Basic training module 2: Foundation of 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°2: Foundation of radiation protection) is the second 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 Foundation Module consists of nine courses.

Course 2.1	Application of ionising radiation
8	**Describe the main uses of radiation in various fields**
8.1	Categorise different types of radiation sources
8.2	Explain application of radiation sources (natural and human made radionuclides; consumer products).
Course 2.2 +2.3	Radiation protection (protection against internal exposure)
9	**Apply physical dosimetry systems**
9.1	List the passive dosimetry devices
9.2	List the active dosimetry devices
9.3	Explain the principles of internal dosimetry
Course 2.4	Protection against external exposure
10	**Apply the three means of protection against ionising radiation (time, display, distance)**
10.1	Apply radiation protection by setting up shielding
10.2	Apply radiation protection by reducing the exposed time
10.3	Apply radiation protection by increase the distance
10.4	Estimate collective dose
Course 2.5	Dose monitoring
11	**Apply the rules of the workplace dosimetry**
11.1	Know the regulatory arrangements put in place (zone dosimetry)
11.2	Know the rules of the Art of nuclear ventilation
11.3	Explain the risk of criticality
12	**Characterise a workplace**
12.1	Supervise a workplace study

Course 2.6	Regulatory context
13	**Using the supra national regulations and national regulatory frame of reference**
13.1	Know the regulation connection between supra national and national
13.2	Identify the actor of regulation (ICRP, IAEA, EU ...)
14	**Use the main regulatory texts**
14.1	Follow the news of regulations
14.2	Make a critical interpretation of regulations (on a topic)
14.3	Achieve the training of exposed persons
Course 2.7	Natural sources of ionising radiation
15	**List the natural sources of ionising radiations**
15.1	Identifying the natural sources of ionising radiations
15.2	Manage the public and environmental radiation protection
Course 2.8	Public and environmental radiation protection
Course 2.9	Ethical considerations
16	**Incorporate ethical considerations**
16.1	Integrate ethical considerations in the medical field
16.2	Integrate ethical considerations in the industrial field
16.3	Communicate information between RPE

4. Marking and assessment criteria

Each of the 9 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 achievedan 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).

The applicant will be expected to have completed the first generic ENETRAP III module as pre-requisites for the Foundation Module (see below for alternative pre-requisites):

Basic training module 1: Basics
1.1 Radioactivity and Nuclear Physics
1.2 Interaction of radiations with matter
1.3 Dosimetry: quantities and units
1.4 Biological effects of radiations
1.5 Physical principles of detection

Accreditation of Prior Certificated Learning (APCL), which covers learning that has been assessed and certificated by an education or training system, will be considered where appropriate, e.g. the applicant has been awarded a Bachelor or Master's degree whose contents demonstrates the above components had been covered and examined. Alternatively, applicants who can demonstrate equivalent achievement through Life Long Learning (LLL) will also be considered. APCL or LLL applications should be made to the Module co-ordinator before starting the module.

6. Learning outcomes and indicators from EQF per training course

Legend:

Competence	**8**	**Describe the main uses of radiation in various fields**
Training course	2.1	Applications of ionising radiation
Activity	8.1	Categorise different types of radiation sources
Learning outcome in terms of knowledge (K), skills (S) or attitude (A)	LO K 8.1.1	Provide an overview of the uses of ionising radiations in different domains

8	**Describe the main uses of radiation in various fields**
Course 2.1	Applications of ionising radiation
8.1	Categorise different types of radiation sources
Knowledge	
LO K 8.1.1	Provide an overview of the uses of ionising radiations in different domains
LO K 8.1.2	Identify the order of magnitude of the activities related to these radioactive sources
Skills	
LO S 8.1.1	Recognise a situation of exposure by seeing a source (picture, video or directly)
8.2	Explain application of radiation sources (natural and human made radionuclides; consumer products).
Knowledge	
LO K 8.2.1	List and categorise applications of ionising radiations for different types of radioactive sources

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 session

9	**Apply physical dosimetry systems**
Course 2.2-2.3	Radiation protection (protection against internal exposure)
9.1	List the passive dosimetry devices
	Knowledge
LO K 9.1.1	Categorise the different systems of passive dosimetry (alpha, beta, gamma and X, including neutron)
LO K 9.1.2	Differentiate the dosimetry of traces (i.e. radon)
	Skills
LO S 9.1.1	Choose the appropriate passive dosimeter
	Attitude
LO A 9.1.1	Keep up to date with changes in technology for passive dosimeter
9.2	List the active dosimetry devices
	Knowledge
LO K 9.2.1	Categorise the various active dosimetry systems (alpha, beta, gamma and X, including neutron)
	Skills
LO S 9.2.1	Choose the appropriate active dosimeter
LO S 9.2.2	Calibrate device for external exposure
	Attitude
LO A 9.2.1	Keep up to date with the changes in technology for active dosimeters
9.3	Explain the principles of internal dosimetry
	Knowledge
LO K 9.3.1	Describe the physical aerosol aspects (particle size) and kinetic models bio
LO K 9.3.2	Give examples of specific dosimetry (extremity, lens, injury ...)
LO K 9.3.3	Distinguish external and internal exposure
	Skills
LO S 9.3.1	Calculate the committed dose by using the dose unit of intake h(g)
	Attitude
LO A 9.3.1	Discuss a case of contamination with an occupational physician

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	9 hours theoretical sessions

10	**Apply the three means of protection against ionising radiation (time, display, distance)**
Course 2.4	Protection against external exposure
10.1	Apply radiation protection by setting up shielding
	Knowledge
LO K 10.1.1	Identify the properties of different shielding materials
	Skills
LO S 10.1.1	Calculate shielding and combination of shields
LO S 10.1.2	Calculate dose/shielding using Monte Carlo and other codes
LO S 10.1.3	Estimate the dose rate due to a point source (characteristics and activity given - beta or photon)
LO S 10.1.4	Estimate the dose rate to different distances from a point source (beta or photon
	Attitude
LO A 10.1.1	Identify the rules of implementation of protection in relation to the source (to protect themselves during installation)
LO A 10.1.2	Identify the technical constraints linked to the wearing of personal protective equipment (lead apron, gloves sealed ...)
10.2	Apply radiation protection by reducing the exposed time
	Knowledge
LO K 10.2.1	Identify the magnitude of the impact of training on exposed time
LO K 10.2.2	Estimate the contribution of the factor "time" to the dose (workplace study)
LO K 10.2.3	Identify the radiation sources and intrinsic characteristics (pulsed-field, energy ...)
	Skills
LO S 10.2.1	Identify how to calculate exposure time (different from time billing)
LO S 10.2.2	Perform a work place study
10.3	Apply radiation protection by increase the distance
	Knowledge
LO K 10.3.1	List the existing tool to increase distance operator/source (distances clips, robotic ...)
	Skills
LO S 10.3.1	Calculate a gain of dose (dose contact vs 50 cm) to the extremities
LO S 10.3.2	Calculate a gain of dose (dose contact vs 50 cm) effective dose
10.4	Estimate collective dose
	Knowledge
LO K 10.4.1	Give the average collective dose in main situation e.g. reactor shutdown...
	Skills
LO S 10.4.1	Calculate a provisional collective dose for an exposed situation
LO S 10.4.2	List methods to decontaminate

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	5 hours theoretical sessions 4 hours tutorials/PW/OJT

11	**Apply the rules of the workplace dosimetry**
Course 2.5	Dose monitoring
11.1	Know the regulatory arrangements in place (zone dosimetry)
	Knowledge
LO K 11.1.1	Describe the workplace dosimetry devices
	Skills
LO S 11.1.1	Locate and identify workplace dosimetry devices during visit (audit)
LO S 11.1.2	Identify the correct place for the workplace dosimeter
	Attitude
LO A 11.1.1	Observe the device installed and their relevance to the source term
11.2	Know the rules of the Art of nuclear ventilation
	Knowledge
LO K 11.2.1	List the characteristics of nuclear ventilation
	Skills
LO S 11.2.1	Identify where to locate the sampling point airflow
LO S 11.2.2	Check local difference of depressions between two premises (cascade of depression)
LO S 11.2.3	Read gauges
	Attitude
LO A 11.2.1	Observe the appropriateness of materials used (sampling tube, pressure drop, elbow) and device (mobile vs. Fixed)
LO A 11.2.2	Consider when opening a door too easy (local depression)
11.3	Explain the risk of criticality
	Knowledge
LO K 11.3.1	Rebuild effective doses following a criticality accident
	Skills
LO S 11.3.1	Be able to read and interpret criticality dosimeters
LO S 11.3.2	Implement and enforce evacuation procedures related to the criticality risk
12	**Characterise a workplace**
Course 2.5	Dose monitoring
12.1	Supervise a workplace study
	Knowledge
LO K 12.1.1	Identify and apply the methodological guide
	Skills
LO S 12.1.1	Conduct a workplace study
LO S 12.1.2	Determine the collective and personal protective equipment
	Attitude
LO A 12.1.1	Integrate the multirisk approach (radiological and other occupational hazards)

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	3-6 (dependent on learning outcome)
ECVET Credit Points	3
Proposed Duration	21 hours theoretical sessions

13	**Using the supra national regulations and national regulatory frame of reference**
Course 2.6	Regulatory context
13.1	Know the regulation connection between supra national and national
Knowledge	
LO K 13.1.1	List the founding texts ICRP, IAEA, Euratom BSS
Skills	
LO S 13.1.1	Search to find the texts for an exposure situation
13.2	Identify the actors of regulation (ICRP, IAEA, EU ...)
Knowledge	
LO K 13.2.1	Explain the process from ICRP, IAEA, EU recommendations to the National Regulation
14	**Use the main regulatory texts**
Course 2.7	Regulatory context
14.1	Follow the news of regulations
Knowledge	
LO K 14.1.1	List the agencies and networks responsible for regulatory watch
Attitude	
LO A 14.1.1	Adopt an attitude of vigilance with respect to regulations on a given topic
14.2	Make a critical interpretation of regulations (on a topic)
14.3	Achieve the training of exposed persons
Knowledge	
LO K 14.3.1	Determine to radiation protection elements needed to provide training
Skills	
LO S 14.3.1	Organise and conduct a training session
Attitude	
LO A 14.3.1	Provide information tailored to the audience

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

15	**List the natural sources of ionising radiations**
Course 2.7	Natural sources of ionising radiation
15.1	Identifying the natural sources of ionising radiations
Knowledge	
LO K 15.1.1	Explain the origin (earth's crust, volcanoes, phosphate fertilisers ...)
LO K 15.1.2	List the public exposure situations (environmental, medical, accident...)
Skills	
LO S 15.1.1	Prioritise the relative contribution of natural sources to the individual dose
LO S 15.1.2	Recognize the contribution from background radiation to the average annual dose
15.2	Manage the public and environmental radiation protection
Knowledge	
LO K 15.2.1	Explain the process from ICRP, IAEA, EU recommendations to the National Regulation
Skills	
LO S 15.2.1	Make calculation using dispersion models

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	9 hours theoretical sessions

16	**Incorporate ethical considerations**
Course 2.9	Ethical considerations
16.1	Integrate ethical considerations in the medical field
Knowledge	
LO K 16.1.1	Explain the absence of dose limits for patients but use of dose optimisation
Attitude	
LO A 16.1.1	Lead a discussion with exposed medical staff
LO A 16.1.2	Integrate and enhance dose feedback (dose management by example or NRD)
16.2	Integrate ethical considerations in the industrial field
Knowledge	
LO K 16.2.1	Explain the justification principle
LO K 16.2.2	Discuss the distribution of doses between operator and subcontractors
LO K 16.2.2	Explain the respect of equity in the distribution of individual doses
Skills	
LO A 16.2.1	Consider that if the exposure is low doesn't mean that the job is not correctly performed (old attitude)

LO A 16.2.2	Adopt an attitude where the efficiency of a work is driven by an optimised dose (ALARA)
LO A 16.2.3	Keep up to date with the annual dosimetry results at your organisation level and national level
LO A 16.2.4	Adopt a transparent attitude in relation to an incident (or insignificant incident)

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