Basic training module 1: Basics in radiation protection

1. Background of the ENETRAP training modules

The ENETRAP project series (FP7 grant agreement n° 605159) developed a European radiation protection training scheme (ERPTS) for RPEs, consisting of three common basis modules, several optional modules and some add-on modules. This basic training module (N°1: Basics in radiation protection) is the first of the three basic mandatory modules. It consists of a number of training courses which are linked to specific competences and activities that a Radiation Protection Expert (RPE) requires in compliance with Council Directive 2013/59/Euratom (BSS).

2. Training module objective

The course participant will gain the knowledge, skills and attitudes to provide expert radiation protection advice to employers, staff and members of the public that will allow him or her to seek the status of Radiation Protection Expert (RPE) from an authorised body.

3. Module overview

The Basics Module consists of five training courses.

Course 1.1	Radioactivity and nuclear physics
1	**Describe the phenomenon of radioactivity**
1.1	Define nuclei property
1.2	Explain principal concept of basics nuclear model
1.3	Define quantities characterising nuclei
Course 1.2	Interaction of radiations with matter
2	**Describe the interaction of ionising radiation with matter**
2.1	Explain the main type of interactions with matter in function of nature and energy of radiations
2.2	Compare with the neutron interactions
2.3	Differentiate the efficiency of different shielding for different radiations
Course 1.3	Dosimetry : quantities and units
3	**Apply the dosimetric concepts**
3.1	Assess and interpret external dosimetry
3.2	Evaluate internal and/or superficial dosimetry
4	**Apply the different operational quantities used for dosimetry**
4.1	Describe dosimetric quantities
Course 1.4	Biological effects of radiation
5	**Identify the biological effects of ionising radiations**
5.1	Classify the different biological effects (deterministic, stochastic and hereditary effects)
6	**Analyse/understand an epidemiological study**
6.1	Assess of the risks linked to doses

Course 1.5	Physical principles of detection
7	**Use different detection devices**
7.1	Make measurement
7.2	Use the appropriate device
7.3	Be able to advice on adapted devices for a situation
7.4	Determine the limit of detection

4. Marking and assessment criteria

Each of the 5 courses requires self-studying previous to the course.

There will be a one hour written examination on the last day of the face to face module that will consists of a multiple choice examination to assess knowledge (K) (70% pass-mark) showing a detailed understanding of the subject.

The candidate must pass all three components (K, S, A) to pass each course. The candidate must also pass all courses to pass the Module.

Evaluation Procedure		
Evaluation Question	**Judgement Criteria**	**Indicators and Descriptors**
To what extent has the course module participant achieved the required RPE KSAs?	The participant's level of achievement of the course module KSAs will be judged by their grade (marks) from the written examinations.	An overall grade (mark) of: <50% indicate a need for further development. 50 – 70% the course module participant has average knowledge and some experience, however, they should upgrade their KSAs to increase their level of qualification. >70% the course module participant has sufficient knowledge and experience.

5. Pre-requisites

The applicant will be expected to have achieved an education to level 6 of the European Qualification Framework (EQF) (e.g. Bachelor degree level either specifically in radiation protection, or in a physical/engineering/mathematical discipline or equivalent through life long learning).

6. Learning outcomes and indicators from EQF per training course

Legend:

Competence	**1**	**Describe the phenomenon of radioactivity**
Training course	1.1	Radioactivity and nuclear physics
Activity	1.1	Define nuclei property
Learning outcome in terms of knowledge (K), skills (S) or attitude (A)	LO K 1.1.1	Explain the different modes of disintegration and desexcitation

1	Describe the phenomenon of radioactivity
Course 1.1	Radioactivity and nuclear physics
1.1	Define nuclei property
Knowledge	
LO K 1.1.1	Explain the different modes of disintegration and desexcitation
LO K 1.1.2	Describe the different type of radiations emitted and their features
Skills	
LO S 1.1.1	Give/predict the type of decay depending on the position of radionucleide over the valley of stability.
LO S 1.1.2	Calculate the activity of a source at any time by using the radioactive decay equation
Attitude	
LO A 1.1.1	React properly in function of radionucleide (Energy, activity, disintegration mode, half-life ...)
1.2	Explain principal concept of basics nuclear model
Knowledge	
LO K 1.2.1	Give the main characteristics of atoms (electrical charge, nuclei, mass and dimension)
Skills	
LO S 1.2.1	Give the composition of any nuclei (p, n and e)
1.3	Define quantities characterising nuclei
Knowledge	
LO K 1.3.1	Define the notions of activity, intensity of radiation, half-life
Skills	
LO S 1.3.1	Use the chart of nuclides and nuclear data and find important constants

Indicators from EQF	
Knowledge	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields
Skill	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
EQF Level	5-6
ECVET Credit Points	2
Proposed Duration	9 hours theoretical sessions 3 hours of tutorials/PW/OJT

2	Describe the interaction of ionising radiation with matter
Course 1.2	Interaction of radiations with matter
2.1	Explain the main type of interactions with matter in function of nature and energy of radiations
Knowledge	
LO K 2.1.1	Define different type of interaction (charged and uncharged particles)
LO K 2.1.2	Describe ionisation and excitation phenomenon
LO K 2.1.3	Interpret attenuation of gamma radiation as a function of thickness and Z
LO K 2.1.4	Know the range of different radiation (alpha, beta, neutron, X and gamma)
LO K 2.1.5	List the different photons interaction effects

LO K 2.1.6	Estimate the energy range of different effects (photoelectric effect, Compton scattering and pair production)
Skills	
LO S 2.1.1	Calculate the range of a beta radiation and the attenuation of a radiation using curves
LO S 2.1.2	Calculate thickness of shielding in function of component (Z) and energy
LO S 2.1.3	Take into account bremsstrahlung and build-up factor in shielding calculation
2.2	Compare with the neutron interactions
Knowledge	
LO K 2.2.1	List the different neutrons interaction effects
LO K 2.2.2	Outline the specificities of absorption and moderation of neutrons source
2.3	Differentiate the efficiency of different shielding for different radiations
Knowledge	
LO K 2.3.1	Apply shielding properties (backscattering, build-up...)
Skills	
LO S 2.3.1	Calculate shielding manually and by using calculation code

Indicators from EQF	
Knowledge	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields
Skill	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
EQF Level	5-6
ECVET Credit Points	1
Proposed Duration	4.5 hours theoretical sessions 1.5 hours tutorials/PW/OJT

3	**Apply the dosimetric concepts**
Course 1.3	Dosimetry : quantities and units
3.1	Assess and interpret external dosimetry
Knowledge	
LO K 3.1.1	Assess individual dose for both external and internal exposure
LO S 3.2.1	Determine the features of a dose monitoring program (area and individual),
3.2	Evaluate internal and/or superficial dosimetry
Knowledge	
LO K 3.2.1	Describe biokinetic models used (ICRP)

4	**Apply the different operational quantities used for dosimetry**
Course 1.3	Dosimetry : quantities and units
4.1	Describe dosimetric quantities
Knowledge	
LO K 4.1.1	Define the deposition and energy transfer
LO K 4.1.2	Define the Relative Biological Effectiveness (RBE)
LO K 4.1.3	Define the LET concept
LO K 4.1.4	Define Effective dose, W_t, W_r...

Indicators from EQF	
Knowledge	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields
Skill	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
EQF Level	5-6
ECVET Credit Points	0.5
Proposed Duration	4.5 hours theoretical sessions

5	**Identify the biological effects of ionising radiations**
Course 1.4	Biological effects of radiations
5.1	Classify the different biological effects (deterministic, stochastic and hereditary effects)
Knowledge	
LO K 5.1.1	List various biological effects (tissue, cellular ...)
LO K 5.1.2	Give and comment on the ICRP risk factors
LO K 5.1.3	Estimate the dose rate to different distances from a radioactive point source (beta or photon)
LO K 5.1.4	Determine the collective and individual protective means both for external and internal exposure
6	**Analyse/understand an epidemiological study**
Course 1.4	Biological effects of radiations
6.1	Assess of the risks linked to doses
Knowledge	
LO K 6.1.1	Interpret epidemiological result
LO K 6.1.2	Describe the concept of radiation detriment by using W_{tissue} and $W_{radiation}$
Skills	
LO S 6.1.1	Make calculation using epidemiological data taken into a specific study

Indicators from EQF	
Knowledge	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields
Skill	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
EQF Level	5-6
ECVET Credit Points	0.5
Proposed Duration	3 hours theoretical sessions

7	**Use different detection devices**
Course 1.5	Physical principles of detection
7.1	Make measurement
Knowledge	
LO K 7.1.1	Describe processes of detection

Skills	
LO S 7.1.1	Adapt measurement techniques according to the source types (e.g. alpha)
LO S 7.1.2	Identify the distances of detection for different type of nuclei
Attitude	
LO A 7.1.1	React appropriately when a device indicates a measure (e.g. panic linked to the sound)
7.2	Use the appropriate device
Knowledge	
LO K 7.2.1	Identify the different kind of probes adapted to one (or more) type of radiation
Skills	
LO S 7.2.1	Identify an unknown source
7.3	Be able to advice on adapted devices for a situation
Knowledge	
LO K 7.3.1	Identify the different providers of detection equipment
Attitude	
LO A 7.3.1	Ensure a technology watch on detection devices
7.4	Determine limit of detection
Knowledge	
LO S 7.4.1	Calculate a detection limit

Indicators from EQF	
Knowledge	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields
Skill	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields
EQF Level	5-6
ECVET Credit Points	1.5
Proposed Duration	3 hours theoretical sessions 6.5 hours tutorials/PW/OJT