



Specialised training module 9: Geological disposal

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 specialised training module (N°9: Geological disposal) is optional and advances on the knowledge, skills and competences acquired in the three basic modules. The module 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 contractors in geological disposal that will allow him or her to seek the status of Radiation Protection Expert (RPE) from an authorised body.

3. Module overview

The Module in geological disposal consists of eight training courses.

Course 9.1	Geological disposal strategies
34	Apply the principles of radiation protection to the storage of nuclear waste in geological disposal
34.1	Describe the principles of geological disposal
Course 9.2	Storage and connected hazards
34.2	Conduct a risk analysis
Course 9.3	Monitoring and operational RP
34.3	Set up and maintain a monitoring scheme
34.4	Operate and improve RP facilities
Course 9.4	Monitoring and operational RP
35	Describe the organisational structure of a disposal
35.1	Organise RP in a disposal and define RP functions and duties
Course 9.5	Radiation accidents, incidents, alarm, emergency, preparedness and response
35.2	Set up emergency plans in an organisational context
35.3	Set up alarm plans
Course 9.6	Application of dosimetry
36	Manage quality control and dosimetry
36.1	Manage dosimetry
Course 9.7	Quality control/assessment and documentation
36.2	Organise quality control/quality assessment of equipment (technical and



	RP)
36.3	Manage documentation of actions
Course 9.8	Interaction with stakeholders and the public
37	Manage interactions with the hierarchy, regulatory bodies and the public
37.1	Manage interactions with the hierarchy
37.2	Manage interactions with regulatory bodies
37.3	Manage interactions with the public and media

4. Marking and assessment criteria

Each of the 8 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 consist of a multiple choice examination to assess knowledge (K) (70% pass-mark) showing a detailed understanding of the subject. Skills (S) and attitude (A) will be assessed in daily oral and/or written and/or practical examinations during the face to face phase.

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.

Indicators from EQF		
Evaluation Question	Judgement Criteria	Indicators and Descriptors
To what extent has the course module participant achieved the required KSAs for RPEs in geological disposal?	The participant's level of achievement of the course module KSAs will be judged by their grade (marks) from the written and oral 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:

(i) 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)

AND

(ii) A minimum of 3 years' experience working in radiation protection environment.



The applicant will be expected to have completed the following 3 generic ENETRAP III modules as pre-requisites for the Module in geological disposal (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

Basic training module 2: Foundation

- 2.1 Application of ionising radiation
- 2.2 Radiation protection
- 2.3 Radiation protection internal dosimetry
- 2.4 Protection against external exposure
- 2.5 Dose monitoring
- 2.6 Regulatory context
- 2.7 Natural sources of ionising radiation
- 2.8 Public and environmental radiation protection
- 2.9 Ethical considerations

Basic training module 3: Occupational

- 3.1 Transport
- 3.2 Design issues
- 3.3 Accidents and emergency issues
- 3.4 Safety culture
- 3.5 Waste management
- 3.6 ALARA culture

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	34	Apply the principles of radiation protection to the storage of nuclear wastes in geological disposal
Training course	9.1	Geological disposal strategies
Activity	34.1	Describe the principles of geological disposal
Learning outcome in terms of knowledge (K), skills (S) or attitude (A)	LO K 34.1.1	Name the suitable host rocks and favourable geological conditions for a disposal



34	Apply the principles of radiation protection to the storage of nuclear wastes in geological disposal
Course 9.1	Geological disposal strategies
34.1	Describe the principles of geological disposal
Knowledge	
LO K 34.1.1	Name the suitable host rocks and favourable geological conditions for a disposal
LO K 34.1.2	List the modes of storage – both interim and final – and the connected hazards
LO K 34.1.3	Describe the multi-barrier principle
LO K 34.1.4	Name the containers used for storage
LO K 34.1.5	List the waste forms and matrices
LO K 34.1.6	Describe the methods of waste treatment
LO K 34.1.7	Illustrate the methods of transport of waste containers
Skills	
LO S 34.1.1	Recognise the hazards within your disposal
LO S 34.1.2	Inform on potential hazards depending on mode of storage, container, matrix and radionuclide inventory
LO S 34.1.3	Comment on RP issues in storage strategies
LO S 34.1.4	Organise and monitor container transportation within a disposal
Attitude	
LO A 34.1.1	Discuss potential hazards with the staff
Course 9.2	Storage and connected hazards
34.2	Conduct a risk analysis
Knowledge	
LO K 34.2.1	Define the basic chemical properties of relevant radionuclides
LO K 34.2.2	Illustrate the mechanisms of leaching from a waste matrix and the influence of chemical parameters
LO K 34.2.3	Characterise the interaction of ions with mineral phases
LO K 34.2.4	Describe the aqueous transport of radionuclides
LO K 34.2.5	Illustrate the pathways of release and dispersion into the biosphere
Skills	
LO S 34.2.1	Estimate the hazard of ion leaching from a waste matrix upon entry of water
LO S 34.2.2	Estimate a migration rate
LO S 34.2.3	Identify relevant pathways of release into the biosphere
LO S 34.2.4	Take appropriate actions upon release from containers or zones
LO S 34.2.5	Estimate the hazards for staff and contractors
Attitude	
LO A 34.2.1	Give expert advice on the RP situation and initiate precautions
Course 9.3	Monitoring and operational RP
34.3	Set up and maintain a monitoring scheme
Knowledge	
LO K 34.3.1	Name the various measuring devices in RP and their proper handling



LO K 34.3.2	Define the handling and maintenance of common monitoring installations
LO K 34.3.3	Illustrate the setup of a permanent in-situ network
LO K 34.3.4	Illustrate the relevant radioanalytical methods
Skills	
LO S 34.3.1	Define critical parameters
LO S 34.3.2	Analyse the data from both permanent and routine RP measurements
LO S 34.3.3	Define an appropriate scheme for routine RP measurements
LO S 34.3.4	Set up and improve an in-situ RP measurement scheme
LO S 34.3.5	Collect representative samples appropriately for further RP analysis
Attitude	
LO A 34.3.1	Apply state of the art RP
34.4	Operate and improve RP facilities
Knowledge	
LO K 34.4.1	Describe the requirements for operational RP
LO K 34.4.2	Identify the pertinent regulations, rules and guidelines
LO K 34.4.3	Define the concepts of radiological work place zoning
Skills	
LO S 34.4.1	Identify and supervise the demands for operational RP and act accordingly
LO S 34.4.2	Conduct RP according to regulations, rules and guidelines
LO S 34.4.3	Create a training sequence and deliver appropriate RP training to the staff
Attitude	
LO A 34.4.1	Propose RP improvements within the organisation

Indicators from EQF	
Knowledge	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles
Skill	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study
EQF Level	6
ECVET Credit Points	1.5
Proposed Duration	50 hours pre course 17 hours face to face Total 67 hours
	The pre-course phase will consist of self-studying. The face to face phase of the course will consist of lectures, practical units and technical visits on geological pre-requisites, containers, waste matrices and storage concepts; release and migration of radionuclides; measurement techniques and activities, and risk assessments and safety.



35	Describe the organisational structure of a disposal	
Course 9.4	Monitoring and operational RP	
35.1	Organise RP in a disposal and define RP functions and duties	
Knowledge		
LO K 35.1.1	Describe the organisational structure of the disposal	
LO K 35.1.2	Identify the relevant regulations, rules and guidelines	
Skills		
LO S 35.1.1	Organise RP in context with the facility's requirements	
LO S 35.1.2	Harmonise RP with relevant units	
Attitude		
LO A 35.1.1	Engage staff to promote a positive RP and safety culture	
LO A 35.1.2	Inform on RP issues	
LO A 35.1.3	Discuss the distinct roles among staff members	
LO A 35.1.4	Adopt a positive attitude towards organisational harmonisation	
Course 9.5	Radiation accidents, incidents, alarm, emergency, preparedness and response	
35.2	Set up emergency plans in an organisational context	
Knowledge		
LO K 35.2.1	Identify the pertaining legislations	
LO K 35.2.2	List technical actions	
Skills		
LO S 35.2.1	Participate in the elaboration of a protocol for medical emergencies in RP areas	
LO S 35.2.2	Set up an emergency protocol for RP in case of fire	
LO S 35.2.3	Set up an emergency protocol for RP in case of technical failures (e.g. power blackout, ventilation failure, etc.)	
Attitude		
LO A 35.2.1	Inform on emergency issues	
35.3	Set up alarm plans	
Knowledge		
LO K 35.3.1	Identify the relevant contact persons	
LO K 35.3.2	List the relevant regulations, rules and guidelines	
LO K 35.3.3	Name the relevant forms of internal and external aggression	
Skills		
LO S 35.3.1	Contribute to the RP matters concerning the setup of an alarm plan for internal and external aggression	
LO S 35.3.2	Define an alarm plan for the release of nuclear material from containers or zones	
LO S 35.3.3	Elaborate an alarm plan for RP technical failures	
Attitude		
LO A 35.3.1	Conduct alarm, emergency, preparedness and RP response trainings	
Indicators from EQF		
Knowledge	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	



Skill	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study
EQF Level	6
ECVET Credit Points	1.5
Proposed Duration	15 hours pre course 4 hours face to face Total 19 hours
	The pre-course phase will consist of self-studying. The face to face phase will consist of lectures on operational RP; alarm and emergency planning in RP; RP in geological disposal

36	Manage quality control and dosimetry
Course 9.6	Application of dosimetry
36.1	Manage dosimetry
Knowledge	
LO K 36.1.1	Name the national regulations for dosimetry
LO K 36.1.2	Describe function and applications of the various dosimeters used for geological disposal and waste management
LO K 36.1.3	Describe the dosimetric quantities and concepts
Skills	
LO S 36.1.1	Supply appropriate dosimetry to staff
LO S 36.1.2	Set up a protocol for the dosimetry of contractors and visitors
LO S 36.1.3	Define suitable documentation
Attitude	
LO A 36.1.1	Promote appropriate dosimetry
Course 9.7	Quality control/assessment and documentation
36.2	Organise quality control/quality assessment of equipment (technical and RP)
Knowledge	
LO K 36.2.1	List the methods of quality control in RP and of calibration of relevant equipment
LO K 36.2.2	Describe interfering factors in radiation measurements
LO K 36.2.3	Illustrate technical aspects of related installations
Skills	
LO S 36.2.1	Set up a routine protocol for quality control/quality assessment
LO S 36.2.2	Train the staff in calibration and quality control of RP equipment
Attitude	
LO A 36.2.1	Train on the importance of quality control/quality assessment
36.3	Manage documentation of actions
Knowledge	
LO K 36.3.1	Describe how to retrieve and compile relevant data
LO K 36.3.2	List the duties of documentation and storage thereof
Skills	
LO S 36.3.1	Organise appropriate documentation of all RP actions



LO S 36.3.2	Compile and store all relevant documentation in compliance with regulations and guidelines
Attitude	
LO A 36.3.1	Discuss documentation issues

Indicators from EQF	
Knowledge	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles
Skill	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study
EQF Level	6
ECVET Credit Points	1.5
Proposed Duration	20 hours pre course 5 hours face to face Total 25 hours
Notes	The pre-course phase will consist of self-studying. The face to face phase of the course will consist of lectures, practical units and technical visits on dosimetry; RP equipment and relevant quality control concepts; documentation

37	Manage interactions with the hierarchy, regulatory bodies and the public
Course 9.8	Interaction with stakeholders and the public
37.1	Manage interactions with the hierarchy
Knowledge	
LO K 37.1.1	Identify the relevant regulatory bodies
LO K 37.1.2	Identify relevant contact persons
LO K 37.1.3	Describe the duties of report
LO K 37.1.4	Describe how to communicate an emergency appropriately with authorities and relevant bodies
Skills	
LO S 37.1.1	Interact professionally and efficiently with all regulating bodies
LO S 37.1.2	Provide the required reports and forward them
Attitude	
LO A 37.1.1	Discuss relevant RP aspects with appropriate actors
37.2	Manage interactions with regulatory bodies
Knowledge	
LO K 37.2.1	Describe the hierarchical structure of the organisation
LO K 37.2.2	List all relevant staff and whom to report
Skills	
LO S 37.2.1	Compile relevant data and write reports according to the duties
LO S 37.2.2	Report to the appropriate actors within the organisation
Attitude	



LO A 37.2.1	Preserve good relations and cooperation with regulatory bodies
37.3	Manage interactions with the public and media
Knowledge	
LO K 37.3.1	Identify the guidelines for interaction with the public and media
LO K 37.3.2	Name relevant confidentiality policies
Skills	
LO S 37.3.1	Interact appropriately with the public and media
LO S 37.3.2	Train the staff accordingly
Attitude	
LO A 37.3.1	Interact adequately with the public and media

Indicators from EQF	
Knowledge	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles
Skill	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study
EQF Level	6
ECVET Credit Points	1.5
Proposed Duration	10 hours pre course 4 hours face to face Total 14 hours
	The pre-course phase will consist of self-studying. The face to face phase of the course will consist of lectures on the interaction with stakeholders and the public.