes of his material or event in the different categories knowledge, skills and competences. The second step is to describe the goal of his learning outcomes and give the right indicator of Table 1 to his knowledge based learning outcomes and give the right indicator of Table 2 to his skills or competence based learning outcomes. Within the ENETRAP II project this first and second step was carried out for the ERPTS, developed in WP4.

The last step of the evaluation process is to compare the descriptor of each learning outcome of his material or event to that of the ERPTS. When the number of the descriptor of the knowledge based learning outcome of his material or event is equal or higher than that of the ERPTS, the material or event comes to be equivalent to the ERPTS.

When the grade of the descriptor of the skill or competence based learning outcomes of his material or event is 'yes', than his material or event is at least equal to that of ERPTS. When the grade of the descriptor of the skill or competence based learning outcome is 'no', than his material or event is only equivalent to ERPTS when the grade of the ERPTS learning outcome is also 'no'.

If all learning outcomes are at least equivalent to the ERPTS the material or event comes to be equivalent to the ERPTS.

*Table 1 Descriptors at which subjects are dealt with in knowledge based learning outcomes:*

| Descriptor | Goal |
| --- | --- |
| 0 | - |
| 1 | Basic awareness of the subject |
| 2 | Understanding of the subject |
| 3 | Detailed understanding of the subject |

*Table 2 Descriptors at which subjects are dealt with in skill and attitude based learning outcomes:*

| Grade | Description |
| --- | --- |
| yes | Fulfilled |
| no | Not fulfilled |

To test the proposed mechanism, we compared both training material and training events of project partners to the ERPTS (WD 5.4). This test showed that the proposed mechanism is a very useful instrument.

To make the evaluation as efficient as possible, we suggest performing the mechanism as a self-assessment. The develop method can be used with any kind of descriptions, so also the descriptions of the terminology of the levels of EQF can be used. The learning outcomes of ERPTS are already described in the terminology of the levels of EQF (WP 4).

*Evaluation of training providers*

Training providers can be evaluated based on 16 significant quality criteria divided in general criteria, organizational criteria and criteria for courses with an exam (WD 5.3).

As a test some partners evaluated themselves and reported whether they fulfilled all or only a few of the 16 quality criteria. When they fulfil all the 16 quality criteria, they equal the proposed quality standard for training providers. This test showed that the proposed mechanism is a very useful instrument (WD 5.4).

Full details are provided in the four deliverables of this work package:

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.

Work Package 6: Creation of a database of training events and training providers

WP6 creates a database of training event and providers conform to the agreed standards. The database will be made public through the ENETRAP II website and is thus available for all interested parties. Such a move would add credibility to the recognition process and would help to provide reassurance to RPE candidates and to employers that the training obtained satisfies an agreed European standard. This database will also incorporate an overview of institutes hosting on-the-job-training possibilities. Special attention will also be given to internships in the stakeholders' organisations, with emphasis on coaching and/or mentoring schemes, whenever appropriate. A link will be made with the existing ENEN database.

It is obvious that the courses organised by or at the premises of the partners can be taken as first examples. Examples of training courses that will be introduced are:

(for Belgium) course for radiation protection expert (in Dutch and French)

(for UK) modular Radiation Protection Training Scheme (RPTS) specifically targeted at new and developing RPEs

(for Germany) Occupational Radiation Protection: Specificities of Waste Management and Decommissioning WP6 focused on the development of a database (DB) to collect the main European education and training (E&T) events in radiation protection (RP), as well as information about the E&T providers. In addition, also on-the-job (OJT) training opportunities are listed, together with information on the research centre, university, hospital, or any other company that hosts the OJT position.

From a technical point of view, the database is set up in three important parts (modules):

- Storage of information related to E&T providers and E&T events, and the roles associated to the management of access and editing by national contact points (NCP), the global coordinator (GC) and other users.
- A maintenance module is developed in such a way that the system gives easy access to the different roles and e-mail notifications are foreseen to make sure the information is updated on a regular basis.
- The web search module is foreseen to allow the end-user to find the required information in an efficient and easy way.

The DB also foresees in a field where information can be found regarding the comparison of the presented training course to the European Reference Training Scheme for RPEs, developed in WP4. The comparison method used, is developed and described in WP5.

The DB is based on a web access, and is structured in such a way that the users can do their searches through different easy mechanisms (a search box, a filtered search by different criteria, a search through a calendar, etc.).

The categories included in the DB are: E&T providers and E&T events. The database also takes special attention over the internships in the stakeholders' organizations, with emphasis on coaching and/or mentoring schemes, whenever appropriate.

The events included in the DB are focused on RPE, RPO and EW, and apply to different kind of training programs like Initial, refresh, specialization, on the job training (OJT) program and others, and the training could be organized as different type event: courses/masters, workshop and opportunities (grants, PhD topics, job offers).

The DB can be accessed via http://enetrap.ciemat.es , and will soon after the closing of the ENETRAP II project be transferred to the EUTERP Foundation. Access will be available through www.euterp.eu.

Further to this short summary, more detailed information regarding the development and use of the database can be found in the following documents:

- WD6.1 REPORT on training events and training providers. Degree of conformity with the agreed standards.
- WD6.2 REPORT about EU wide Data Base of training events and training providers on RP according the standard developed in WP3 and WP4
- User's guide to facilitate the use of the DB and the CD containing the installation and configuration of the process.

Work Package 7: Development of some course material examples (text book, e/b-learning module,…)

Providing examples of standardized training material meeting the requirements of the European Radiation Protection Training Scheme (ERPTS) was the main goal of the deliverables of WP7 of ENETRAP II.

WP4 establishes the reference standard for Radiation Protection Expert Training (ERPTS). The smallest structure of this training scheme is a module and the "common basis" part is made up of 3 modules. To issue standardized training material, we decided to start working on the "common basis" part and especially on its first module. Even if the conclusions of WP4 (ERPTS of RPE) were essential for the project, the training material has also to deal with conclusions of WP2 (Background of RPE) and WP3 (Background and ERPTS of RPO).

Taking all these points into consideration, it has been decided that the final training material will be made up of a textbook, and a complementary cyber book. The ergonomics of a textbook allowing the reader to have a complete idea of the content at a glance, and the power of dematerialized resources used in an educational goal through a cyber-book, are combined to create optimized training material.

The first step and main work consisted of the development of the detailed content in order to meet the learning outcomes. A study of "Radiation Protection" publications of the past 10 years confirmed the idea of using the book "Principes de radioprotection-réglementation" (recently published and coordinated by C. Jimonet and H. Metivier) as a starting point for the textbook project, mainly for its highly pedagogical approach. To fit with the RPE training scheme, six chapters have been developed: 1. Radioactivity and nuclear physics, 2. Interaction of radiation with matter, 3. Dosimetry, 4. Biological effects of radiation, 5. Physical principles of detection, 6. Applications of ionizing radiation (overview). The road map given to the authors was: to write with a very progressive approach for the learner, introducing topics step by step with a lot of examples, a lot of exercises, and at the end, allowing the reader himself to evaluate himself his progression in the knowledge of the module. The result is a homogeneous textbook that completely covers the ERPTS learning outcomes.

As mentioned before, a cyber-book will also be part of the whole training material to develop the concept of "learning more". Based on an integrative approach, we have selected a learning and content management system (LMS/CMS) able to manage several types of embedded educational resources. After assessment of several Leaning Management Systems, the Moodle platform has been selected. In order to insert complementary pedagogical resources in the cyber-book, specific ENETRAP II web pages have been created (http://www.rpe-training.eu/login/index.php). This summary of the cyber book is organized in the same 6 chapters of the textbook. As an example of the complement between the two pedagogical resources, we can name the topic "radionuclide's chart" whose explanation and use are developed in chapter 1 "Radioactivity and nuclear physics" of the cyber book whereas the concept is just mentioned in the textbook.

To take advantage of the new technologies which allow learners to access different types of resources and choose those that suit them, we are interested in the following resources: hypertext links and/or flash code, exercises with solutions, b-learning (.ppt soundtrack with video), audio podcasts, serious games and radiation protection forums. Up to now, we have worked on synchronized PowerPoint files (b-learning) based on the shooting of a pilot session course on radiation protection at Karlsruhe Institute of Technology (KIT) in Germany (WP8). We have also developed serious games related to dose exposure and dose rate calculation in which the virtual dose rate meter's design used is the same as the one used in real situations in nuclear power plants or installations. Such pedagogical tools are very powerful with the learner moving in a virtual environment picturing the real professional one.

In conclusion, the production of the module 1 "common basis" training material in the combined form of a textbook plus cyber book is a first step. In the next ones, collaboration is needed to complete at least the whole "common basis" training resources, and then progressively tackle the themes of the specialized modules as described in WP4.

Work Package 8: Organise pilot sessions, test proposed methodologies and monitor the training scheme effectiveness

In the first phase of WP8, suitable existing courses for pilot sessions of the European Radiation Protection Training Scheme ERPTS for RPE were identified. A remodelled 3 to 4 weeks radioisotope training was finally chosen, which included the Common Basis modules "Basics", "Foundation" and "Occupational RP" and the optional module "Unsealed Sources, Research and Non-Nuclear".

In order to organise pilot sessions (WD8.1) advertisement activities were taken. Learning Outcomes (LO) of the modules were defined in terms of knowledge, skills and attitude. A training program conforming to the reference standard and the proposed methodologies was developed jointly with JRC/ITU as main participant's provider. Special emphasis was put on laboratory exercises and technical visits on ITU practice-oriented topics.

The pilot sessions in March 2011 at the Karlsruhe Training Center were followed by 9 participants from 8 different EU countries.

The evaluation of the effectiveness of the training scheme (WD8.2) was done through assessment of the LOs mainly for knowledge and skills. The success of the course was additionally evaluated by questionnaires directly at the end and as follow-up.

The following major conclusions could be drawn and recommendations made to other WPs as feedback:
- The modular RPE pilot training events, conforming to the agreed standards, were successful and highly appreciated. The ERPTS with its proposed modules and topics has turned out as being effective.
- Defining LOs as proposed has proven to be straightforward and represented an effective tool for learning assessment.
- Training of skills and attitude (through laboratory exercises, workshops and technical visits) was highly welcomed.
- Effective advertisement represents an important item for successful training organization. Defining training agreements with the end-user was an additional motivation to send participants.
- However, it has been stated by participants and employers that international training events for RPE can only be attractive when endorsed and/or mutually recognized certificates, stamps or credit points are available.

Two other pilot modules ("NORM" and "Medical Domain") were considered for action but could not be realized for different reasons. A complete set of basic and specialized modules for RPE being recognized and accredited by the relevant authorities (e.g. HERCA) would be of utmost benefit for the Member States in the future.

Work Package 9: Introduction of the training passport and mutual recognition system of RPEs

The introduction of the training passport and mutual recognition system of RPEs is based on the development of a framework and a procedure for the mutual recognition of RPEs. The basis for the recognition is the acquisition of knowledge, skills and attitudes/competences as they have been defined in a reference standard. The recognition therefore applies both to the individual RPE and to the curriculum providing the learning outcomes to the individual and their validation. Three deliverables have been defined to achieve this objective.

A procedure has been developed for the mutual recognition and qualification of RPE education and training programmes. The qualification relies on the assessment of the content of the courses and training sessions with respect to the reference syllabus of learning outcomes developed under WP 4. The procedure allows for a self-assessment by the training provider following the comparison tools developed under WP5. In addition to the content of the courses and the training sessions, the organisation and the delivery of the course material to the candidate RPEs by the provider is evaluated with respect to a quality management reference. The report on the self-assessment and on the quality audit is submitted to and evaluated by an international body, composed by a selection of EUTERP members and regulatory bodies. This body delivers the qualification of the provider/course combination which entails its recognition as a component of the RPE qualification throughout the European Union.

Concerning the mutual recognition of RPEs, no actual tests were performed by the WP leader. Mechanisms need to be put forward, and a strong collaboration with HERCA and EUTERP needs to be set up. Although not being able to perform this task within the ENETRAP II project, it is of utmost importance and will give added value to the mobility of RPEs in Europe. The core of the ENETRAP II Consortium is looking into possibilities to continue this work, building further on the other ENETRAP II results, but unfortunately outside of its time frame.

Different approaches to a European Passport of Competences have been evaluated. The most promising tool because of its recognition and use already by some industrial stakeholders and its simplicity and clarity of the information seems to be the Europass Curriculum Vitae (CV). The report describes the approaches and the advantages and drawbacks of the different models. The Europass is a document with annexed certificates provided by the individual. It has no independent validation of the provided information. Nevertheless it is widely accepted throughout the European Union as a standard format for CVs.

<u>Work Package 10: Collaboration for building new innovative generations of specialists in radiation protection</u>

This small WP was added to the project in order to draw attention to the attraction of young students and early-stage researchers into radiation protection. Suggestions were made to create a website to attract young people. In addition, and more concretely, student exchanges were organized between Romania and France. They have taken some action related to the "RP circus", a French initiative (www.rpcirkus.org).