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Synthesis Report on the ECVET implementation in the nuclear energy sector

Towards the experimental testing of ECVET

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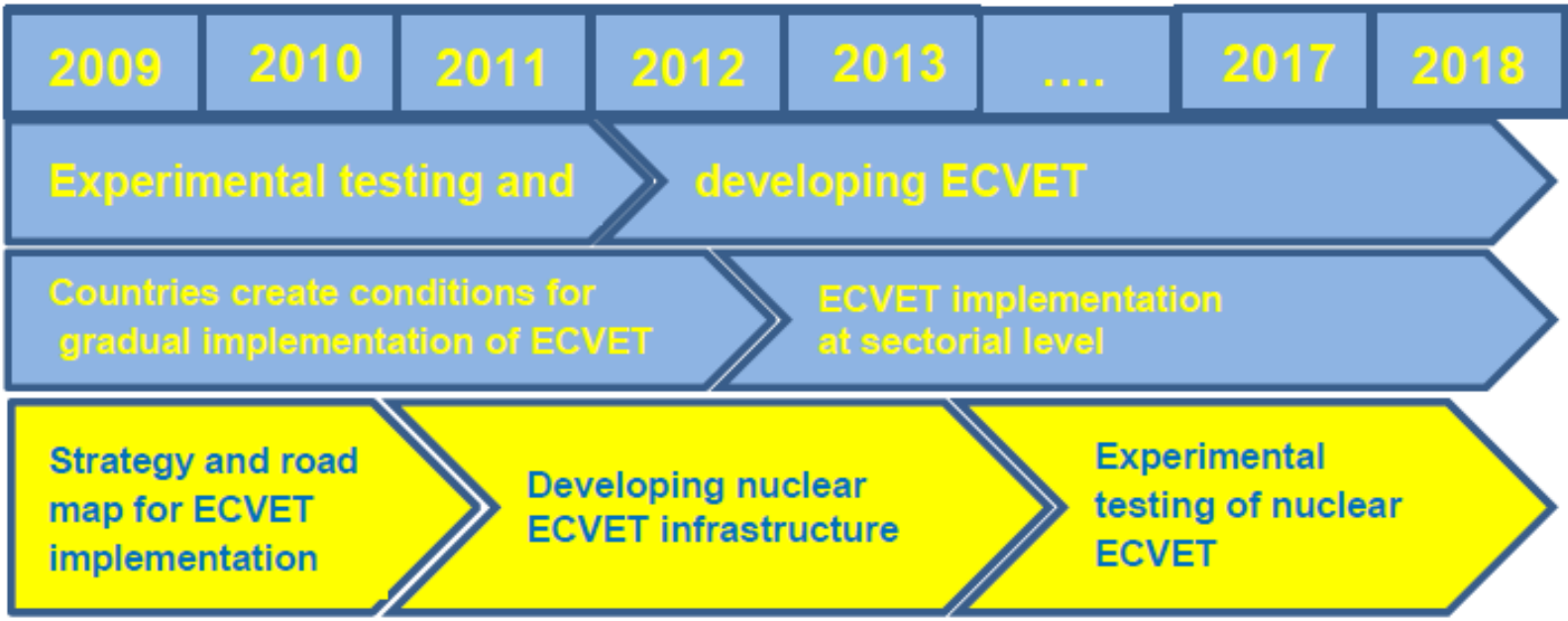

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Towards the experimental testing of ECVET in the nuclear sector

Abstract
The ECVET is a cornerstone of European policies in E&T, as long as it connects the world of E&T to the world of work. There are not standard solutions at EU level for problems dependent on the national legislation. ECVET pilot projects could identify solutions at national level.

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Foreword

Significant progress has been achieved in recent years on the European Credit System on Vocational Education and Training (ECVET) implementation in the nuclear energy sector. Within ECVET Forum in 2015, held in Barcelona, the nuclear energy sector was considered a success story in terms of ECVET implementation.

Factors constraining the progress in ECVET implementation in the nuclear sector remain. For that reason there is a need to better understand the EU policy on modernisation of both education and training (E&T), and EU single market. The barriers impeding the implementation of ECVET should be analysed, in the light of these policies, with the aim of outlining actions that may improve current situations where progress is slowed down.

The present document aims to provide an EU-wide overview of the status towards the implementation of the ECVET in the nuclear energy sector, carried out to meet the requirements of the Recommendation of the European Parliament and the Council on the establishment of ECVET, from 18 June 2009.

In addition, this report highlights several actions that may boost the progress ECVET implementation:

- to develop ECVET infrastructure as a tool for the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes.
- to set up nuclear ECVET pilot projects to identify solutions to the problems that are dependent on the national legislation;
- to connect the nuclear E&T to the nuclear labour market by boosting the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes or market needs.

Executive summary

Policy context

The report addresses the White Paper on the future of EU, The Recommendation of the European Parliament and the Council on the establishment of the European Credit System for Vocational Education and Training (ECVET), and the Energy Union project.

The report was done for senior policy makers, managers and experts.

The issue at stake is to complete the experimental implementation of ECVET and shifting to the ECVET implementation at the nuclear sector scale.

The stake is high because the sustainability of all the ECVET implementation process depends on the results of nuclear ECVET pilot projects.

The report is relevant by emphasising the issues to overcome in order to complete the experimental implementation of ECVET and shifting to the ECVET implementation at the nuclear sector scale.

The report is relevant for two policies: Single market & trade; nuclear E&T modernization.

Key conclusions

The main conclusions:

- There is not a standard legal solution at EU level for solving issues like the permeability between different education and learning schemes, the gradual accumulation of new learning outcomes (LO) and the competent body able to recognise qualifications, units and modules.
- The nuclear ECVET pilot projects are the most effective tool to identify solutions to the problems that are dependent of the national legislation.
- The nuclear ECVET pilot projects would be financed under Erasmus+ programme
- The Info package of Erasmus+ programme should be updated in order to include the customised tools for ECVET implementation in the nuclear sector
- The nuclear ECVET pilot projects will test two ECVET processes: acquiring learning outcomes in the context of mobility abroad (it impacts the labour market) and qualification-oriented training programs development (it impacts the E&T system)

The main assumptions behind the existing policy on ECVET implementation were confirmed.

Two new problems that have been identified: the gradual accumulation of new LO is blocked; the need for designation of the competent body able to recognise qualifications, units and modules.

The possible adjustment to the problem of the identification of the authority responsible for a given qualification, considering two situations: a) when qualifications are under the responsibility of a ministry or a national competent body, there is no possibility of a supra national authority for the recognition of national qualifications; b) when qualifications are under the responsibility of and awarded by the nuclear sector, ENEN could be defined as the independent body, trusted by the nuclear stakeholders, for recognition of units and/or qualification and training programmes.

The innovation arisen is the transition from E&T- discipline oriented (where the qualifications addressed are not specified and the LO accumulation is not driven by the labour market needs) to the E&T- qualification oriented (where the LO accumulation is driven by the labour market needs).

The uncertainty on ECVET implementation regards the ECVET Recommendation update or the release of an ECVET Directive.

Main findings

The findings are related to several layers of ECVET implementation.

Regarding sector's major HR challenges: to fill-in the 30% gap between HR demand and supply and to adapt nuclear E&T system to comply more with labour market demands

Regarding sector's major HR solution: the solution to the sector's HR problems has two components: 1) "Nuclearisation" is the solution for filling up the 30% HR gap by engaging individuals from non-nuclear sector and training them to get a nuclear qualification; 2) The ECVET infrastructure development, is the tool for the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes (market needs).

The main results of the ECVET implementation are:

- Nuclear ECVET visibility increased at EU level following the 12 publications on the ECVET related topics, three of them in International Journal of Nuclear Power.
- ECVET connects the nuclear E&T with the nuclear market.
- By introducing flexible qualifications, ECVET facilitates the workers' lifelong learning, mobility and flexible learning pathways.
- ECVET infrastructure development as a tool for the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes. ECVET infrastructure means the customisation of the implementation tools of ECVET to the nuclear sector needs, such as: classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is embedded); progression routes in decommissioning; methodology for nuclear qualification design; methodology for design of qualification-oriented training programmes.

Related and future JRC work

Next steps: 2018: defining a harmonized approach on ECVET pilot projects (pp) of main Euratom stakeholders; 2019: Ten ECVET pp to be financed under the Erasmus+; 2022: assessment of nuclear ECVET pp outcomes; 2023: nuclear sector would consider the shift to the ECVET implementation at nuclear sector scale.

Quick guide

The key terms and concepts:

- Learning outcome (LO) is what the learner knows, understands and is able to do after completing a learning process
- Unit of learning outcomes (ULO): a set of LOs that represents the smallest part of a qualification that would be assessed & validated independently
- Flexible qualification: structured in ULOs and LOs
- ECVET implementation is based on a stepwise approach:
  - the development of a strategy and road map for ECVET implementation
  - the development of the nuclear ECVET infrastructure; it means the customisation of the implementation tools of ECVET
  - experimental testing of ECVET through pilot projects

1 Introduction

1.1 Purpose of the report

The aim of this report is to provide an overview of the status of ECVET implementation in the nuclear energy sector, carried out to meet the requirements of the white paper on the future of EU, from 25 March 2017, and the Recommendation of the European Parliament and the Council on the establishment of ECVET, from 18 June 2009 [1].

The Report addresses the main aspects of ECVET implementation in the nuclear energy sector and updates targeted groups with the latest developments, as defined in the

Table 1.

Table 1. Aspects of ECVET implementation and targeted groups

Aspects of ECVET implementation	Targeted groups
Policy relevant outcomes regarding ECVET implementation	Senior policy makers across the EC
JRC's contribution to the ECVET implementation	Managers across the EC
Getting a deep understanding of ECVET innovations	Nuclear stakeholders involved in ECVET implementation
Supporting ECVET pilot projects, initiatives and experimentations in ECVET at nuclear sector level	Practitioners and experts involved in ECVET implementation

1.2 Policy context and background

One of the basic ideas of EU vision White Paper is to preserve the achievements that EU has already attained and to tackle new projects in the interest of EU citizens. In this context, it is generally accepted that the EU single market is one of the most important achievements of EU.

In all five scenarios considered by the White Paper**,** the EU single market is strengthened, including in the energy sector, and is constantly a policy priority as shown in the Table 2.

Table 2. Single market & trade policy within the five scenarios

Scenario ➡ / **Policy ⬇**	**Carrying on**	**Nothing but the single market**	**Those who want more do more**	**Doing less more efficiently**	**Doing much more together**
Single market & trade	Single market is strengthened, including in the energy and digital sectors; the EU27 pursues progressive trade agreements	Single market for goods and capital strengthened; standards continue to differ; free movement of people and services not fully guaranteed	As in "Carrying on", single market is strengthened and the EU27 pursues progressive trade agreements	Common standards set to a minimum but enforcement is strengthened in areas regulated at EU level; trade exclusively dealt with at EU level	Single market strengthened through harmonisation of standards and stronger enforcement; trade exclusively dealt with at EU level

As part of the EU single market, the Energy Union is a European priority project, identified by the Juncker Commission as one of the ten political priorities [2], in which five dimensions are closely interlinked: enhance security of energy supply; a fully integrated European energy market; energy efficiency contributing to moderation of demand; decarbonising the economy; and research, innovation and competitiveness.

According to all energy mix scenarios, presented in the European Commission's (EC) Energy Roadmap 2050 [3], nuclear energy will remain in the energy mix to support

the challenges of the Energy Union project. Besides power production, nuclear technologies are increasingly used in the various industrial and medical applications.

In this context, strengthening the nuclear energy market - as part of the fully integrated European energy market - assumes the implementation of several measures:

- stopping further reduction in nuclear existing competences;
- implementing of common European tools and principles for E&T modernization (EQF; ESCO and ECVET)
- introduction of flexible qualifications, with the view of facilitating workers' lifelong learning, mobility and flexible learning pathways;
- developing the ECVET infrastructure as the precondition for starting the development of training programmes-qualification oriented.

During the past decades, several common European tools and principles for education and training (E&T) modernization, illustrated in the Figure 1, have been developed at European level in order to increase the quality, transparency and harmonization of the national education systems and to facilitate worker's free movement within EU single market.

Figure 1. The common European tools and principles for the modernization of education and training

Source: Cedefop

These tools and principles create mechanisms to put into practice the objectives of the Copenhagen Process, such as: the framework for transparency of qualifications and competences (Europass); the European Qualifications Framework for lifelong learning (EQF); the Quality Assurance Framework for VET (EQAVET); the European Credit System for Vocational Education and Training (ECVET); the principles on validation of non-formal and informal learning.

Among the nine common European tools and principles for E&T modernization, the European Credit system for Vocational Education and Training (ECVET) has a particular importance. It facilitates also the process of E&T system adaptation to the labour market needs. The adaptation of E&T system to the labour market needs should aim to facilitate lifelong learning, mobility and flexible learning pathways.

ECVET has been continuously developed since the Copenhagen Declaration (European Commission, 2002), with the view of promoting transparency, comparability, transferability and recognition of competence and/or qualifications, between different countries and at different levels. Cedefop was involved in this process quite from the beginning and carried out, in 2003, a feasibility study which conducted to key elements of the future ECVET.

The Maastricht Communiqué (European Commission, 2004) gave priority to ECVET, underlining the importance of testing and implementing this instrument. In 2006/2007

the ECVET proposal was submitted to a Europe-wide consultation. At the same time also two European studies (ECVET connexion and ECVET reflector) contributed to defining the ECVET instrument.

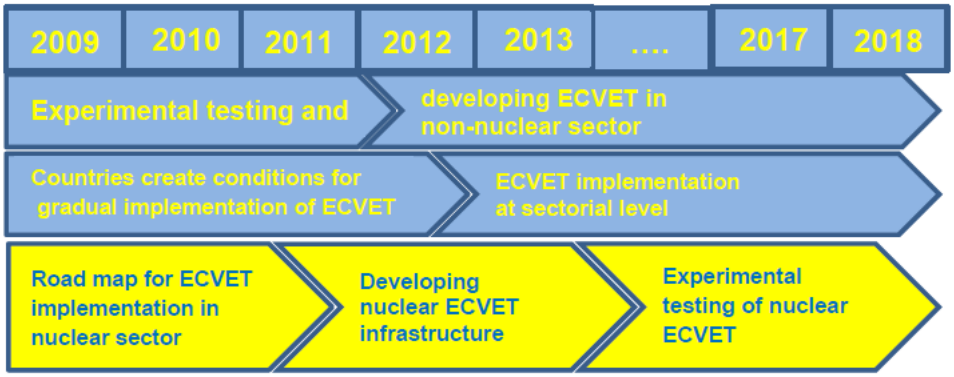
The European communiqués of Helsinki (European Commission, 2006b) and Bordeaux (Bordeaux Communiqué, 2008) stressed the importance of testing ECVET. The results were that ECVET had to be further developed and that ECVET/EQF related networks had to be build. It also strongly encouraged the learning outcomes approach and the need to establish links with Europass and validation processes.

In June 2009 the European Parliament and the Council signed the European Recommendation on the establishment of ECVET.

The Europe 2020 strategy has incorporated and reinforced the reforms devised by the Copenhagen Process, as a response to the new challenges of the EU as a single economy: ageing of the labour market, integration of the 28 different economies, and need for a workforce mobile and increasingly competent.

Following the Recommendation on the establishment of ECVET adoption by the European Parliament and by the Council (18 June 2009), the timeline for ECVET implementation foresees two actions types, at MS level and at sectorial level, as is illustrated in the Figure 2.

Figure 2. The timeline for ECVET implementation



The actions at member state level (middle line in Figure 2) concern the adaptation of national legislation in order to create the conditions for gradual implementation of ECVET. This process was successfully completed in the period 2009-2012. From 2012 onward, the development of ECVET should be focused on each economic sector.

The ECVET implementation in the non-nuclear sector (upper line in Figure 2) was conceived in two phases.

In the first phase, ECVET concepts and principles have been tested through pilot projects, at non-nuclear sector level, and introduced to ensure that conditions for the gradual application of ECVET to VET qualifications are in place across Europe by 2012. There are 19 ECVET pilot projects [4] from non-nuclear sectors (aircraft industry; automotive, health care, metal industry, etc.) that have been financed through lifelong learning programme.

In the second phase the progressive implementation at sectorial level continued; the most advanced sectors in ECVET implementation are the automotive industry (with maintenance sub-sector); aircraft industry (with maintenance sub-sector) and services industry.

In the nuclear energy sector (lower line in Figure 2), the ECVET implementation has followed a different approach than in non-nuclear sector and was designed in three phases.

In the first phase a strategy and road map for ECVET implementation were developed:

- 2009: the European Human Resource Observatory in the Nuclear Energy Sector (EHRO-N) was established with the mission to be the central initiative in the field of nuclear human resources (HR) and Education & Training (E&T), and keep focusing on monitoring of resources needed in the nuclear sector. EHRO-N is based in JRC-Knowledge for Nuclear Safety, Security and Safeguard Unit (JRC.G.10);
- 2010: EHRO-N and the main stakeholders of the Euratom R&TD programmes (DG RTD, DG EAC, DG JRC and DG ENER)[5] developed a strategy and road map for ECVET implementation in the nuclear energy sector [6] (common approach regarding nuclear qualifications, vision and implementation tools of ECVET);
- 2011: the process of ECVET implementation started with customised workshops and seminars for NES, organized by JRC, that are in fact the driving force for ECVET implementation in the NES.

The second phase was focused on the development of the nuclear ECVET infrastructure. That means the customisation of the implementation tools of ECVET to the specific needs of the nuclear energy sector. The implementation tools of ECVET, are: classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is embedded); job description of 140 jobs within three phases of NPP life cycle; Decommissioning sub-sector progression routes; methodology for nuclear qualification design; methodology for training programmes-qualification oriented design [7]. The ECVET infrastructure is common and connects the two worlds: the world of learning (nuclear E&T) and the world of work (nuclear labour market).

The third phase, experimental testing of ECVET through pilot projects, intends to test primarily two ECVET processes: acquiring learning outcomes (competences) in the context of mobility abroad and development of qualification-oriented training programmes.

1.3 Next steps in ECVET implementation

The process of ECVET implementation in the nuclear energy sector is running since 2011 and has reached the stage of experimental testing of ECVET through pilot projects.

Because in most cases, qualifications are under the responsibility of a Ministry, there is not a standard legal solution at EU level for solving the issues like: the permeability between different education/learning schemes; gradual accumulation of new LO; and the competent body able to recognise qualifications, units and modules.

In those cases, the nuclear ECVET pilot projects are the most effective tool for identification of solutions to the problems that are dependent of the national legislation.

Moreover, the sustainability of the whole ECVET implementation process, on which JRC worked out, and the possibility to shift to the ECVET implementation at the nuclear sector scale depend on the results of ECVET pilot projects and on the commitment of the nuclear stakeholders to support ECVET.

In this context, the necessary further actions for completing the third phase of ECVET implementation are:

- 2018: defining a common approach of the main stakeholders (DG RTD, DG EAC, DG JRC, DG ENER and REA) of the Euratom R&TD programmes regarding the experimental testing of ECVET though nuclear ECVET pilot projects;
- 2019: 10 ECVET pilot projects to be financed under the Erasmus+;
- 2022: assessment of nuclear ECVET pilot projects outcomes;
- 2023: nuclear sector would consider the shift to the ECVET implementation at nuclear sector scale.

2 Methodological aspects of ECVET implementation

The legislation together with the technical documentation, mainly developed by Cedefop, forms the foundations of European policies in education and training. The ECVET can be rightly considered a cornerstone of European policies in E&T, as long as it shapes the general features and integrates the tools for its implementation.

Moreover, ECVET is the second most important reform after Bologna process, leading to reshaping of the world of E&T and the world of work (labour market).

When a sector decides to implement ECVET, in particular the nuclear energy sector, some preconditions should be met beforehand:

- to develop a sector strategy and a road map for ECVET implementation
- to involve the main stakeholders (employers/nuclear industry; authorities for qualifications; academia; research organizations; training providers; also international organizations such as IAEA, ENS and ENEN) in the ECVET implementation process;
- all stakeholders should get a deep understanding of ECVET innovations;
- to master at least three tools for E&T modernization: EQF, ESCO and ECVET;
- to set up nuclear-VET networks with the view of ECVET implementation and training modernisation;

2.1 Sectorial approaches to EQF and ECVET in Europe

The 23 April 2008 Recommendation on the establishment of the European Qualifications Framework for lifelong learning (EQF) of the European Parliament and Council has set as one of its objectives to ensure, for the overall VET system, the comparability of different qualifications systems and their levels in Europe.

Most MS have developed the National Qualifications Frameworks (NQF) having at the core of the referencing process the EQF.

The sectorial approach to building qualifications and qualification frameworks reflects the need by professionals to notably facilitate professional mobility, increase comparability and transparency of qualifications, address up-to-date and continuously-evolving labour concerns, stick closer to work processes described in more accurate terms, provide VET solutions tailored to the needs of the sector.

In this regard, a noticeable trend lies in the growing consciousness that sectorial endeavours need to cover not only national but European sectorial concerns as well since we are ultimately all a part of a single European economic and labour market where work processes are roughly equivalent and call for the acquisition of the same knowledge, skills and responsibility/autonomy by all workers performing same level activities.

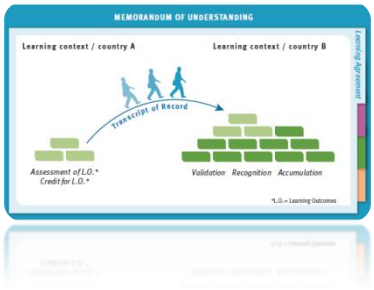
Whereas in the past many Sectorial Qualifications Frameworks (SQFs) used to be aimed merely at providing a catalogue of qualifications, nowadays, the need for referencing to a common framework – the EQF - stimulates the adoption of a learning outcomes approach, even though the descriptors and the levels used in SQFs do not necessarily match descriptors and levels of the EQF.

ECVET is a multifunctional tool with three functions, which enable to connect the world of learning to the world of work.

a) ECVET is a tool that facilitates the free movement of workers into EU single market, aiming at the flexible accumulation of new learning outcomes as illustrated in the Figure 3.

b) ECVET is one of the 9 common European tools & principles, shown in the Figure 1, for E&T modernization. All nine common European tools and principles are handling with the new concept of Learning Outcome/LO. LO refers to observable and measurable Knowledge/K, Skills/S and Responsibility/Autonomy (R/A)

Figure 3. ECVET facilitates the flexible accumulation of new Los

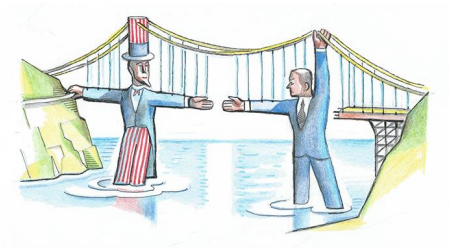


Source: Cedefop

c) ECVET connects the world of E&T to the world of work using the qualification concept as a bridge, as is shown in the Figure 4.

This bridge has two pillars. One pillar is represented by the employers who define the job requirements in terms of LOs or competences. The second pillar is represented by the training providers who provide the LOs or competences, requested by the employers or by the labour market.

Figure 4. ECVET connects the world of learning to the world of work



Source: https://www.strategy-business.com/article/00367

In this context, a training programme-qualification oriented delivers only competences/ LOs that are missing from the targeted qualification and saves time and money being 30-50% shorter than a complete training programme.

2.2 Current status of ECVET implementation

2.2.1 ECVET in the non-nuclear sector

The commitment of the EU Member States concerning the European Credit System for Vocational Education and Training is still very moderate [8]. To promote implementation of ECVET the European Commission issued two calls for proposals to finance international partnerships aimed to test the implementation of the ECVET process in the contexts of mobility. As a result, a total of nineteen ECVET pilot projects have been selected and completed within two periods, 2008-2011 and 2011-2014.

The pilot projects, developed in different economic sectors (automotive industry, aeronautical industry, tourism, health care, etc.), became an informative source on the practical application of ECVET by providing information about its implementation possibilities in different sectors and dissemination of information about the best practices, difficulties and results of the individual projects.

In the conclusions of the final conference of the ECVET pilot projects of the first generation, 2012, it is stressed that there is a need to further strengthen the common

European features of the ECVET system while adopting it at national or sectorial level, instead of merely picking up those elements that seem to easily fit.

2.2.2 ECVET in the nuclear energy sector

The ECVET implementation in the nuclear energy sector is well framed within the general timetable of ECVET implementation in the EU as it is shown in the Figure 2. Main stakeholders of the Euratom R&T programmes (DG RTD, DG EAC, DG JRC, DG ENER) started in 2010 to lay the foundations of ECVET by developing a common approach regarding nuclear qualifications, vision, implementation instruments of ECVET in the nuclear energy sector and a strategy and road map [9].

The four partners took over specific tasks as following: DG RTD has supported ***indirect actions*** representing Euratom FP7 and Horizon 2020 research and training programmes; DG JRC together with DG EAC have driven ***direct actions***; and DG EMPL offered scientific support and guidance through the ECVET Team.

Direct actions are activities that have been undertaken by JRC within the institutional projects as well since 2010, upon request of the European Commission's Directorate-Generals for Innovation and Research (DG RTD) and Education and Culture (DG EAC). Direct actions have the objective of ECVET implementation in the NES. The outcomes of direct actions are the customised tools for ECVET implementation in the nuclear energy sector, described in the chapter 3.

Indirect actions are represented by research and training programmes that had been financed by the Seventh Framework Program of European Atomic Energy Community (Euratom FP7) and Horizon 2020. The Euratom Fission Training Scheme (EFTS) projects were "coordination actions" in the area of nuclear education and training with the overall objective of promoting mobility, borderless cooperation and lifelong learning. These training schemes are ambitious vocational education and training (VET) or continuing professional development (CPD) programmes. The EFTS are thus the first attempt in ECVET implementation, aimed at introducing the concept of learning outcomes in training and career development in the nuclear fission sector.

Nuclear industry has certain particularities to be taken in consideration when developing projects related to training, education and professional qualification within the sector:

- the omnipresence of safety and security aspects when it is referred to any nuclear activity, and also the environmental and public opinion issues intrinsically associated to energy production by atomic fission. Related to that, an extensive regulatory framework has been developed over decades, resulting in the highly regulated regime that rules nowadays the nuclear activities. The role of the national regulatory bodies introduces a great diversity in practices on the supply, demand and accreditation of education and training, making the implementation of ECVET additionally challenging [10].
- the qualifications required by nuclear sector correspond mostly to the upper levels of the European Qualifications Framework (EQF), addressing research and industry workers with higher education levels, i.e. EQF level 6 to 8 (bachelor, master and doctorate levels or equivalent). Although transferability and comparability between ECTS and ECVET is an overall issue, it becomes especially relevant in the nuclear field, where the qualifications correspond mostly to the upper levels of the EQF.
- nuclear industry has a great degree of internationalisation, both for the regular movement of workers and materials and for the transnational agreements that govern it to a great extent. Moreover, safety concerns, intrinsically linked to nuclear activities, make the availability of sufficient workforce crucial. The competence of this workforce must be continuously up-to-date, demanding consistent lifelong training schemes besides initial learning upon taking up a job.

- the movement of learners -either students or professionals- is also encouraged by the restricted availability of suitable facilities and expertise. In this context, synergies stemming from mobility become not merely beneficial, but essential. Completing the in-house and on-the-job training with learning periods in different organizations and countries is often necessary for acquiring and maintaining an appropriate level of competence.
- the prospective on the demand of nuclear experts in the medium term suggests the necessity for "nuclearisation" of a number of professionals with initial non-nuclear background.

Developing transparency of qualifications in the nuclear field in order to facilitate professional mobility at the European scale is an important task. Each MS has its own nuclear policy and nuclear regulator. Many of the countries have developed national qualifications, which are overseen by national accreditation organisations.

Further, this section introduces the key innovations brought by ECVET that might impact the modernization of the two worlds, the world of work and the world of learning.

2.3 Innovations brought by ECVET

The practitioners involved in E&T asked frequently the following question: "is it possible to apply ECVET principles in both education and training?"

In order to answer to this question we have to distinguish between education and training.

Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits. Education frequently takes place under the guidance of educators, but learners may also educate themselves. Education can take place in formal, informal or non-formal settings and any experience that has a formative effect on the way one thinks, feels, or acts may be considered educational.

Training refers to the teaching and learning activities carried on for the primary purpose of helping the individuals to acquire and apply the knowledge, skills, and responsibility/autonomy needed by a particular job.

Additional criteria for differentiation of education and training are shown in the Table 3.

Table 3. Criteria for education and training differentiation

	Education	**Training**
Definition	It deals mainly with knowledge acquisition and understanding of natural, economic and social lows.	It deals mainly with skills and responsibility/autonomy acquisition in addition to knowledge.
Purpose	A knowledge acquisition process in answer to the need to maintain completeness and continuity of expertise across generations.	A process of acquiring specific skills required to properly performing a well-defined job or function, usually to an established standard.
Suppliers	primarily academic institutions	primarily experts in Continuous Professional Development/ CPD (e.g. mix of industry & academia)
Audience	individuals under initial formation	individuals having already a degree or qualification

Being aware about the differences between education and training, the answer to the E&T practitioners question, is yes, both education and training could be modernized, based on the ECVET principles (new concept of learning outcome), with some amendments:

- all stakeholders involved (authorities for qualifications, nuclear industry, nuclear regulatory bodies (NRB), training providers, etc.) should get a deep understanding and mastering of ECVET innovations;
- the targeted audience of an education programme: individuals who have not a degree or a qualification and are under initial education;
- the targeted audience of a training programme (or CPD- Continuous Professional Development): individuals who have already a degree or a qualification and intend to improve the initial qualification;

- the exit-outcome of an education programme should be wider than the exit-outcome of a training programme; it describes the labour market needs in terms of occupations or a common occupation for several sectors (Eg: Bachelor programme Mechanical Engineering);
- the exit-outcome of a training programme describes the labour market needs in terms of qualification or just specific skills of a qualification (Eg: training programme oriented to the qualification 3.7.1. Radioactive Waste Management (RWM);

2.3.1 Flexible qualification

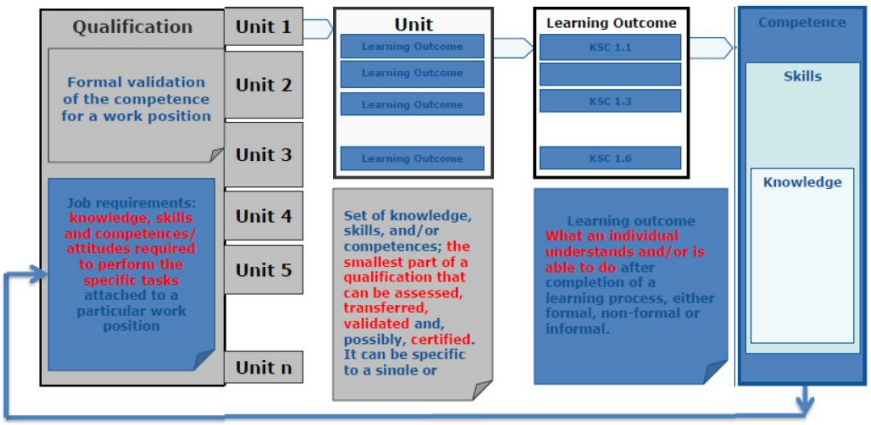
According to the ECVET principles, a flexible qualification or unit-based qualification is structured in units of learning outcomes as is shown in the Figure 5. A unit of learning outcomes (ULO) is a set of knowledge and skills, according to the Responsibility/Autonomy ([1]). A ULO represents the smallest part of a qualification that would be assessed and validated independently. These features of a unit of learning outcomes increase the qualification's degree of transparency for someone who has no nuclear background. The qualification also becomes more flexible and adaptable to the market changes.

A learning outcome (LO) is what an individual knows, understands and is able to do after completion of a learning process.

According to the new EQF, the former learning outcome descriptors: Knowledge, Skills and Competence (KSC) have been changed. The descriptor Competence (C) was replaced by responsibility/autonomy (R/A). The new descriptors of learning outcomes are: Knowledge (K), Skills (S) and Responsibility/Autonomy(R/A). They define and characterize the EQF levels.

The implementation of the new EQF descriptors into the methodology for nuclear qualifications design was developed by means of an updated template for qualification design. The Figure 6 shows an extract from the updated template for qualification design, in the case of the 3.7.1. Radioactive Waste Management (RWM) qualification.

Figure 5. The structure of a flexible qualification



1 The term 'competence' as heading for the third column of the EQF descriptors (Annex II to the 2008 Recommendation on EQF) would be changed into 'Responsibility/Autonomy' as the term 'competence' is not used consistently in the 2008 EQF Recommendation. Removing this conceptual inconsistency would strengthen the learning outcomes approach promoted by the EQF.
Responsibility/Autonomy in the context of the EQF is the ability of the learner to apply knowledge and skills autonomously and with responsibility. (Proposal for a COUNCIL RECOMMENDATION on the European Qualifications Framework for lifelong learning and repealing the Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning) COM (2016) 383/2

Figure 6. The updated template for qualification design

Qualification title: Radioactive Waste Management (3.7.1.) **EQF level 6**

List of units of learning outcomes over 3 flexible qualifications from decommissioning and operation

	3.9.1 Radiation Protection Expert	**2.3.1** Management of Radioactive Waste &RP	**3.7.1** Radioactive Waste Management
U1	Radiation Protection – TU (3.9.1;2.3.1; 3.7.1)		
U2	Accident and emergency issues – TU (3.9.1;2.3.1; 3.7.1)		
U3	Team and project management – TU (3.9.1;2.3.1; 3.7.1)		
U4	Interaction with other nuclear areas/departments – TU (3.9.1;2.3.1; 3.7.1)		
U5	Evaluation and optimization of individual and collective doses – BU (3.9.1 ; 2.3.1)		Decommissioning management SU (3.7.1)
U6	Management of health, radiological and environmental risks - BU (3.9.1; 2.3.1)		
U6/7		Radioactive waste management – BU (3.7.1 ; 2.3.1)	

Unit of learning outcomes No.6: RADIOACTIVE WASTE MANAGEMENT / BU (2.3.1; 3.7.1)

Autonomy/Responsibility

Manage complex activities related to radioactive waste management including handling, treatment and storage. Take responsibility for decisions related to technologies, processes, nuclear and industrial safety as well as impact to environment.

Skills	**Knowledge**
S.6.1. Evaluate and control the level of contamination and induced activities of radioactive waste S.6.2. Select optimal solution and manage radioactive waste categorisation S.6.3. Manage radioactive waste handling and transport S.6.5 Apply proper criteria for treated waste classification and handling S.6.6. Evaluate and manage collected data about waste characteristics S.6.9. Comply activities with national program in decommissioning S.6.10. Developing waste management program, specifications and procedures S.6.11. Apply appropriate solutions in packaging	K.6.1. Waste characterisation and categorisation K.6.2. Dosimetry K.6.3. Nuclear safety and radiation protection K.6.4. Relevant national and international legislation and guidelines K.6.5. Health protection K.6.6. Environmental protection K.6.7. Nuclear safety culture and human factor K.6.8. Protective clothing and protective equipment K.6.9. Transport, handling and storage of radioactive waste K.6.10. Treatment and long term storage K.6.11. National policy and program in decommissionning K.6.12. Waste conditioning including packaging

Assessment criteria:

Characterisation of radioactive waste
Handling with radioactive waste
Proper use of radiation control equipment
Developing specifications and procedures
Evaluation of radiation protection measures
Manipulation with active waste
Effective shielding measures

Recommended assessment methods:

Practical exercises
Situational judgement tests
Lessons learned
Case studies
Task solving

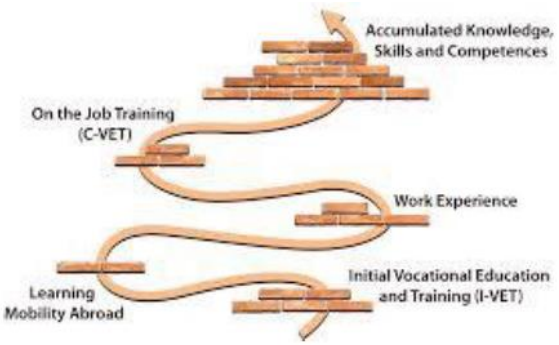
2.3.2 Flexible learning pathway

Flexible qualifications (unit-based qualifications) open the door to the gradual accumulation of learning outcomes and to the flexible learning pathway.

The process of gradual accumulation of learning outcomes, called also flexible learning pathway illustrated in the Figure 7, is one of the key innovations brought by ECVET. Gradual accumulation of learning outcomes, no matter in what education or learning scheme, lead to a flexible learning pathway.

This key feature facilitates lifelong learning, as well as geographical mobility.

Figure 7. The flexible learning pathways



Source: Cedefop

The new learning outcomes or competences, represented as bricks in the Figure 6, could be acquired within different learning systems:

- formal learning: Initial Vocational Education and Training (I-VET);
- non-formal learning: Learning Mobility Abroad; On-the-Job Training (C-VET);
- informal learning: Work Experience.

Regardless of the learning system from which the learning outcomes or competences are coming, they should be validated and recognized by a competent authority.

Since in most cases the qualifications are under the responsibility of a Ministry or a national competent body, there is not a standard legal solution at EU level for solving the permeability between different education or learning schemes and sectors.

2.3.3 Competence - based qualification system

Our understanding of qualifications and how they are used is changing.

The traditional understanding of a qualification (within knowledge-based qualification system (K-B QS) was a certificate that was issued after the successful completion of a study programme. This definition is still widely used, and is included in the ISCED 2011 proposal ([2]), but in practice qualifications are increasingly outcomes-led.

The qualification definition of the EQF illustrates the paradigm shift from knowledge-based qualification system (K-B QS) to competence-based qualification system (C-B QS). It defines a qualification as "a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards ".

This move towards learning outcomes is changing the way in which qualifications are developed and awarded. Developers are now required to be much more conscious of the relevance of knowledge, skills and responsibility/autonomy for a qualification. These changes have had a very profound effect on qualifications development in vocational education in many countries. They are now also beginning to affect higher education and general education qualifications. But different contexts change the perspective on quality and relevance.

There are several dimensions of the qualification's relevance. It may concern:

- the relevance for the learners in terms of access to learning, transfer, progression, mobility and entry into the labour market;
- the relevance for the education and training systems themselves in terms of increased communication and coordination between the stakeholders and subsystems (initial VET, continuing VET, etc.) and in terms of consistency and relevance of standards;
- the relevance for the labour market in terms of matching supply and demand of skills: most changes in the labour market take place in existing occupations; the review of existing qualifications is an important opportunity to reconsider the relevance for the labour market;
- the relevance for the country in terms of competitiveness: a country without a qualifications framework may risk exclusion from a regional or even global market of skills; learners and workers from a country outside a network of frameworks could find their mobility hindered.

The beneficiaries of qualifications systems have different expectations from qualifications, as Table 4 shows. These different perspectives make it a challenging task to develop qualifications that are relevant and meaningful for all stakeholders.

2 Within the context of ISCED 2011, a qualification is the official confirmation, usually in the form of a certified document, of the successful completion of an educational programme or of a stage of a programme

The qualification concept connects the two worlds, the world of work and the world of learning, and facilitates the interactions between them. A paradigm shift within the world of work, from knowledge-based qualification system to competence-based qualification system led to another paradigm shift within the world of learning. Currently a paradigm shift is taking place from E&T based on inputs towards the outcome-based learning. It is about the transition from discipline-oriented education and training, where the qualifications addressed are not specified, to the qualification-oriented (or market-oriented) education and training.

Table 4. Relevance of qualifications for different stakeholders

Employers	Individuals	Society
Recruitment	Mobility	Educated and active citizens
Relevance	Progression	Basic numeracy and literacy
Specificity	Portability	Cultural identity
Competence	Breadth	Accountability
Adaptability	Career development	Progression
Accountability	Individual development	Qualified workforce
Return on investment	Recognition	Employability
Legal obligations	Reward	Mobility

The qualification achievement in a knowledge-based qualification system is based on a diploma or certificate that has been awarded after the completion of a formal education/learning scheme and in a given time frame.

The qualification achievement in the competence-based qualification system is a result of gradual accumulation of learning outcomes, no matter the education/learning scheme, the sector and disregarding the time spent in the accumulation process.

In the Table 5 there is a comparison between the two qualification systems in terms of compatibility with EQF.

Therefore, the competence-based qualification system is compatible with the key ECVET innovations: gradual accumulation of learning outcomes, flexible learning pathway; and it facilitates lifelong learning as well as geographical mobility.

The process of developing the training programmes, starting from flexible qualifications, should be understood in the context of the shift from knowledge-based qualification system to the competence-based qualification system within the EU single market.

Table 5. Compatibility of the qualification system with the EQF

Qualification system ➡	**K-B QS**	**C-B QS**
Indicator ⬇		
Job requirements	Defined in terms of knowledge/K	Defined in terms of LO/ competences
EQF compatible	No	Yes
Qualification type	Rigid qualification	Flexible qualification
Learning pathway	Rigid learning pathway	Flexible learning pathway
Qualification achievement	diploma/certificate	gradual accumulation of LO/ competences
E&T system	TP-discipline oriented	TP-qualification/market oriented
Question- within hiring interview	"what curricula did you study to obtain your degree (or your qualification)?"	• "what can you do now that you have • obtained your degree?"

In practice, the gradual accumulation of new learning outcomes is blocked due to the absence of legislation for validation and recognition of new learning outcomes acquired, no matter the learning system. In fact, there is no permeability between education or learning schemes and sectors. Overcoming the lack of permeability between education/learning schemes and sectors is one of the ECVET implementation challenges.

2.4 Methodology for qualification design

The ECVET requirements for qualification design are described in Annex 1.

The qualification design sequence aims to answer to several questions: what is the qualification title and numbering code? how to design units of learning outcomes (ULOs) and learning outcomes (LOs)? and how to identify common units and common competences over several qualifications?

As a result, the qualification design workflow encompasses three steps.

On the first step, the qualification title and numbering code is taken from the classification of occupations, qualifications and jobs, developed by JRC for the nuclear sector. The classification is the tool that correlates jobs, qualifications and occupations in the nuclear sector (Annex 2).

On the second step, qualification is structured in units of learning outcomes. According to ECVET principles, a flexible qualification is structured in units of learning outcomes as it is shown in the Figure 3. A unit of learning outcomes (ULOs) is a set of knowledge and skills, according to the Responsibility/Autonomy that represents the smallest part of a qualification that would be assessed and validated independently. These features of a unit of learning outcomes increase the qualification's degree of transparency and understandability for someone who has no nuclear background. The qualification also becomes more flexible and adaptable to the market changes.

According to the new EQF (Annex 3), the learning outcome descriptors are not the same as previously: Knowledge, Skills and Competence (KSC). The descriptor Competence (C) was replaced by responsibility/autonomy (R/A). The document precise the descriptors of learning outcomes in Knowledge (K), Skills(S) and Responsibility/Autonomy(R/A). It defines and characterizes the levels.

The "updated template" for qualification design (shown in the Figure 6) is quite different from the previous document for several reasons:

- the new EQF (Annex 3), introduces responsibility/autonomy as a descriptor instead of competence. Of course we were used to take on board responsibility/autonomy as a tool to distinguish EQF levels. But now it is a bit different;
- the most important component of a LO is the Skills (column 2 in the Annex 3) but never knowledge (column 3), because knowledge is always embedded in skills and never for itself (that is why in the "improved template" Skills are before the Knowledge)

Usually Assessment criteria (Assessment protocols) are not included in the template for qualification design. They come later when bodies in charge of exams have to create ways to estimate the training outcomes. In the "improved template" Assessment criteria and Assessment methods were included as a reminder for LO designers to consider the ECVET requirement: "The learning outcomes in a unit should be assessable through one or several assessments."

On the third step, there are additional filters in order to identify subtle features over several qualifications:

- *ECVET compliance review*; the draft qualification is checked by the ECVET experts to ensure that was set up according to ECVET principles;
- *cross-cutting analysis*, in order to identify common units and common competences across several qualifications;
- *structural check* of qualifications in order to get better coherence of the several qualifications

In the Figure 6 is an example of the template of qualification design in the case of the Radioactive Waste Management (RWM) qualification, having the code number 3.7.1.

2.5 Methodology for training design

This section deals with the implications of flexible qualifications (unit-based qualifications) on learning and training design.

We have seen within the paragraph §2.2 that flexible qualifications facilitate the validation of non-formal and informal learning and they can visualise progress in learning, but learning outcomes have also found their way into the provision of learning.

2.5.1 The concept of training programme based on exit-outcomes

The central idea of outcomes-based learning is that training programmes and qualifications should be defined by the results that the learner should achieve rather than by inputs from training providers. The inputs provided by a training organization represent teaching methods, duration of programme and assessment methods. By making those results clear in terms of what the learner has gained, rather than what the institution has provided, learners should be able to transfer their achievements for further learning and career development.

Following the above approach for defining the results that the learner should achieve after completing a training programme, the term "exit-outcomes" was introduced. It defines the results that the learner should achieve for the labour market needs in terms of qualifications or occupations, as shown in the Figure 8.

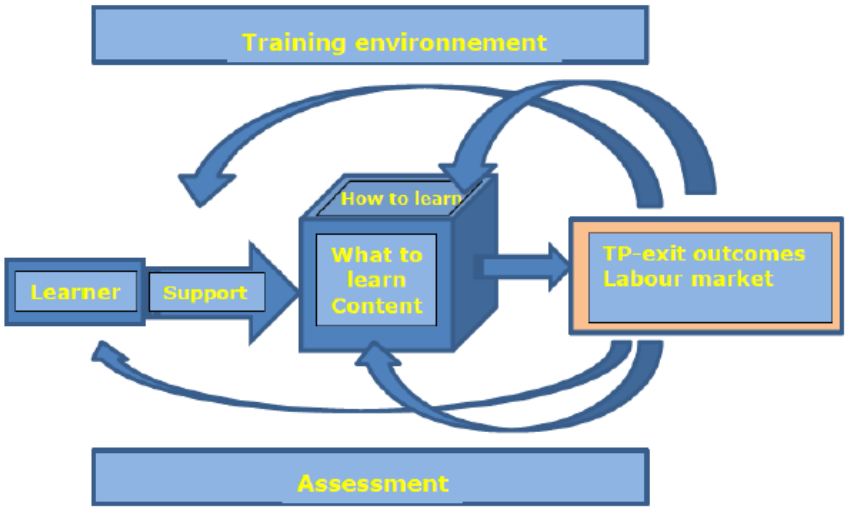
The concept of training programme based on exit-outcomes includes six elements:

- learner: who is enrolled in the training program with the view of acquiring the necessary competences (or learning outcomes) for getting a qualification required by the labour market;
- exit-outcomes of the training programme as a whole describe the labour market needs in terms of qualifications or occupations; the training program exit outcomes are the main motivation for learners to take a given training programme;
- content: is what the learners/students learn in order to reach the training programme-exit outcomes;
- assessment: represents the examinations designed to assess the extent to which the learners had learned the content; assessment includes also content assessment based on the feedback from learners;
- support: represents learners-teachers interactions (courses, workshops, laboratories) and support materials offered to learners in order to pass through the training programme and to reach the training programme-exit outcomes;
- learning approach: defines how learners study the prescribed content (how to learn).

Since the exit-outcomes of a training programme are defined in terms of qualifications or occupations, the training programme based on exit outcomes is called also market-oriented training program.

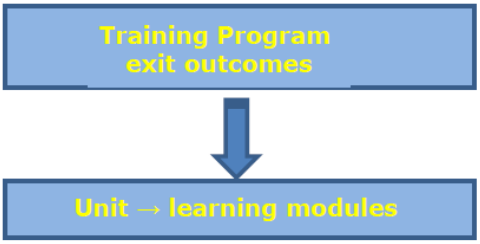
Considering exit-outcomes a central component of the training should be the basis for development and evaluation of training programme. The exit outcomes of a training programme determine the aims and objectives of the different training programme phases.

Figure 8. The structure of the training programme based on exit-outcomes



A design sequence of a training program based on exit outcome would be adopted, as it is shown in the Figure 9. The exit outcomes are defined first, and then, the learning modules linked to each unit of learning outcomes from a qualification are derived from these training program exit outcomes. This process is repeated for each unit.

Figure 9. The design process of a training programme based on exit-outcomes



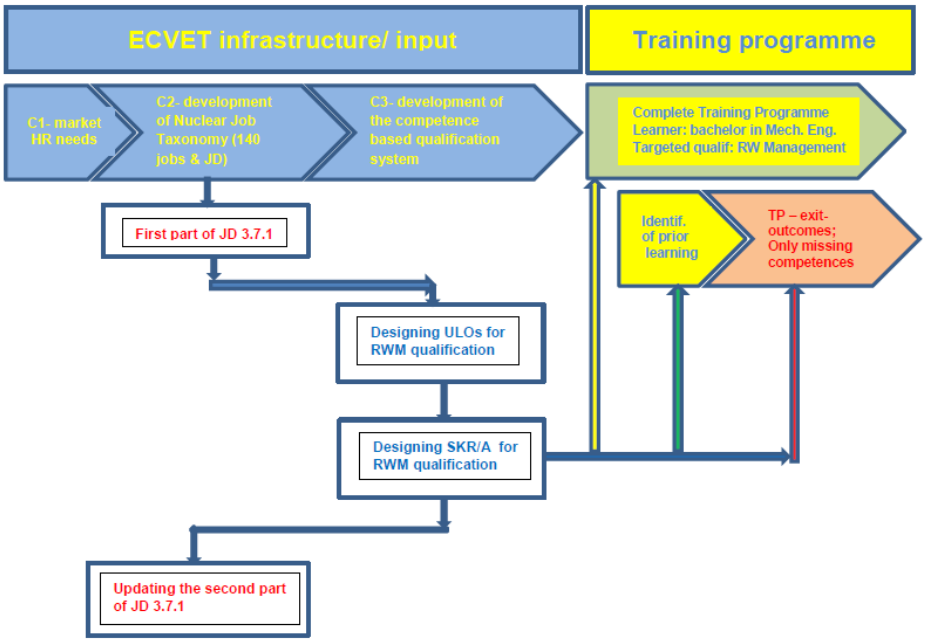
Using the concept of training programme based on exit outcomes, the nuclear education and training system develops "tailor made" training programmes, called also qualification-oriented training programmes or training programs based on exit outcomes. These "tailor made" training programmes generate the required competences for a targeted qualification or occupation, so that the length of this training programme-qualification oriented is shorter than a discipline-oriented training program.

2.5.2 From qualification design to training design

There are some prerequisites for starting the development of a qualification-oriented training program, as shown in the Figure 10:

- ECVET infrastructure or ECVET input should be in place;
- a qualification-oriented training programme (or based on exit-outcomes) should address a qualification or an occupation; the tools for the identification of the targeted qualification and its features are the first and second components of ECVET (C1+C2);
- the targeted qualification should be structured in units of learning outcomes, as a flexible qualification; the tool for the identification of ULOs of targeted qualification is the third component of ECVET (C3);

Figure 10. From qualification to training design using ECVET principles



The specific role of ECVET infrastructure in providing input for the development of qualification-oriented training programmes is the following:

- first component of ECVET (C1)- helps the identification of the nuclear market needs in terms of qualifications and/or occupations;
- second component of ECVET (C2)- defines the nuclear market needs in more detail, in terms of job requirements or learning outcomes/competences; job requirements are provided by job descriptions that are part of Nuclear Job Taxonomy (NJT):

  - 140 representative jobs within the three phases of NPP life cycle (New build; Operation and Decommissioning);
  - job description defines job requirements in terms of learning outcomes/competences;

- third component (C3)- provides the flexible qualifications, meaning the identification of units of learning outcomes/ULOs within the targeted qualification.

Finally, we can identify the main implications of flexible qualifications (unit based qualifications) on training design:

- Starting from flexible targeted qualification, with the help of ECVET infrastructure, two types of training programs could be developed: a) a complete training program for learners who are debutants in the profession and b) a customised training program for learners who have work experience even in non-nuclear jobs.
- A customised training programme assumes the identification of prior learning and only missing competences from the targeted qualification are delivered. In this way, the duration of a customised training program is in average 40% shorter than a complete training program.
- The main benefit of a training programme based on exit-outcomes (called also training programme-market oriented or qualification oriented) is that it generates the required competences for a targeted qualification, being shorter length and less costly than a training programme-disciplines oriented.

3 JRC's progress towards ECVET implementation

The European Human Resources Observatory – Nuclear (EHRO-N), by means of its operating agent-the JRC.G.10 of the European Commission (EC), initiated in 2011 the preparation of a Nuclear Job Taxonomy. This answered the request of DG RTD and DG EAC to promote the implementation of the European Credit System for Vocational Education and Training (ECVET) in the nuclear sector.

Therefore, the ECVET implementation started with the development of the Nuclear Job Taxonomy (NJT) and evolved towards a more complex strategy for ECVET implementation encompassing three phases, as shown in the Table 6.

The first phase, the development of a strategy and road map for ECVET implementation, encompasses the following activities:

- in 2009 the European Human Resource Observatory in the Nuclear Energy Sector (EHRO-N) was established with the mission to be the central initiative in the nuclear HR and Education & Training fields, focusing on knowledge management and monitoring of the resources needed in the nuclear sector. EHRO-N is managed by the JRC Unit Knowledge for Nuclear Safety and Security (JRC.G.10);
- in 2010 EHRO-N and the main stakeholders of the Euratom R&TD programmes (DG RTD, DG EAC, DG JRC and DG ENER) developed a strategy and a road map for ECVET implementation in the nuclear energy sector (common approach regarding nuclear qualifications, vision and implementation tools of ECVET);
- during the period 2011-2017, several workshops and seminars were organized with the purpose of helping the nuclear stakeholders to understand the ECVET innovations, creating national networks and setting up ECVET pilot projects.

The second phase, the development of the nuclear ECVET infrastructure, is focused on the customisation of the implementation tools of ECVET, developed mainly by Cedefop, to the specific needs of the nuclear energy sector:

- The implementation tools of ECVET that are the subject of customisation are: classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is included); nuclear job description; methodology for nuclear qualification design; mobility tools; tools for assessment, validation, recognition and accumulation of learning outcomes; methodology for designing training programs based on customised ECVET infrastructure (flexible qualifications).
- The ECVET infrastructure is common and connects the two worlds: nuclear E&T (the world of learning) and nuclear labour market (the world of work).

The third phase, experimental testing of ECVET through pilot projects, is the first "reality" trial of ECVET:

- pilot projects should test primarily, at small scale, two ECVET processes: acquiring LO/ competences in the context of mobility abroad (it impacts the labour market) and development of qualification-oriented training programs (it impacts the E&T system);
- involvement of employers in the qualification achievement and in training design will help the understanding of ECVET benefits for actual work processes in the nuclear sector;
- pilot projects could prepare the ground for the future ECVET full implementation within the nuclear sector.

The JRC's progress towards the ECVET implementation is significant. The development of nuclear ECVET infrastructure is the precondition for successful completion of the third phase, the experimental testing of ECVET through pilot projects [11].

Table 6. The JRC road map for ECVET implementation

#	Component	Phase	Activities	Findings/Achievements
1	Support and guidance for ECVET implementation: • stakeholders awareness about ECVET • stakeholders involved: authorities for qualification, nuclear industry, NRB, training providers, etc.	Development of a strategy and road map for ECVET implementation	• strategy and road map for ECVET implementation	• 3 phases
			• customised ECVET workshops- direct actions organized by the JRC	• Nuclear Job Taxonomy • job description • methodology for qualification design
			• customised ECVET seminars - direct actions organized by the JRC	• getting a deep understanding and mastering of ECVET innovations • creating national VET networks
2	Scanning the HR demand & supply in the NES	Development of ECVET infrastructure	1st EHRO-N survey - 2012 2nd EHRO-N survey - 2014	• by 2020 – deficit of 30 % nuclear experts
			• Nuclear Job Taxonomy • Classification of occupations, qualifications and jobs in NPP life cycle	• 140 jobs were identified within 3 phases of a NPP life cycle (new built; operation and decommissioning)
3	Development of competence- based qualification system for NES		The shift from knowledge-based qualification to competence-based qualification system	• 140 JD – job requirements defined in terms of KSR/A (in answer to the LM needs)
			Designing flexible qualifications based on ECVET approach (unit based qualifications)	• Study case on a pool of 6 qualifications (5 from decommissioning +1 from operation)
4	The development of the mobility tools	Experimental testing of ECVET through pilot projects	Memoranda of understanding, learning agreements and learners' transcripts of records	• Covered through the indirect actions (ECVET pilot projects)
5	The qualification achievement process		Developing specific tools for assessment, validation, recognition and accumulation of learning outcomes	
6	ECVET pilot projects: • developing training programs-qualification oriented • acquiring LO/ competences		• developing training programs-qualification oriented • acquiring LO/ competences during mobility abroad	• setting up ECVET pilot projects • EFTS= European Fission Training Scheme • EFTS& Horizon 2020 projects-indirect actions-supported by the DG RTD

3.1 Strategy for ECVET implementation in the NES

By definition, a strategy should provide answers to three questions: Where are we? Where are we going? And how to get there?

The strategy for ECVET implementation defines the steps that are leading to the nuclear labour market and nuclear E&T modernization and are described in this section.

3.1.1 Where we are in terms of HR sector needs?

According to all scenarios presented in the European Commission's (EC) Energy Roadmap 2050, nuclear energy will remain in the energy mix to support the challenges of security of supply and to meet the ambitions set out in the Carbon Plan [12]. Safe and successful operation of all nuclear power plants (NPPs) in Europe is in the interest of all EU nations. Educated and trained workforce as an essential prerequisite of the nuclear safety has to be considered in an EU context. Besides power production, nuclear technologies are increasingly used in the various industrial and medical applications, raising concerns regarding the supply of experts with very specific knowledge, skills and responsibility.

As the development of nuclear E&T is primarily defined by the policies and national regulations for the nuclear sector, and only secondarily, through the general policies that apply to the high education (HE) and vocational education and training (VET) systems, main attention is given to the educational activities specific for the nuclear field [13].

EHRO-N identified the HR sector's major challenges, through two surveys on HR demand and supply that were developed before [14] and after Fukushima accident [15]. The sector's major HR challenges identified are: to fill-in the 30% gap between HR demand and supply and to adapt nuclear education and training (E&T) system to comply more with labour market demands.

Adapting the nuclear education and training systems across Europe is crucial also for the accomplishment of the four freedoms of the EU single market: free movement of goods, services, capitals and workers. A particular importance for the labour market has the 4th freedom, free movement of workers. The achievement of free movement of workers requires a better correlation between the world of work and the world E&T. In this way the nuclear E&T system will contribute to the real EU single market needs: to facilitate lifelong learning, mobility and flexible learning pathways.

3.1.2 Where are we going? What are the solutions?

Aspects such the global competitiveness of European economy and worker mobility, lifelong learning, recognition, transfer and validation of learning outcomes (competences) have become more important in EU and national education policies. These are supported by the EU agency Cedefop (European Centre for the Development of Vocational Training) in coordination with DG EAC (Directorate-General for Education and Culture). One of the current challenges for knowledge management and competence building in the EU nuclear industry sector is to implement the common European tools and principles for E&T modernization.

Three tools, EQF, ESCO and especially important European Credit System for Vocational Education and Training (ECVET), are relevant for workers' mobility, lifelong learning and flexible learning pathway.

The importance of keeping critical competences in nuclear industry has been acknowledged by the nuclear community already in the '90s [16]. In recent years, a number of studies have been undertaken to examine the concern that nuclear education and training are in decline. In its conclusions of December 2008 the European Council emphasized strongly that *'the preservation of skills in the nuclear field requires a general effort involving public and private players and in particular the nuclear industry'* [17].

European Commission alongside other international organisations took a leading role to ensure the continuity of knowledge and expertise in this field. The *Second Situation Report on Education and Training in the Nuclear Energy Field in the European* Union, the most recent Commission Staff Working Document, issued in October 2014 [18], gives an overview of the latest E&T efforts and formulates recommendations in line with the enhanced requirements to nuclear safety in the EU.

Current developments in E&T in the nuclear energy sector are based on various activities and funding instruments both at EU and national levels. Within the Europe 2020 strategy for smart, sustainable and inclusive growth, new flagship EU initiatives dedicated to the triangle research, energy and education propose several research and E&T actions in energy sector, namely:

- Innovation Union - Turning ideas into jobs, green growth and social progress [19]
- Resource-efficient Europe - Towards a resource-jobs, green growth and social progress
- Resource-efficient Europe - Towards a resource-efficient, low-carbon economy, Rethinking Education: Investing in skills for better socio-economic outcomes [20]

Energy policy is the competence of the state. According to the Euratom Treaty (1957) [21], art. 33, each member state has a responsibility to ensure that adequate expertise is available in the nuclear field, delivered through the E&T. The New Directive, amending the Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, adopted in July 2014, further stresses the importance of E&T in nuclear sector [22] set the requirements for maintaining high level of competences in the relevant fields.

The continued contribution of nuclear power in the energy mix and other nuclear technologies applications requires sufficient skilled people to construct, operate, decommission and regulate nuclear facilities, as well as to work in the areas of radiation protection, medical uses of irradiation and radiobiology. It is paramount to the nuclear safety to satisfy these requirements, but it is challenging. The technologies needed to use nuclear energy in a safe and sustainable way are complex, often cutting-edge, and multidisciplinary. The costly infrastructure required to educate and train the several hundred thousand highly skilled persons working in this sector across the EU have to be considered too. The nuclear energy sector is also characterized by lengthy time frames -a commitment of at least 100 years is needed to sustain nuclear infrastructure throughout plant operation, decommissioning and waste disposal.

Since 2009, the European Human Resource Observatory in the Nuclear Energy Sector (EHRO-N) has monitored the situation with nuclear workforce. EHRO-N's reports on demand/supply in the nuclear labour market quantify the current status of nuclear education in the Member States (MSs) and stresses that competences in critical nuclear technologies are becoming difficult to sustain. The demography of those working in the industry, research and academia indicates that, given the ageing workforce profile, there is the danger of competence being deteriorated and ultimately lost.

In the situation when nuclear industry cannot afford further reduction in existing competences and needs to develop new ones in the fields of decommissioning and waste management, a strategy has to be developed to attract young people, retain staff and attract experts from other industries.

The solutions, identified by EHRO-N surveys, to stop further reduction in existing competences are:

- "Nuclearisation" is the solution for filling up the 30% HR gap. In this context "Nuclearisation" means to hire individuals from non-nuclear sector and training them to get a nuclear qualification.

- The ECVET infrastructure development, as a basis for nuclear E&T system adaptation to the labour market demands.

3.1.3 The road map to get there

The three phases of ECVET implementation have been already explained. If we are going more in depth, we will find six components of ECVET, as listed in the Table 6. One phase of ECVET implementation could cover several ECVET components.

The first component of ECVET, on supporting nuclear stakeholders and national VET networks in ECVET implementation, is in fact the driving force for the implementation of ECVET in the NES. JRC developed two tools, so called customised workshops and seminars, to provide support and guidance to the national VET networks in getting a deep understanding of the ECVET innovations and of the common European tools for E&T modernization.

The process of the ECVET implementation in the nuclear energy sector started with customised workshops and seminars for NES, organized by JRC and listed in the Table 7:

- a series of six workshops were organized in the period 2011-2015, with the purpose of developing a Nuclear Job Taxonomy and job descriptions (JD) for all the representative jobs within three phases of NPP life cycle: new built (NB), operation (O) and decommissioning (D).
- a new series of workshops followed in the period 2015-2016, were focused on ECVET input preparation for training design in decommissioning.

In parallel, three ECVET Seminars were organized, along the period 2012-2014, with the purpose of helping the nuclear stakeholders in understanding the ECVET innovations, creating national networks and setting up ECVET pilot projects. These seminars are aimed to make ECVET known and understood among professionals in nuclear education and training. Nonetheless, the implementation of the ECVET concepts for nuclear qualifications was tested in study cases, which are practical exercises of the transfer of job requirements into the formulation of learning outcomes and units.

The three customised ECVET Seminars and the last two workshops have taken place with the support of ECVET-team facilitators.

A short "real story" about ECVET implementation emphasizes that those seminars are not enough for making ECVET known and understood among nuclear professionals. Within a workshop on ECVET related topics, held in Ispra in February 2016, the leader of an EFTS project asked: why all EFTS projects are blocked in the ECVET related issues?

The question reveals that some nuclear experts and even training providers did not get a complete understanding of common European tools and principles for E&T modernization before implementing ECVET principles in the EFTS projects. Moreover, the question shows that the effort for explanation of ECVET innovations should be continuous before the experimental phase of ECVET implementation.

The next four components (C2-C5) form the nuclear ECVET infrastructure that is common and connects the two worlds, the world of nuclear education and training and the world of work (nuclear labour market).

ECVET infrastructure is the precondition for the achievement of free movement of workers and E&T systems adaptation to the labour market needs.

ECVET infrastructure encompasses tools like: Classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is embedded); job description of 140 jobs within the three phases of a NPP life cycle; Decommissioning sub-sector progression routes; methodology for nuclear qualification design; and methodology for design of qualification-oriented training programs.

Table 7. The workshops and seminars to support the ECVET implementation

Year	Workshop		ECVET seminar	
	Place and date	**Purpose**	**Place and date**	**Purpose**
2011	Bergen, NL Oct 2011	Development of Nuclear Job Taxonomy & Job descriptions		
2012	Petten, NL Feb 2012		Brussels, BE Sept 2012	To assist VET networks in: • getting a deep understanding and mastering of ECVET innovations • preparation of toolbox for E&T modernization: ESCO; EQF & ECVET
	Thessaloniki, GR Oct 2012			
2013	Bergen, NL May 2013		Budapest, HU Oct 2013	First exercise on designing nuclear qualification; Learning Outcomes (LOs) and ULOs
	Madrid, ES Nov 2013			
2014			Rome, IT Nov. 2014	To support national VET networks in setting up ECVET pilot projects
2015	Istanbul, TR Feb 2015			
	Lisbon, PT Oct. 2015	Designing flexible qualifications based on ECVET approach (unit based qualifications)		
2016	Bergen, NL Oct. 2016	ECVET input for training design in decommissioning		

It is relevant to underline that in all direct actions (workshops and seminars), organised by the JRC, about 70 nuclear and ECVET experts were involved, representing a wide range of stakeholders of the nuclear sector such as operators, utilities, engineering companies, universities, training providers and vendors. The external experts covered for their provenance twelve EU member states and two non-EU countries. In this way the customized implementation tools of ECVET reflect the sector's current needs.

The 6th ECVET component (C6) is meant to test the two ECVET processes (development of qualification-oriented training programs and acquisition of learning outcomes/competences during mobility abroad at small scale through pilot projects.

3.2 Classification of nuclear occupations, qualifications and jobs

3.2.1 The need for classification development

The Classification of nuclear occupations, qualifications and jobs was generated by the need of increasing the nuclear sector visibility within EU single market and to facilitate the "nuclearisation" process:

- to get visibility within EU single market, the nuclear jobs and qualifications should be registered in ESCO online database; as a consequence the classification of nuclear occupations, qualifications and jobs followed the ESCO pattern of classification;
- to facilitate the "nuclearisation" process, the nuclear jobs and qualifications should be more transparent and understandable for individuals without nuclear background.

The Classification of nuclear occupations, qualifications and jobs was developed in answer to practical needs of ECVET implementation process:

- The first step was the Nuclear Job Taxonomy (NJT) development. The NJT is a list of 140 representative jobs within three phases of NPP life cycle: New Built (NB), Operation (O) and Decommissioning (D), displayed in the Annex 2/column 4. The original list of the representative jobs in a NPP, developed by NJT is shown in the Annex 4.
- While continuing with the development of competence-based qualification system, we realized that there is needed of a tool to correlate the jobs with the qualifications (Annex 2/column 3). As consequence, the Classification of qualifications and jobs in the NES was developed.
- To be fully in line with the ESCO database requirements, the Classification of qualifications and jobs in the NES was extended with the occupations in Annex 2, columns 1 and 2.

Therefore, the Classification of nuclear occupations, qualifications and jobs started with the development of the Nuclear Job Taxonomy (NJT) and ended by including this NJT in the classification.

Since the classification of nuclear occupations, qualifications and jobs concerns the three phases of the NPP life cycle, the Annex 2 is organized in three tables: Table 2.1 for NPP New Built phase; Table 2.2 for NPP Operation phase; and Table 2.3 for NPP Decommissioning phase. In addition the title of each table (From jobs to occupations in the three NPP life cycle phases) suggests this evolution of Classification development. The numeric code of the job is the same as in the original NJT (Annex 4).

The Classification was further developed by:

- Defining qualifications (Annex 2, column 3): the titles of the qualifications were defined in relation with the functional categories of the jobs listed in the Table 8.
- Defining restricted occupations (Annex 2, column 2): the restricted occupations titles are in line with the core competences (KSR/A) of the corresponding family of jobs.
- Defining broader occupation (Annex 2, column 1): the title of broader occupation was defined in relation with the specific phase of the NPP life cycle.

The following definitions were applied:

- Broader occupation: a group of jobs involving similar tasks and that require a similar skills set;
- Restricted occupation: the family of jobs having similar core competences (KSR/A)

- A qualification has 3 dimensions: a) is the formal validation of the competence for a work position; b) job requirements are defined in terms of Learning Outcomes (LO/SKR-A); c) a qualification should be structured in ULOs and LOs; a qualification could cover several jobs or only one job; the titles of the qualifications were defined based on the functional categories of jobs in the NES.
- A job is bound to a specific work context and executed by one person; it may have the same title with the corresponding qualification

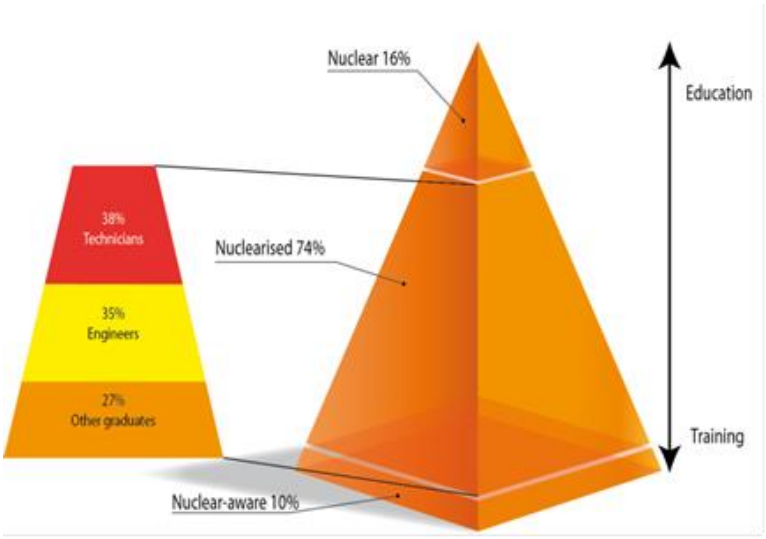
Table 8. Job classification and normalised titles

Occupational Categories↓	**Management**	**Specialist**	**Executive**	←Functional Categories.
Professional	Manager Supervisor	Engineer Expert	Operator	Job titles
Technician	Officer Foremen	Technician Specialist	Operator Fitter	
Craft		Welder Craftsman	Operative Worker	

3.2.2 The nuclear work force structure

The nuclear workforce structure, identified in 2010 within the first EHRO-N survey, is called also Nuclear Skills Pyramid and is represented in Figure 11.

Figure 11. Nuclear Skills Pyramid



Nuclear Skills Pyramid reveals the nuclear work force structure and the training needs for each worker type:

- Nuclear experts (16%): employees with a specialised formal education in nuclear subjects (e.g. nuclear engineering, radiochemistry, radiation protection, etc.); they need competency refresh training.
- "Nuclearised" staff (74%): people with formal education and training in non-nuclear sector (e.g. mechanical, electrical, civil engineering, systems); they need training to get a nuclear qualification.

- Nuclear-aware staff (10%): people with non-nuclear competences (e.g. electricians, mechanics, and other craft and support personnel); they need training on labour safety and security to work in the NPP.

3.3 Candidate entry and progression in decommissioning

Since the "nuclearisation" was identified as the key instrument for filling the 30% HR gap in decommissioning, it raised the need for a tool that should help the candidate entry and progression in the decommissioning.

A tool to support the candidate entry and progression in the decommissioning was developed by the JRC, in support of the ELINDER project (European Learning Initiatives for Nuclear Decommissioning and Environmental Remediation) ([3]).ELINDER project is an initiative of the JRC, having the overall aim to raise the interest of students and professionals and to stimulate careers in this important and emerging field, by offering a set of attractive theoretical and practical learning opportunities.

The target groups of the ELINDER project are students at the end of their education cycle, young professionals at the start of their career and experienced professionals and managers who change their career orientation towards nuclear decommissioning.

The tool that facilitates the identification of the "entry point" and progression routes in decommissioning, for people with a different educational or professional background is presented in Table 9.

There are no formal entry requirements for candidates undertaking these qualifications. Assessment is open to any candidate who has the potential to reach the standards for the qualification.

There are no age limits for these qualifications unless there is a legal requirement of the process or the environment.

The procedure for entrance point identification or targeted qualification, using the progression routes in decommissioning, for candidates with prior experience and qualifications, is the following:

- identification of candidate's prior learning;
- depending on the candidate's prior learning and targeted qualification, he/she will take a customised training programme:

  -a complete training program for candidates who are debutants in the profession
  -a customised training program for learners who have work experience even in non-nuclear jobs
- the customised training program delivers only missing competences of the targeted qualification. In this way, the duration of a customised training program is in average 40% shorter than a complete training program.

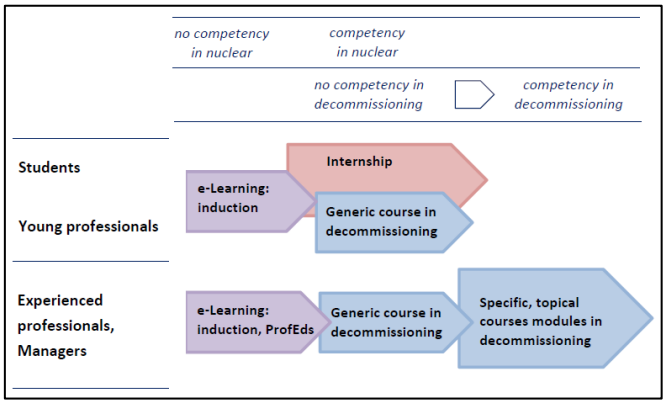
3 The overall aim of the ELINDER project is to raise the interest of students and professionals and to stimulate careers in this important and emerging field, by offering a well-structured spectrum of "entry points" and a set of attractive theoretical and practical learning opportunities.

Table 9. Progression routes in decommissioning

Occupational categ.	Functional categ.	Qualification	Jobs	No of Qualif.
Professional EQF 6-8	Management	3.1.1 Decommissioning management	3.1.01. Project Manager	22
			3.1.02. Contractors Manager	
			3.1.03. Management System Manager	
			3.1.04. Training Manager	
			3.1.05. Licensing Manager (for decommissioning)	
			3.1.06. Communication and PR Manager	
			3.1.07. Financial Manager	
			3.1.08. Site Manager	
		3.2.1 Decontamination management	3.2.02. Decontamination Supervisor	
		3.3.1 Preparatory work management	3.3.03. Engineering Support Manager	
		3.3.2 Decommissioning planning	3.3.05. Decommissioning Supervisor	
		3.4.1 Dismantling management	3.4.02. Dismantling Supervisor	
		3.6.1. Site clean-up management	3.6.01. Clean up Supervisor	
		3.7.1. Radioactive Waste Management	3.7.01. Radioactive Waste Manager	
			3.7.02. Radioactive Waste Manager- characterisation	
			3.7.03. Radioactive Waste Manager- processing	
		3.8.1. Management of maintenance in decommissioning	3.8.01. Maintenance Engineer – Manager	
			3.8.02. Maintenance Supervisor	
		3.9.1. Radiation Protection Expert	3.9.01. Radiation Protection Manager	
			3.9.02. Radiation Protection Officer	
		3.9.6. Radiochemistry management	3.9.08. Radiochemistry Manager	
		3.10.1.Site release management	3.10.01. Final Release Process Supervisor	
Technician EQF 4-5	Specialist	3.2.1 Decontamination management	3.2.01. Decontamination Planner	12
		3.3.1 Preparatory work management	3.3.01. Site Engineer	
			3.3.02. Spent Fuel Management Engineer	
		3.3.2 Decommissioning planning	3.3.04. Decommissioning Planner	
		3.4.1 Dismantling management	3.4.01. Dismantling Planner	
		3.5.1 Demolition management	3.5.01. Demolition Planner	
		3.5.2 Demolition specialist	3.5.02. Demolition Civil Engineer	
		3.7.1. Radioactive Waste Management	3.7.07. Transport responsible	
		3.9.4. Industrial Safety specialist	3.9.04. Industrial Safety Engineer	
			3.9.05. Safety Case Expert	
		3.9.5. Environmental specialist	3.9.06. Environmental Expert	
		3.9.7. Nuclear laboratory specialist	3.9.09. Nuclear Laboratory Technician Chemistry	
Craft EQF 2-3	Executive	3.2.2 Decontamination executive	3.2.03. Decontamination Worker	10
		3.3.3 Decommissioning executive	3.3.06. Decommissioning Operator	
			3.3.07. Decommissioning Worker	
		3.4.2 Dismantling executive	3.4.03. Dismantling Worker	
		3.5.3 Demolition executive	3.5.03. Demolition Worker	
		3.6.2. Site clean-up executive	3.6.02. Clean up Worker	
		3.7.1. Radioactive Waste Management	3.7.04. Radioactive Waste Worker-characterisation	
			3.7.05. Radioactive Waste Worker- processing	
		3.8.2. Maintenance for decommissioning executive	3.8.03. Maintenance Worker	
		3.9.3. Radiation Protection Worker	3.9.03. Radiation Protection Worker	
	E N T R A N TS WITH PRIOR EXPERIENCE & QUALIFICATIONS			44

The ELINDER project developed a training programme by pooling and enhancing already existing learning initiatives of 14 different European partners active in the field of decommissioning as well as the IAEA. Depending on the professional experience of each candidate as well as on her/his actual and targeted level of knowledge, skills and competence the programme offers customised courses as illustrated in the Figure 12.

Figure 12. Training courses depending on previous learning



Source: ELINDER project

3.4 JRC's progress towards ECVET infrastructure development

The development of the nuclear ECVET infrastructure means the customisation of the implementation tools of ECVET to the specific needs of the nuclear energy sector, such as: Classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is embedded); job description of 140 jobs within the three phases of NPP life cycle; Decommissioning progression routes; methodology for nuclear qualification design; and methodology for training programmes-qualification oriented design.

The nuclear ECVET infrastructure is common and connects the two worlds, which were in the past apart, the world of nuclear education and training and the world of work (nuclear labour market). By contrast with the road infrastructure which is visible, as is shown in the Figure 13, the ECVET infrastructure is like the invisible part of an iceberg (see Figure 14). As a result, some stakeholders are not aware about ECVET infrastructure importance.

Figure 13. Road and electric infrastructure the prerequisite for free movement of goods

Source: https://www.strategy-business.com/article/Hedge-Fund-Meet-Highway?gko=2a45f

Moreover, the nuclear ECVET infrastructure has two pillars. The first pillar supports the labour market and encompasses tools that describe nuclear labour market needs: nuclear jobs taxonomy (NJT), job descriptions (JD) and the methodology for qualification design.

The second pillar is supporting E&T and gathers tools meant for E&T modernization: European Qualification Framework; flexible qualifications and methodology for designing training programs based on exit-outcomes.

Figure 14. The ECVET infrastructure the prerequisite for free movement of workers

Pilot pr.	Sector addressed		ECVET feature tested
ANNETTE	Education	-	LO nuclear courses EQF 6
CORONA II	Training	Labour market	- training pr.-qualif. EQF 5 - acquiring LO during mobility
ENETRAP III	Training	-	Training Scheme-RPE qualif. EQF 7
Petrus II	Training	-	Training Scheme- qualif. of EQF 7
ELINDER	Training	Labour market	- turning TP-disciplines oriented in TP-qualif. oriented/EQF 7 - acquiring LO during mobility

ECVET infrastructure - in nuclear energy sector

Labour market:

- **NJT- 140 jobs**
- **JD- job requirements defined as LO**
- **Methodology for qualification design**

Education & T:

- **EQF – in place**
- **6 flexible qualif.**
- **Classification of OQJ**
- **Methodology for designing TP-market oriented**

The nuclear ECVET infrastructure, developed by JRC, is in place and is available for the third phase of ECVET implementation, testing ECVET, at small scale, through pilot projects.

The nuclear pilot projects are the tool for finding by doing sustainable solutions for ECVET implementation in the nuclear energy sector.

3.5 From training programmes-disciplines oriented to training programmes-qualifications oriented

The ELINDER project started with Pooling of Decommissioning Training in the EU and a pool of six discipline-oriented courses on decommissioning was established (displayed in the left side of Figure 15). Usually a discipline-oriented course is exhaustive and the targeted qualifications are not specified. This kind of courses is suitable for initial education, but is not recommended for training or continuous personal development (CPD).

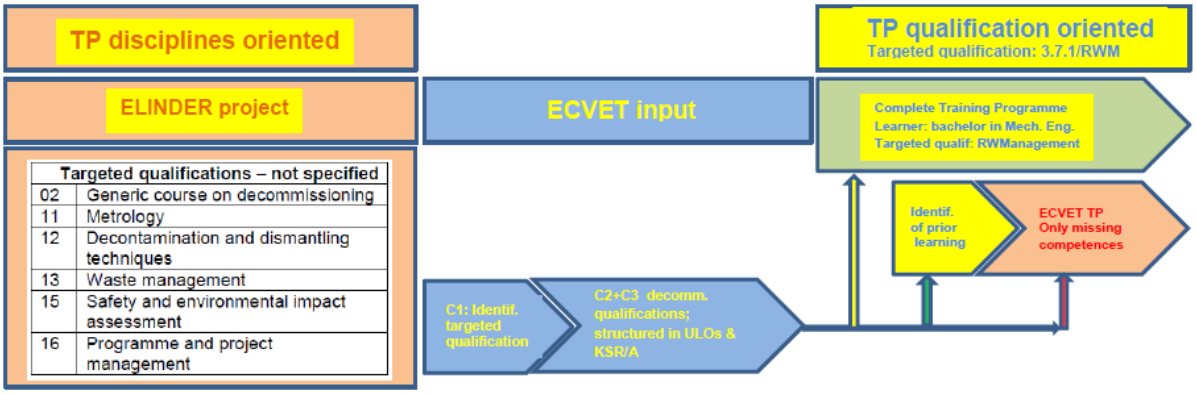
For training needs or CPD the customised training programmes are most efficient. A customised training programme implies the identification of prior learning and only missing competences from the targeted qualification are delivered. In this way, the duration of a customised training program is in average 40% shorter than a complete training program.

In this context, a new problem has been identified: how to turn the existing discipline-oriented training programmes (TP) into a qualification-oriented TP?

In answer to this new problem, the JRC conducted a case study on turning the existing discipline-oriented training programs (TP) into training programmes oriented to the qualification RWM/3.7.1.

The process of turning the existing disciplines-oriented training programs (TP) into training programme (TP) oriented to the qualification RWM/3.7.1 is represented in the Figure 15. The conversion process consists in using the existing ECVET infrastructure as a tool for extracting the LO/competences embedded into the discipline-oriented courses, and transfer them to the training programme oriented to the qualification RWM/3.7.1.

Figure 15. ECVET infrastructure for extracting competences associated with targeted qualification RWM/3.7.1



3.5.1 Identification of common units

Based on the methodology described at paragraph §2.5, a training programme-qualification-oriented (or based on exit-outcomes) should address specific qualifications.

As consequence, the first step of the case study was the identification of targeted qualifications from decommissioning and operation, listed in the Table 10. In this pool, five qualifications belong to decommissioning and one is from operation.

The targeted qualifications of a qualification-oriented training program (or based on exit-outcomes) should be structured in units of learning outcomes, as flexible qualifications.

So that, in the second step of the case study, the targeted qualifications of the qualification-oriented training programme were designed as flexible qualifications. (structured in units of learning outcomes). The targeted qualifications designed as Flexible qualifications are presented in details in the Annex 5.

Table 10. Targeted qualifications for training programme-qualification oriented

Targeted qualification	NPP phase	Jobs covered
3.1.1. Decommissioning Management	Decommissioning	3.1.01. Project Manager
		3.1.02. Contractors Manager
		3.1.03. Management System Manager
		3.1.04. Training Manager
		3.1.05. Licensing Manager (for decommissioning)
		3.1.06. Communication and PR Manager
		3.1.07. Financial Manager
		3.1.08 Site Manager
3.7.1. Radioactive Waste Management		3.7.01. Radioactive Waste Manager
		3.7.02. Radioactive Waste Manager-characterisation
		3.7.03. Radioactive Waste Manager-processing
3.3.1. Preparatory work Management		3.3.01. Site Engineer
		3.3.02. Spent Fuel Management Engineer
		3.3.03. Engineering Support Manager
3.9.1. Radiation Protection Expert		3.9.01 Radiation Protection Manager
3.8.1 Management of maintenance in Decommissioning		3.8.01. Maintenance Engineer – Manager
		3.8.02. Maintenance Supervisor
2.3.1. Management of Radioactive Waste &RP	Operation	2.4.01 WM&RP Manager

Further, in the third step, the six targeted qualifications from Table 10 were split in the two groups of three qualifications shown in Table 11. The additional filters applied in the qualification design, are:

- ECVET compliance review: the draft qualifications have been checked against ECVET requirements from Annex 1, to ensure that they are set up according to ECVET principles.
- Transversal analysis crossing three qualifications, in order to identify common units and common competences
- Structural check of qualifications, to ensure a better coherence of the three qualifications in terms of harmonization of common units.

The common units that correspond to common competences were identified through transversal analysis over a group of three qualifications (3.9.1; 2.3.1; 3.7.1) and displayed in Table 11.

Three types of units of learning outcomes were identified: transversal units (TU), common units over three qualifications; bilateral units (BU), common units over two qualifications; and single units (SU), belonging only to one qualification.

In the same way, two transversal units (TU) and six single units (SU) were identified over a group of two qualifications (3.3.1; 3.8.1).

Table 11. Common units over six flexible qualifications

	3.9.1 Radiation Protection Expert	**2.3.1 Management of Radioactive Waste &RP**	**3.7.1 Radioactive Waste Management**
U1	Radiation Protection – TU (3.9.1; 2.3.1; 3.7.1)		
U2	Accident and emergency issues – TU (3.9.1; 2.3.1; 3.7.1)		
U3	Team and project management – TU (3.9.1; 2.3.1; 3.7.1)		
U4	Interaction with other nuclear areas/departments – TU (3.9.1; 2.3.1; 3.7.1)		
U5	Evaluation and optimization of individual and collective doses – BU (3.9.1 ; 2.3.1)		Decommissioning management - SU (3.7.1)
U6	Management of health, radiological and environmental risks - BU (3.9.1; 2.3.1)		
U6/7		Radioactive waste management – BU (3.7.1 ; 2.3.1)	

	3.1.1 Decommissioning Management	**3.3.1 Preparatory work Management**	**3.8.1 Management of maintenance in Decommissioning**
U1	Management of Decommissioning projects – TU (3.1.1; 3.3.1; 3.8.1)		
U2	Safety and security -TU(3.1.1; 3.3.1; 3.8.1)		
U3	Management - SU	Operation, maintenance and engineering - SU	Facility maintenance - SU
U4	Integrated management system in decommissioning - SU	Preparatory work and spent fuel - SU	-
U5	Communication and public relation - SU	-	-

3.5.2 Learning modules design based on flexible qualifications

The ECVET input for the JRC case study, focused on the training programme oriented to the qualification Radioactive Waste Management (3.7.1), provides the following data:

- The targeted qualifications of the training programme development (Table 9) were identified using the Classification of nuclear occupations, qualifications and jobs (part of the first and second components of ECVET - C1+C2)
- The targeted qualification of the training program (Radioactive Waste Management - 3.7.1) was structured in units of learning outcomes (as flexible qualification)- Annex 5 and paragraph §3.5 (third component of ECVET - C3)

The development process of a qualification-oriented training programme starts by defining the exit-outcome of the training program. The exit-outcome of a training program is a statement that has two main components: the first one identifies the core skills required for a specific job; the second one defines additional skills.

The exit-outcomes of the training programme oriented to the qualification Radioactive Waste Management (3.7.1) are:

- identification of the core skills required for the specific job: at the end of a customised training programme oriented to the qualification Radioactive Waste Management (3.7.1), the learner is able to take over one of the three jobs: Radioactive Waste Manager (3.7.01), Spent Radioactive Waste Manager-characterization (3.7.02), and Radioactive Waste Manager-processing (3.7.03).

- identification of the additional skills: the learner should have 3-4 year experience in lower positions, even in non-nuclear sector.

The training programme design sequence proceeds with the identification of learning modules within each unit of learning outcomes from the targeted qualification. In this way the learning modules linked to each ULOs from a qualification are derived from exit outcomes of the training program and the process is repeated for each ULOs.

Learning modules are developed by picking up skills and knowledge associated with a given ULOs in order to build a pedagogical and coherent set.

The learning modules identified within each unit of learning outcomes from the targeted qualifications are described in Annex 6.

In order to provide the reader with an image about the two learning modules identified within unit 6 of the qualification Radioactive Waste Management (3.7.1), the Figure 16 shows the template used for the design of learning modules.

Figure 16. The learning modules identified within the unit 6 of qualification RWM (3.7.1.)

Qualification title: Radioactive Waste Management (3.7.1.) **EQF level 6**

List of training modules over 3 flexible qualifications from decommissioning and operation

	3.9.1 Radiation Protection Expert	**2.3.1** Management of Radioactive Waste &RP	**3.7.1** Radioactive Waste Management
	11M=9TM+2BM	**13M**=9TM+4BM	**12M**=9TM+2BM+1SM
U1	Radiation Protection – **3TM** (3.9.1;2.3.1; 3.7.1)		
U2	Accident and emergency issues – **2TM** (3.9.1;2.3.1; 3.7.1)		
U3	Team and project management – **3TM** (3.9.1;2.3.1; 3.7.1)		
U4	Interaction with other nuclear areas/departments – **1TM** (3.9.1;2.3.1; 3.7.1)		
U5	Evaluation and optimization of individual and collective doses U5 (3.9.1 ; 2.3.1)- **1BM**		Decommissioning management (3.7.1)- **1SM**
U6	Management of health, radiological and environmental risks U6 (3.9.1; 2.3.1)-**1BM**		
U6/7		Radioactive waste management – U6/7 (3.7.1 ; 2.3.1) **2BM**	

Unit of learning outcomes No.6: RADIOACTIVE WASTE MANAGEMENT/ BU(3.7.1 ; 2.3.1)		
M6.1: Handling and transport radioactive waste		**Remarks/limits/ advices**
S.6.1. Evaluate and control the level of contamination and induced activities of radioactive waste S.6.2. Select optimal solution and manage radioactive waste categorisation S.6.3. Manage radioactive waste handling and transport S.6.5 Apply proper criteria for treated waste classification and handling S.6.6. Evaluate and manage collected data about waste characteristics S.6.9. Comply activities with national program in decommissioning S.6.10. Developing waste management program, specifications and procedures S.6.11. Apply appropriate solutions in packaging	K.6.1. Waste characterisation and categorisation K.6.2. Dosimetry K.6.3. Nuclear safety and radiation protection K.6.5. Health protection K.6.6. Environmental protection K.6.7. Nuclear safety culture and human factor K.6.8. Protective clothing and protective equipment K.6.9. Transport, handling and storage of radioactive waste K.6.12. Waste conditioning including packaging	
M6.2: Storage radioactive waste		
S.6.4. Apply proper techniques for optimal storage of waste S.6.7. Ensure radiation protection support for waste manipulation and storage S.6.8. Evaluate radiation situation in d econtamination, handling, transport and storage process	K.6.4. Relevant national and international legislation and guidelines K.6.10. Treatment and long term storage K.6.11. National policy and program in decommissioning	M7.1 is recommended as a prerequisite

In the Table 12 there is an overview of learning modules identified crossing the two groups of qualifications. Following the methodology described at §2.4, training modules were identified inside each unit of learning outcomes. Three types of modules were defined: transversal modules (TM) -common module over three qualifications; bilateral modules (BM) -common module over two qualifications; single module (SU) -belonging to one qualification.

If we analyse the learning modules crossing all six qualifications, we should remark that some learning modules have very close contents. It is the case of learning module Decommissioning management which belongs to the qualification (3.7.1) and Management of Decommissioning projects that is common for three qualifications (3.1.1;

3.3.1; 3.8.1). One transversal module can be designed after comparison and limited adjustments of the four qualifications involved (3.1.1; 3.3.1; 3.8.1 and 3.7.1).

Based in the learning modules identified, the training providers will develop the content of courses or training activities.

Depending on candidate background and prior learning, two types of training programs (TP) could be developed: complete training programmes (when learners are debutants in the profession); customised training programmes (for workers having work experience, even in non-nuclear sector)

The estimated length of a customised training programme - oriented on the qualification 3.7.1, for an individual with work experience, is:

- the prior learning ≈ 40% from a complete TP
- the customised TP provides only competences that are missing from the targeted qualification ≈ 60% from a complete TP
- the duration of an customised TP is 40% shorter than a complete TP
- customised qualification-oriented TP saves time and money

Table 12. Learning modules for qualifications 3.9.1; 2.3.1; 3.7.1; 3.3.1 and 3.8.1

	3.9.1 Radiation Protection Expert	**2.3.1 Management of Radioactive Waste &RP**	**3.7.1 Radioactive Waste Management**
	3.9.1/11M=9TM+2BM	**2.3.1/13M=**9TM+4BM	**3.7.1/12M=**9TM+2BM+1SM
U1	Radiation Protection – **3TM** (3.9.1; 2.3.1; 3.7.1)		
U2	Accident and emergency issues – **2TM** (3.9.1; 2.3.1; 3.7.1)		
U3	Team and project management – **3TM** (3.9.1; 2.3.1; 3.7.1)		
U4	Interaction with other nuclear areas/departments – **1TM** (3.9.1;2.3.1; 3.7.1)		
U5	Evaluation and optimization of individual and collective doses U5 (3.9.1 ; 2.3.1)- **1BM**		Decommissioning management (3.7.1) - **1SM**
U6	Management of health, radiological and environmental risks U6 (3.9.1; 2.3.1)-**1BM**		
U6/7		Radioactive waste management – U6/7 (3.7.1 ; 2.3.1) **2BM**	
	3.1.1 Decommissioning Management	**3.3.1 Preparatory work Management**	**3.8.1 Management of maintenance in Decommissioning**
	3.1.1 no LM	**3.3.1/7M=**5TM+2SM	**3.8.1/7M=**5TM+2BM
U1	Management of Decommissioning projects_**2 TM** (3.1.1; 3.3.1; 3.8.1)		
U2	Safety and security_**3 TM** (3.1.1; 3.3.1; 3.8.1)		
U3	Management	Operation, maintenance and engineering support-**1SM**	Facility maintenance -**1SM**
U4	Communication and PR	Preparatory Work and spent fuel-**1SM**	
U5	Integrated management system in decommissioning		

3.6 Pilot projects - tool for testing ECVET at small scale

As it has been emphasised, the third phase of ECVET implementation (the experimental testing of ECVET through pilot projects) is the first "reality trial" of ECVET at small scale.

Given that qualifications are in most cases under the responsibility of a ministry or a national competent body, there is not a standard legal solution at EU level for solving issues such as the permeability between different education/learning schemes, the gradual accumulation of new LO and the identification of the competent body able to recognise qualifications, units and modules.

In this context, the sectorial pilot projects are the most effective tool to identify solutions to the problems that are dependent of the national legislation.

Nuclear ECVET pilot projects aim at:

- testing primarily two ECVET processes: acquiring LO/competences in the context of mobility abroad (it impacts the labour market) and training programs-qualification oriented development (it impacts the E&T system);
- involving national authorities for qualifications, in order to find legal solutions for validation and recognition of new learning outcomes acquired by individuals, no matter the learning system;
- involving employers in the qualification achievement and in training design will help the understanding of ECVET benefits for work processes in the nuclear sector;
- preparing the ground for the future ECVET full implementation within the nuclear sector.

Additional requirements for nuclear ECVET pilot projects are:

- The Euratom Fission Training Scheme (EFTS) projects were limited to the introduction of learning outcomes (LO) within the existing discipline-oriented courses/training programmes.
- The introduction of the learning outcomes (LO) in discipline-oriented courses/training programmes, as EFTS projects did, is not in line with the ECVET approach because the process of accumulation of LO/competences is not driven by the labour market needs.
- The added value of ECVET regarding E&T modernization is the transition from disciplines-oriented E&T, where the qualifications addressed are not specified and the accumulation of LO/competences is not driven by the labour market needs, to the qualification-oriented (or market oriented) E&T where the accumulation of LO/competences is driven by the labour market needs.
- In support of E&T modernization, based on the ECVET approach, the JRC developed a methodology for turning a discipline-oriented training programme into a qualification-oriented training programme.

The major ongoing nuclear pilot projects that are testing different ECVET features are listed in the Table 13.

Table 13. Nuclear pilot projects testing ECVET features

Pilot project	Process tested		ECVET feature tested
ANNETTE	Education	Mobility abroad	- training scheme for a qualification EQF 6 - acquiring LO during mobility
CORONA II	Training	Mobility abroad	- training scheme for a qualification EQF 5 - acquiring LO during mobility
ENETRAP III	Training	-	Training Scheme for a RPE qualification EQF 7
Petrus II	Training	-	Training Scheme for a qualification EQF 7
ELINDER	Training	Mobility abroad	- turning TP-disciplines oriented in TP-qualification oriented - acquiring LO during mobility

The nuclear ECVET infrastructure, developed by the JRC, is in place and all ongoing nuclear ECVET pilot projects could use it, from now on, in order to complete different activities on the acquisition new LO/competences and/or development of qualification-oriented training programmes.

In order to promote a harmonized approach of the ECVET pilot projects, it is advisable that they are set up in four phases and use the customised tools for the implementation of ECVET (or nuclear ECVET infrastructure) whenever they are available, as is shown in the Table 14.

After finding a solution to support, for example, permeability at bilateral level (between two companies from two different countries), through a pilot project, the competent bodies of several countries would sign a memorandum of understanding describing communalities of qualifications and the procedure of recognition. In this context, the ECVET pilot projects represent bridges between the different national certifications for mutual recognition.

Table 14: Customised tools for the implementation of ECVET

Phase	**Purpose**	**Activities and tools for the implementation of ECVET**
Preliminary phase	Selecting one or more qualifications to be tested/targeted qualification	• use JRC Classification of nuclear occupations, qualifications and jobs(*) for selecting the targeted qualification- Annex 1 • setting-up the project consortium (according to the targeted qualifications taken into account) • JRC- Template for targeted qualification design (structured in unit of learning outcomes/ULOs) (*)-Annex 2 • drawing up an agreement among partners (MoU)- Cedefop tool/template • identification of national authority for qualification/accreditation body-JRC approach
Preparation phase	Organizing the stay abroad of learners	• elaborating a Learning Agreement (LA)- Cedefop tool/template • agreeing on the specific learning outcomes to be gained during the learning period abroad- Cedefop tool/template • training programme-qualification oriented development- JRC - Methodology for training program-qualification oriented development(*) – Annex 3
Implementation phase	Learning period abroad	• teaching activities • learning activities/ On the job learning • assessment activities at host organization
Final phase	Qualification/ ULOs achievements	• assessment and recognition of the learning outcomes achieved abroad. • collaboration with national accreditation body
Note: (*) - customised tools for the implementation of ECVET, developed by JRC		

4 Conclusions

The process of ECVET implementation in the nuclear energy sector is running since 2011 and has reached the stage of ECVET testing at small scale through pilot projects.

The conclusions that derive from ECVET implementation concern some key aspects of the process: policy context, main results, main findings and next steps.

Policy context

The report addresses the White Paper on the future of EU, The Recommendation of the European Parliament and the Council on the establishment of ECVET, and the Energy Union project.

The issue at stake is the completion of the experimental implementation of ECVET and shifting to the ECVET implementation at the nuclear sector scale.
The stake is high because the sustainability of the whole ECVET implementation process depends on the results of nuclear ECVET pilot projects.

The report is relevant by emphasising the issues to be overcome in order to complete the experimental implementation of ECVET and shifting to the ECVET implementation at the nuclear sector scale. In addition, the report is relevant for two policies: EU single market & trade (ECVET facilitates the free movement of workers) and nuclear E&T modernization with the view of filling up the 30% gap between the HR demand and supply in the nuclear labour market.

Main results

About 70 nuclear and ECVET experts representing a wide range of stakeholders from the nuclear sector (operators, utilities, engineering companies, universities, training providers and vendors) have been involved in all direct actions (workshops and seminars). The external experts covered for their provenance twelve EU member states and two non-EU countries. In this way the customised implementation tools of ECVET were developed by the most representative experts from nuclear energy sector;

The main results of the ECVET implementation:

- The visibility of the nuclear ECVET has increased at EU level following the twelve publications on the ECVET related topics, three of them in International Journal of Nuclear Power.
- ECVET connects the nuclear E&T with the nuclear labour market.
- By introducing flexible qualifications in the nuclear energy sector, ECVET facilitates the workers' lifelong learning, mobility and flexible learning pathways.
- The ECVET infrastructure has been developed as a tool for the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes. ECVET infrastructure means the customisation of the implementation tools of ECVET to the nuclear sector needs, such as: Classification of nuclear occupations, qualifications and jobs in NPP life cycle (Nuclear Job Taxonomy is embedded); progression routes in decommissioning; methodology for nuclear qualification design; and Methodology for training programmes-qualification oriented design.

Nuclear ECVET infrastructure is in place (could be used all over EU) and is available for testing ECVET, at small scale, through pilot projects.

Main findings

The findings concern several layers of ECVET implementation.

Regarding major HR challenges of the nuclear energy sector, the need to overcome the 30% gap between HR demand and supply and to adapt nuclear E&T system to comply more with labour market demands

The solution to the HR sector problems has two components: 1) "Nuclearisation" to fill the 30% HR gap by engaging individuals from non-nuclear sector and training them to get a nuclear qualification; 2) The ECVET infrastructure development, the tool for the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes or qualification oriented.

Two new problems have been identified. There are not standard legal solutions at EU level for solving problems that are dependent on the national legislation or on the national competent body (the permeability between different education/learning schemes; gradual accumulation of new LO; and the competent body able to recognise qualifications, units and modules). In this context, the most effective tool to identify solutions for those problems is the nuclear ECVET pilot projects.

An innovation appeared. It is about the paradigm shift from E&T based on inputs towards E&T based on exit-outcomes. This paradigm shift within the nuclear learning was induced by the paradigm shift within the labour market, from knowledge-based qualification system to the competence-based qualification system.

In the E&T based on exit-outcomes (or qualification oriented), the learning process is driven by the labour market needs.

The uncertainty on ECVET implementation concerns the delay of the Recommendation update or the replacement by an ECVET directive.

Next steps

The question of the competent body able to recognise qualifications, units and modules is on the table (training programmes). The sustainability of all the qualification and training framework on which the JRC has worked depends on the trust that each actor gives to the documents/awards/diploma delivered. In order to identify a respected body in charge of the strategic matter of official recognition of qualifications, units and modules in the nuclear sector, we have two distinct situations:

- When the qualifications are under the responsibility of a Ministry or a national competent body, there is no possibility of a supra national authority for the recognition of national qualifications. In that case, the way to support recognition is that competent bodies of different countries sign a memorandum of understanding describing the commonalities of qualifications and the procedure of recognition.
- When qualifications are under the responsibility of and awarded by the nuclear sector, ENEN could be defined as the independent body, trusted by the nuclear stakeholders, for recognition of units and/or qualification and training programmes.

In order to complete the experimental implementation of ECVET and shifting to the ECVET implementation at the nuclear sector scale, the necessary next steps are:

- 2018 - defining a common approach of the main stakeholders (DG RTD, DG EAC, DG JRC and DG ENER, ERA) of the Euratom R&TD programmes regarding the experimental testing of ECVET though nuclear ECVET pilot projects;
- 2019 - about 10-ECVET pilot projects to be financed under the Erasmus+

  - The Info package of Erasmus+ programme should be updated in order to include the customised tools for ECVET implementation in the nuclear sector
  - The nuclear ECVET pilot projects will test two ECVET processes: acquiring learning outcomes(LO) in the context of mobility abroad (it impacts the labour market) and development of qualification-oriented training programs- (it impacts the E&T system);
  - By contrast, the EFTSs (Euratom Fission Training Scheme) projects were limited to the introduction of learning outcomes (LO) within the existing discipline-oriented courses.

- 2022 - assessment of nuclear ECVET pilot projects outcomes.
- 2023 - nuclear sector would consider the shift to the ECVET implementation at nuclear sector scale.

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List of abbreviations

C-B QS	Competence-Based Qualification System
CEDEFOP	European Centre for the Development of Vocational Training
CPD	Continuous Professional Development
C-VET	Continuing Vocational Education and Training
DG EAC	European Commission Directorate-General for Education and Culture
DG EMPL	European Commission Directorate-General for Employment
DG ENER	European Commission Directorate-General for Energy
DG JRC	European Commission Directorate-General Joint Research Centre
DG RTD	European Commission Directorate-General for Research and Innovation
E&T	Education and Training
EC	European Commission
ECTS	European Credit Transfer and accumulation System
ECVET	European Credit System for Vocational Education and Training
EFTS	Euratom Fission Training Schemes
EHRO-N	European Human Resources Observatory for Nuclear Energy Sector
ENELM	European Nuclear Energy Labor Market
ENEN	European Nuclear Education Network
ENS	European Nuclear Society
ENSREG	European Nuclear Safety Regulators Group
EQAVET	European Quality Assurance in Vocational Education and Training
EQF	European Qualifications Framework for lifelong learning
ESCO	European Skills, Competences, qualifications and Occupations
EURATOM	European Atomic Energy Community
FORATOM	The European Atomic Forum is the Brussels-based trade association for the nuclear energy industry in Europe
FP7	Euratom Seventh Framework Programme of the European Atomic Energy Community
FPP	Fossil Power Plant
HE	High Education
HR	Human Resources
IAEA	International Atomic Energy Agency
I-VET	Initial Vocational Education and Training
JRC	Joint Research Centre
K-B QS	Knowledge-Based Qualification System
KIC	Knowledge and Innovation Communities
KSC	Knowledge, Skills and Competence
KSC/A	Knowledge, Skills and Competence/Attitude
LA	Learning Agreement
LLL	Lifelong Learning
LO	Learning Outcome
MoU	Memorandum of Understanding
MS	Member States
NEA OECD	Nuclear Energy Agency, Organisation for Economic Cooperation and Development
NES	Nuclear Energy Sector
NESA	Nuclear Energy Skills Alliance, UK
NJT	Nuclear Job Taxonomy
NPP	Nuclear Power Plant
NPP-CRO	Nuclear Power Plant – Control Room Operator qualification
NPR	Nuclear Power Reactor
NQF	National Qualifications Framework for lifelong learning
NRB	Nuclear Regulatory Body
NUC-VET CS	NUClear-Vocational Education and Training Credit System
R/A	Responsibility/Autonomy
REA	Research Executive Agency

TP	Training Programme
TSO	Technical Safety Organisation
ULOs	Unit of Learning Outcomes
VET	Vocational Education and Training

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Annex 1. The ECVET requirements for nuclear qualifications design

Qualification designing process	ECVET requirements
Designing Learning Outcomes or S, K, R-A	The learning outcomes description should be clearly expressing what the learners are expected to know and be able to do so that it can be used as basis to design assessment tasks and define assessment criteria
	The learning outcome/LO: refers to observable and measurable KSR/A; LO statements have three main components: a) *action word* - identifies the performance to be demonstrated b) *learning statement* - specifies what learning will be demonstrated in the performance; c) statement of the *criterion/*standard for acceptable performance Example: (The student) Analyses the thermal power of the NPR, in terms of their effects on the cooling agent flow. (LO from U1 of CRO/Control Room Operator qualification)
	It is advisable to have 5-6 LO-statements within an unit in order to be clear the link with the labour market/addressed qualification; For each LO-statements should be mentioned the corresponding components (SKR/A)-do not apply here!
	The component S (skills) of LO = it shows what the learner is able to do/prepare; skills should be defined by suitable verbs that denote the learner's ability to carry out physical or intellectual tasks resulting into a concrete outcome.
	The component K (knowledge/understanding) of LO= it is defined using verbs that offer to the learner the opportunity to demonstrate what he/she knows/understands.
	The component R-A (Responsibility/Autonomy' of LO= is the ability of the learner to apply knowledge and skills autonomously and with responsibility.
Designing Units of Learning Outcomes	The learning outcomes in a unit should be assessable through one or several assessments methods.
	Unit of Learning Outcomes (ULOs) = a set of knowledge and skills, according to the **Responsibility/Autonomy**[1] that represents the smallest part of a qualification that would be assessed and validated independently.
	The title of the ULOs corresponds to the main functions/role of the job/qualification. When a qualification covers several jobs, the ULOs should represent the common denominator of the main functions/role of the jobs.
	The number of the ULOs would be between 4-6
	Choosing the size of the ULO = problem of optimizing the time spent for assessment and validating of the ULOs accumulated by an individual
Designing assessment criteria	The qualitative assessment criteria define what "the acceptable performance" is and are in line with the descriptors defining levels in the European Qualifications Framework (Annex II). For a given EQF level of a qualification (eg. EQF 6), **defining qualitative assessment criteria means** to customize the KSR/A descriptors of EQF 6 to KSR/A of the given qualification.
	The assessment criteria are covering the whole elements of S/K/R-A. It is a package linking S/K/R-A as the result of the learning process. There are not specific and independent criteria for K/S/R-A.
	The criteria is targeting mainly in skills or in responsibility/autonomy and never in knowledge as K can't be assessed exclusively and by itself. Is always embedded in S/R- A.
	In defining the assessment criteria the wording must take into account the ranking in quantitative scales of the performance assessed by the assessment criteria.
	Defining the assessment criteria give the opportunity to the training providers, when designing the training programme to choose the methods, this fits better in their programme.
Assessment methods	Several recommended assessment methods: Practical tests; Voting system; Situational judgment tests Case study; Written exams; Practical exercises on simulator Task solving; Grid test with multiple choice Interviews Situational judgement tests; Practical exercises; Mock-up; Peer review

Annex 2. The classification of nuclear occupations, qualifications and jobs

Table 2.1: From jobs to occupations in NPP New Built

Occupations		Qualifications	Jobs
1	2	3	4
Broader occupation	**Restricted occupation**		
NPP new built activities	1.0 SAFETY ASSESSMENT	1.0.1. Nuclear Safety Management	1.0.01 Nuclear Safety Manager
		1.0.2. Safety Assessment Specialist	1.0.02 Safety Assessment Specialist
		1.0.3. Safety Design Specialist	1.0.10. Safety Design Engineer
	1.1. SITE LOCATION	1.1.1. Site characterization management	1.1.01.Site Characterization Manager
		1.1.2. Geological and environmental specialist	1.1.05 Geological Expert
			1.1.06 Environmental Expert
	1.2 DESIGN	1.2.1. Design Management	1.2.01. Design Manager
		1.2.2. Technical Draughtsman	1.2.02. Civil Technical Draughtsman
			1.2.03. Electrical Technical Draughtsman
			1.2.04. Mechanical Technical Draughtsman
		1.2.3. Design Specialist	1.2.05. Mechanical Design Engineer
			1.2.06. Civil Design Engineer
			1.2.07. Electrical Design Engineer
			1.2.08. I&C Design Engineer
			1.2.09. System Design Engineer
			1.2.12. HVAC Design Engineer
			1.2.13. HVAC Technical Draughtsman
	1.3 CONSTRUCTION	1.3.1. Construction Project management	1.3.01. Construction Project manager
		1.3.2. Transverse Engineer	1.3.02. Transverse Engineer
		1.3.3. Discipline Specialist	1.3.03. Mechanical Discipline Engineer
			1.3.06. Electrical Discipline Engineer
			1.3.08. I&C Discipline Engineer
	4	11	22

Table 2.1: From jobs to occupations in NPP New Built-Continuation

Occupations		Qualifications	Jobs
1	**2**	**3**	**4**
Broader occupation	**Restricted occupation Occupation PT (Preferred term)**		
NPP new built activities	1.3 CONSTRUCTION	1.3.4. Construction Engineer	1.3.05. Civil Construction Engineer
			1.3.07. Electrical Construction Engineer
			1.3.04. Mechanical Construction Engineer
			1.3.09. I&C Construction Engineer
			1.3.25. HVAC Construction Engineer
		1.3.5. Construction Specialist	1.3.10. Mechanical Construction Technician
			1.3.11. Civil Construction Technician
			1.3.12. Electrical Construction Technician
			1.3.13. I&C Construction Technician
			1.3.26 HVAC Construction Technician
			1.3.22. Welder
		1.3.6. Construction executive	1.3.14. Mechanical Construction Worker
			1.3.15. Civil Construction Worker
			1.3.16. Electrical Construction Worker
			1.3.17. I&C Construction Worker
		1.3.7. Quality, safety and environmental management	1.3.21. Environmental Manager
		1.3.8. Quality control specialist	1.3.20. Quality Control Technician
	1.4 COMMISSIONING	1.4.1 Licensing Management	1.4.07. Licensing Manager
		1.4.2. Commissioning Management	1.4.06. Commissioning Manager
		1.4.2. Commissioning specialist	1.4.01. Electrical Commissioning Engineer
			1.4.02. Mechanical Commissioning Engineer
			1.4.03. Civil Commissioning Engineer
			1.4.04. I&C Commissioning Engineer
			1.4.05. NI System Commissioning Engineer
1	4**/5**	11//**19**	22//**46**

Table 2.2: From jobs to occupations in NPP Operation

Occupations		Qualifications	Jobs
1	**2**	**3**	**4**
Broader occupation	**Restricted occupation Occupation PT (Preferred term)**		
NPP operation activities	2.1 NUCLEAR OPERATIONS	2.1.1. Management for NPP operation	2.0.01. Plant Manager
			2.1.03. Production Manager
			2.1.06. Engineering Manager
			2.1.07. Operation Manager
		2.1.2. Management for NPP Licensing	2.1.02. Licensing Officer
		2.1.3. Management for employee training	2.1.04. Training Officer
		2.1.4. Management for NPP Quality Assurance	2.1.05. Quality Assurance Officer
	2.2. NPP OPERATORS	2.2.1. Operator in control room	2.2.01. Shift Engineer
			2.2.02. Senior Reactor Operator/CRO
			2.2.05. Turbine Operator
		2.2.2. Operator in the field	2.3.01. Field Operator Technician
			2.3.02. Field Operator Worker
	2.3 WASTE MANAGEMENT & RP	2.3.1. Management of Radioactive Waste &RP	2.4.01. WM&RP Manager
		2.3.2. Radiation Protection Officer	2.4.02. Radiation Protection Officer
		2.3.3. Radiation Protection Worker	2.4.03. Radiation Protection Worker
	2.4 CHEMISTRY	2.4.1. Chemistry Management	2.5.01. Chemistry Manager
			2.5.02. Chemistry Supervisor
		2.4.2. Chemistry Specialist	2.5.03. Chemistry Technician
	2.5 SAFETY AND SECURITY	2.5.1. Safety and Security Management	2.6.01. Safety and Security Manager
		2.5.2. Industrial Safety Specialist	2.6.02. Industrial Safety Technician
		2.5.3. Fire Protection Executive	2.6.03. Fire Protection Worker
		2.5.4. Fire Protection Management	2.6.04. Fire Protection Supervisor
	5	15	22

Table 2.2: From jobs to occupations in NPP Operation –Continuation

Occupations		Qualifications	Jobs
1	**2**	**3**	**4**
Broader occupation	**Restricted occupation Occupation PT (Preferred term)**		
NPP operation activities	2.6 MAINTENANCE	2.6.1. Maintenance Management	2.7.13. Maintenance Manager
			2.7.14. Maintenance Planning Officer
		2.6.2. Maintenance Specialist	2.7.03. Mechanical maintenance Technician
		2.6.3. Electrical Management	2.7.07. Electrical Supervisor
		2.6.4. Electrical Specialist	2.7.01. Electrical Technician
		2.6.5. Electrical executive	2.7.04. Electrical worker
		2.6.6. Electronic-I&C Management	2.7.08. Electronic-I&C Supervisor
		2.6.7. Electronic-I&C Specialist	2.7.02. Electronic-I&C Technician
		2.6.8. Electronic-I&C executive	2.7.05. Electronic-I&C Worker
		2.6.9. Mechanical Management	2.7.09. Mechanical Supervisor
		2.6.10. Mechanical executive	2.7.06. Mechanical Worker
		2.6.11. Civil Engineering Specialist	2.7.15. Civil Engineering Technician
		2.6.12. Welder Specialist	2.7.11. Welder
	2.7 ENGINEERING	2.7.1. Design Engineer	2.8.01. Mechanical Design Engineer
			2.8.02. Civil Design Engineer
			2.8.03. Electrical Design Engineer
			2.8.04. I&C Design Engineer
		2.7.2. Reactor Physicist	2.8.07. Reactor Physicist
	2.8. CANDU	2.8.1. Fuel Machine Operator for CANDU	2.9.01. Fuel Machine Operator for CANDU
		2.8.2. System Responsible Engineer	2.9.02. System Responsible Engineer
1	**8**	15//**31**	22//**42**

Table 2.3: From jobs to occupations in nuclear decommissioning

Occupations		Qualifications	Jobs
1	2	3	4
Broader occupation	**Restricted occupation Occupation PT (Preferred term)**		
Decommissioning activities	3.1 Management	3.1.1 Decommissioning management	3.1.01. Project Manager
			3.1.02. Contractors Manager
			3.1.03. Management System Manager
			3.1.04. Training Manager
			3.1.05. Licensing Manager (for decommissioning)
			3.1.06. Communication and PR Manager
			3.1.07. Financial Manager
			3.1.08. Site Manager
	3.2 Decontamination	3.2.1 Decontamination management	3.2.01. Decontamination Planner
			3.2.02. Decontamination Supervisor
		3.2.2 Decontamination executive	3.2.03. Decontamination Worker
	3.3 Preparatory work	3.3.1 Preparatory work management	3.3.01. Site Engineer
			3.3.02. Spent Fuel Management Engineer
			3.3.03. Engineering Support Manager
		3.3.2 Decommissioning planning	3.3.04. Decommissioning Planner
			3.3.05. Decommissioning Supervisor
		3.3.3 Decommissioning executive	3.3.06. Decommissioning Operator
			3.3.07. Decommissioning Worker
	3.4 Equipment dismantling	3.4.1 Dismantling management	3.4.01. Dismantling Planner
			3.4.02. Dismantling Supervisor
		3.4.2 Dismantling executive	3.4.03. Dismantling Worker
	3.5 Building and structures demolition	3.5.1 Demolition management	3.5.01. Demolition Planner
		3.5.2 Demolition specialist	3.5.02. Demolition Civil Engineer
		3.5.3 Demolition executive	3.5.03. Demolition Worker
	3.6. Site clean up	3.6.1. Site clean-up management	3.6.01. Clean up Supervisor
		3.6.2. Site clean-up executive	3.6.02. Clean up Worker
1	6	13	26

Table 2.3: From jobs to occupations in nuclear decommissioning-Cont.

Occupations		Qualifications	Jobs
1	**2**	**3**	**4**
Decommissioning activities	3.7. Radioactive waste	3.7.1. Radioactive Waste Management	3.7.01. Radioactive Waste Manager
			3.7.02. Radioactive Waste Manager- characterisation
			3.7.03. Radioactive Waste Manager- processing
		3.7.2. Radioactive Waste executive	3.7.04. Radioactive Waste Worker-characterisation
			3.7.05. Radioactive Waste Worker- processing
			3.7.07. Transport responsible
	3.8. Maintenance	3.8.1. Management of maintenance in decommissioning	3.8.01. Maintenance Engineer – Manager
			3.8.02. Maintenance Supervisor
		3.8.2. Maintenance for decommissioning executive	3.8.03. Maintenance Worker
	3.9. Health, safety and environmental professionals	3.9.1. Radiation Protection Expert	3.9.01. Radiation Protection Manager
		3.9.2. Radiation Protection Officer	3.9.02. Radiation Protection Officer
		3.9.3. Radiation Protection Worker	3.9.03. Radiation Protection Worker
		3.9.4. Industrial Safety specialist	3.9.04. Industrial Safety Engineer
			3.9.05. Safety Case Expert
		3.9.5. Environmental specialist	3.9.06. Environmental Expert
		3.9.6. Radiochemistry management	3.9.08. Radiochemistry Manager
		3.9.7. Nuclear chemistry laboratory specialist	3.9.09. Nuclear Laboratory Technician Chemistry
	3.10 Site release	3.10.1.Site release management	3.10.01. Final Release Process Supervis
1	6/**10**	13//**25**	26//**44**

Annex 3: Annexes to the EQF revision

Strasbourg, 10.6.2016
COM(2016) 383 final

ANNEXES 1 to 6

ANNEXES

to the

Proposal for a Council Recommendation on the European Qualifications Framework for lifelong learning and repealing the Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning

ANNEX I
Definitions

The definitions that apply in the context of this Recommendation are the following:

(a) *Qualification*: a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards;

(b) *National qualifications system*: all aspects of a Member State's activity related to the recognition of learning and other mechanisms that link education and training to the labour market and civil society. This includes the development and implementation of institutional arrangements and processes relating to quality assurance, assessment and the award of qualifications. A national qualifications system may be composed of several subsystems and may include a national qualifications framework;

(c) *National qualifications framework*: an instrument for the classification of qualifications according to a set of criteria for specified levels of learning achieved, which aims to integrate and coordinate national qualifications subsystems and improve the transparency, access, progression and quality of qualifications in relation to the labour market and civil society;

(d) *International qualification*: a certificate, diploma, degree or title awarded by a n international body (or a national body accredited by an international body) and used in more than one country, which includes learning outcomes based on standards developed by an international body, organisation or company;

(e) *International sectorial qualification*: an international qualification relevant to a sector of economic activity developed by an international sectorial organisation or an international company;

(f) *Learning outcomes*: statements of what a learner knows, understands and is able to do on completion of a learning process

(g) *Knowledge: the ou*tcome of the assimilation of information through learning. Knowledge is the body of facts, principles, *theories* and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual;

(h) *Skills*: the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

(i) Responsibility/Autonomy in the context of the EQF is the ability of the learner to apply knowledge and skills autonomously and with responsibility*;*

(j) *Validation of non-formal and informal learning*: the process of confirmation by an authorised body that an individual has acquired learning outcomes measured against a relevant standard and consists of the following four distinct phases: identification through dialogue of particular experiences of an individual, documentation to make visible the individual's experiences, a formal assessment of these experiences; and certification of the results of the assessment which may lead to a partial or full qualification;

(k) Formal recognition of learning outcomes: the process of granting official status by a competent authority to acquired learning outcomes for purposes of further studies or employment, through i) award of qualifications (certificates, diploma or titles), ii) validation of non-formal and informal learning, iii) grant of equivalence, credit or waivers;

(l) *Credit:* demonstrates that a part of a qualification, consisting of a coherent set of learning outcomes has been assessed and validated by an authorised body, according to an agreed standard; credit is awarded by competent bodies when the individual has achieved the defined learning outcomes, evidenced by appropriate assessments; credit can be expressed in a quantitative value (e.g. credits or credit points) demonstrating the estimated workload a typical individual needs for achieving related learning outcomes;

(m) *Credit systems:* systems for the recognition of credit(s). These systems can comprise inter alia equivalences, exemptions, units/modules that can be accumulated and transferred, the autonomy of providers who can individualise pathways, and through validation of non- formal and informal learning*;*

(n) *Credit transfer:* the process of allowing individuals who have accumulated credit in one context to have it valued and recognised in another context.

ANNEX II

Descriptors defining levels in the European Qualifications Framework (EQF)

Each of the 8 levels is defined by a set of descriptors indicating the learning outcomes[1] relevant to qualifications at that level in any system of qualifications.

	Knowledge	Skills	Responsibility/ Autonomy
	In the context of EQF, knowledge is described as theoretical and/or factual.	In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods,	In the context of the EQF responsibility/autonomy is described as the ability of the learner to apply knowledge and skills autonomously and
Level 1 The learning outcomes relevant to Level 1 are	basic general knowledge	basic skills required to carry out simple tasks	work or study under direct supervision in a structured context
Level 2 The learning outcomes relevant to Level 2 are	basic factual knowledge of a field of work or study	basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	work or study under supervision with some autonomy
Level 3 The learning outcomes relevant to Level 3 are	knowledge of facts, principles, processes and general concepts, in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	take responsibility for completion of tasks in work or study adapt own behaviour to circumstances in solving problems
Level 4 The learning outcomes relevant to Level 4 are	factual and theoretical knowledge in broad contexts within a field of work or study	a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for

[1] Learning outcomes are statements of what a learner knows, understands and is able to do on completion of a learning process. They are generally classified as 'knowledge, skills and competences'. In the context of the EQF, the last element is limited to 'responsibility/autonomy' since the descriptors herewith reflect statements commonly agreed between Member States for application of this Recommendation and these do not correspond fully to the conceptual definitions.

Level 5* The learning outcomes relevant to Level 5 are	comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	exercise management and supervision in contexts of work or study activities where there is unpredictable change
Level 6** The learning outcomes relevant to Level 6 are	advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts take responsibility for managing professional development of individuals and groups
Level 7*** The learning outcomes relevant to Level 7 are	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	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	manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
Level 8**** The learning outcomes relevant to Level 8 are	knowledge at the most advanced frontier of a field of work or study and at the interface between fields	the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including

Compatibility with the Framework for Qualifications of the European Higher Education Area

The Framework for Qualifications of the European Higher Education Area provides descriptors for three cycles agreed by the ministers responsible for higher education at their meeting in Bergen in May 2005 in the framework of the Bologna process. Each cycle descriptor offers a generic statement of typical expectations of achievements and abilities associated with qualifications that represent the end of that cycle.

* The descriptor for the short cycle developed by the Joint Quality Initiative as part of the Bologna process, (within or linked to the first cycle), corresponds to the learning outcomes for EQF level 5.

** The descriptor for the first cycle corresponds to the learning outcomes for EQF level 6.

*** The descriptor for the second cycle corresponds to the learning outcomes for EQF level 7.

**** The descriptor for the third cycle corresponds to the learning outcomes for EQF level 8.

ANNEX III
Criteria and procedures for referencing national qualifications frameworks and systems to the European Qualifications Framework

1. The responsibilities and/or legal competence of all relevant national bodies involved in the referencing process, are clearly determined and published by the competent authorities.

2. There is a clear and demonstrable link between the qualifications levels in the qualifications framework or system and the level descriptors of the EQF.

3. The national qualifications framework or system and its qualifications are based on the principle and objective of learning outcomes and linked to arrangements for validation of non-formal and informal learning and, where these exist, to credit systems.

4. The procedures for inclusion of qualifications in the national qualifications framework or for describing the place of qualifications in the national qualification system are transparent.

5. The national quality assurance system(s) for education and training refer(s) to the national qualifications framework or system and are consistent with the principles on quality assurance as specified in annex IV of this Recommendation.

6. The referencing process shall include the stated agreement of the relevant assurance bodies that the referencing report complies with the relevant national quality assurance provisions and practice.

7. The referencing process shall involve international experts and the referencing reports shall contain the written statement of at least two international experts from two different countries on the referencing process.

8. The competent national body or bodies shall certify the referencing of the national qualifications framework or system with the EQF. One comprehensive report, setting out the referencing, and the evidence supporting it, shall be published by the competent national bodies and shall address separately each of the criteria. The same report can be used for self-certification to the Qualifications Framework of the European Higher Education Area, in accordance with the self-certification criteria of the latter.

9. Ideally within 3 months from the endorsement of the referencing report or its update, Member States and other participating countries shall publish the referencing report and provide relevant information for comparison purposes on the relevant European web-services.

10. Further to the referencing process, all new certificates, diploma or qualification supplement issued by the competent authorities should contain a clear reference, by way of national qualifications frameworks or system, to the appropriate EQF level.

ANNEX IV
Quality assurance principles for qualifications referenced to the European Qualifications Framework[2]

Vocational education and training, higher education, non-formal and informal learning in the private sector or international qualifications referenced to the EQF should be quality assured to enhance trust in their quality and level. Quality assurance principles at European level for general education are subject to ongoing discussions in the context of ET 2020.

Without prejudice to national quality assurance arrangements that apply to national qualifications, **quality assurance of *qualifications* referenced to the EQF:**

1. addresses the design of qualifications as well as application of the learning outcomes approach
2. addresses the process of certification, ensuring valid and reliable assessment according to agreed and transparent learning outcomes based standards
3. consists of feedback mechanisms and procedures for continuous improvement
4. involves all relevant stakeholders at all stages of the process
5. is composed of consistent evaluation methods, associating self-assessment and external review
6. is an integral part of the internal management, including sub-contracted activities, of bodies issuing qualifications referenced to the EQF
7. is based on clear and measurable objectives, standards and guidelines
8. is supported by appropriate resources
9. includes a systematic and cyclical evaluation by external monitoring bodies, based on at least the principles in this annex of internal quality assurance systems related to qualifications,
10. includes the publication of its evaluation results, including electronic accessibility at national and European level

    External monitoring bodies or agencies referred to in principle (9) should be subject to cyclical external review by competent authorities. The result of this external review, outside the field of higher education, should be publicly and electronically available through a European register.

[2] These common principles are fully compatible with the European Standards and Guidelines (ESG) for Quality Assurance in the European Higher education Area and with European Quality Assurance in VET (EQAVET).

ANNEX V

Principles for credit systems related to the European Qualifications Framework

The EQF and national qualifications frameworks, when complemented by credit systems, support better individuals when moving i) between various levels of education and training, ii) within and between sectors of education and training iii) between education and training and the labour market and iv) within and across borders. Different credit systems, closely linked to qualification systems and frameworks, should work together to support transitions and facilitate progression.
To this aim, credit systems linked to qualifications reference to the EQF should be in line with the following principles:

1. Credit systems should be put in place to create flexible learning pathways, for the benefit of individual learners.
2. When designing and developing qualifications, the learning outcomes approach and the relevant credit arrangement(s) should be systematically used to facilitate transfer of (components of) qualifications and progression in learning.
3. Credit systems should facilitate transfer of learning outcomes and progression of learners across institutional and national borders.
4. Credit systems must be underpinned by explicit and transparent quality assurance.
5. The credit acquired by an individual should be documented, expressing the acquired learning outcomes, their level, the name of the competent credit awarding institution and, where relevant, the related credit value.
6. Systems for credit transfer and accumulation should seek synergies with arrangements for validation of non-formal and informal learning, working together to facilitate and promote transfer and progression.
7. Credit systems should be developed and improved through the cooperation between stakeholders at national and European level.

ANNEX VI
Indicative elements of a common format for the electronic publication of information on qualifications

DATA			**Required / Optional**
Title of the qualification			Required
Subject*			Required
Country/Region (code)			Required
EQF Level			Required
Description of the qualification	Either	Knowledge	Required
		Skills	Required
		Responsibility/Autonomy	Required
	Or	Open text field describing what the learner is expected to know, understand and able to do	Required
Awarding body**			Required
Credit points/ notional workload needed to achieve the learning outcomes			*Optional*
Internal quality assurance processes			*Optional*
External monitoring body			*Optional*
Further information on the qualification			*Optional*
Source of information			*Optional*
Link to relevant qualification supplement			*Optional*
URL of the qualification			*Optional*
Information language (code)			*Optional*
Entry requirements			*Optional*
Expiry date (if relevant)			*Optional*
Ways to acquire qualification			*Optional*
Relationship to occupations			*Optional*

** ISCED FoET 2013
** The minimum required information on the Awarding body should facilitate to find information on the Awarding body. This would be the name of the Awarding body, or if applicable the name of the group of Awarding bodies, completed with a URL or contact information

Annex 4: Nuclear Job Taxonomy (May 2015)

1. NEW BUILD	
1.0. SAFETY ASSESSMENT	1.0.01. Nuclear Safety Manager 1.0.02. Safety Assessment Specialist 1.0.10. Safety Design Engineer
1.1. SITE LOCATION	1.1.01. Site Characterisation Manager ~~1.1.02. Licensing Manager~~ 1.1.05. Geological Expert 1.1.06. Environmental Expert
1.2 DESIGN	1.2.01. Design Manager 1.2.02. Civil Technical Draughtsman 1.2.03 Electrical Technical Draughtsman 1.2.04 Mechanical Technical Draughtsman 1.2.05. Mechanical Design Engineer 1.2.06. Civil Design Engineer 1.2.07. Electrical Design Engineer 1.2.08 I&C Design Engineer 1.2.09. System Design Engineer 1.2.12. HVAC Design Engineer 1.2.13. HVAC Technical Draughtsman 1.2.18. I&C Technical Draughtsman
1.3. CONSTRUCTION	1.3.01. Construction Project manager 1.3.02. Transverse Engineer 1.3.03. Mechanical Discipline Engineer 1.3.04. Mechanical Construction Engineer 1.3.05. Civil Construction Engineer 1.3.06. Electrical Discipline Engineer 1.3.07. Electrical Construction Engineer 1.3.08. I&C Discipline Engineer 1.3.09. I&C Construction Engineer 1.3.10. Mechanical Construction Technician 1.3.11. Civil Construction Technician 1.3.12. Electrical Construction Technician 1.3.13. I&C Construction Technician 1.3.14. Mechanical Construction Worker 1.3.15. Civil Construction Worker 1.3.16. Electrical Construction Worker 1.3.17. I&C Construction Worker 1.3.18. Occupational Safety Manager 1.3.19. Quality Manager 1.3.20. Quality Control Technician 1.3.21. Environmental Manager 1.3.22. Welder 1.3.25. HVAC Construction Engineer 1.3.26. HVAC Construction Technician
1.4. COMMISSIONING(*)	1.4.01. Electrical Commissioning Engineer 1.4.02. Mechanical Commissioning Engineer 1.4.03. Civil Commissioning Engineer 1.4.04. I&C Commissioning Engineer 1.4.05. NI System Commissioning Engineer 1.4.06. Commissioning Manager 1.4.07. Licensing Manager

2. OPERATION	
	2.0.01. Plant Manager
2.1. NUCLEAR OPERATIONS AND WASTE MANAGEMENT	2.1.02. Licensing OfficeR 2.1.03. Production Manager 2.1.04. Training Officer 2.1.05. Quality Assurance Officer 2.1.06. Engineering Manager 2.1.07. Operation ManageR
2.2. OPERATORS IN CONTROL ROOM	2.2.01. Shift Engineer 2.2.02. Senior Reactor Operator 2.2.05. Turbine Operator
2.3. OPERATORS IN THE FIELD	2.3.01. Field Operator Technician 2.3.02. Field Operator WorkeR
2.4. WASTE MANAGEMENT & RP	2.4.01. WM&RP Manager 2.4.02. Radiation Protection Officer 2.4.03. Radiation Protection Worker
2.5. CHEMISTRY	2.5.01. Chemistry Manager 2.5.02. Chemistry Supervisor 2.5.03. Chemistry Technician
2.6. SAFETY AND SECURITY	2.6.01. Safety and Security Manager 2.6.02. Industrial Safety Technician 2.6.04. Fire Protection Worker 2.6.05. Fire Protection Supervisor
2.7. MAINTENANCE	2.7.01. Electrical Technician 2.7.02. Electronic-I&C Technician 2.7.03. Mechanical Maintenance Technician 2.7.04. Electrical Worker 2.7.05. Electronic-I&C Worker 2.7.06. Mechanical Worker 2.7.07. Electrical Supervisor 2.7.08. Electronic-I&C Supervisor 2.7.09. Mechanical Supervisor 2.7.11. Welder 2.7.13. Maintenance Manager 2.7.14. Maintenance Planning Officer 2.7.15. Civil Engineering Technician
2.8. ENGINEERING	2.8.01. Mechanical Design Engineer 2.8.02. Civil Design Engineer 2.8.03. Electrical Design Engineer 2.8.04. I&C Design Engineer 2.8.07. Reactor Physicist
2.9. CANDU	2.9.01. Fuel Machine Operator for CANDU 2.9.02 System Responsible Engineer

3. DECOMMISSIONING	
3.1. MANAGEMENT	3.1.01. Project Manager 3.1.02. Contractors Manager 3.1.03. Management System Manager 3.1.04. Training Manager 3.1.05. Licensing Manager 3.1.06. Communication Manager 3.1.07. Financial Manager 3.1.08. Site Manager
3.2. DECONTAMINATION	3.2.01. Decontamination Planner 3.2.02. Decontamination Supervisor 3.2.03. Decontamination Worker
3.3. PREPARATORY WORK FOR DECOMMISSIONING (2)	3.3.01. Site Engineer 3.3.02. Spent Fuel Management Engineer 3.3.03. Engineering Support Manager 3.3.04. Decommissioning Planner 3.3.05. Decommissioning Supervisor 3.3.06. Decommissioning Operator 3.3.07. Decommissioning Worker
3.4. DISMANTLING/EQUIPMENT	3.4.01. Dismantling Planner 3.4.02. Dismantling Supervisor 3.4.03. Dismantling Worker
3.5. DEMOLITION (BUILDING AND STRUCTURES)	3.5.01. Demolition Planner 3.5.02. Demolition Civil Engineer 3.5.03. Demolition Worker
3.6. SITE CLEAN UP	3.6.01. Clean up Supervisor 3.6.02. Clean up Worker
3.7. RADIOACTIVE WASTE (1)	3.7.01. Radioactive Waste Manager 3.7.02. Radioactive Waste Manager-characterisation 3.7.03. Radioactive Waste Manager-processing 3.7.04. Radioactive Waste Worker-characterisation 3.7.05. Radioactive Waste Worker-processing 3.7.07. Transport responsible
3.8. MAINTENANCE	3.8.01. Maintenance Engineer – Manager 3.8.02. Maintenance Supervisor 3.8.03. Maintenance Worker
3.9. HEALTH, SAFETY AND ENVIRONMENT	3.9.01. Radiation Protection Manager 3.9.02. Radiation Protection Officer 3.9.03. Radiation Protection Worker 3.9.04. Industrial Safety Engineer 3.9.05. Safety Case Expert 3.9.06. Environmental Expert 3.9.08. Radiochemistry Manager 3.9.09. Nuclear Laboratory Technician - Chemistry
3.10 SITE RELEASE	3.10.1 Final Release Process Supervisor

Annex 5: The targeted qualifications designed as flexible qualifications

5.1 Qualification title: Decommissioning Management – numeric code 3.1.1.

The present qualification applies to 8 jobs, specified in the Table 9, increasing their extensive scope.

<table>
<tr><td colspan="2">Unit of learning outcomes No. 1: MANAGEMENT OF DECOMMISSIONING PROJECTS /
TU(3.1.1; 3.3.1; 3.8.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex decommissioning activities, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.1.1. Coordinate planning, scheduling, implementing and monitoring activities and projects
S.1.2. Manage resources involved in the project
S.1.3. Monitor implementation of plans and procedures to ensure compliance with project schedules, safety procedures and legislation
S.1.4. Perform risk estimation and management and cost control
S.1.5. Select contractors and establish contracts
S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures
S.1.7. Intervene, analyse, manage and resolve business and technical conflicts between the company and the contractors
S.1.8. Develop procedures and obtain permits (licensing for decommissioning)</td><td>K.1.1. Decommissioning methodology, techniques and strategies
K.1.2. Environmental impact of nuclear power;
K.1.3. Remediation methods;
K.1.4. Risk estimation and management
K.1.5. Management and workflow of the project
K.1.6. Information technology
K.1.7. Nuclear decommission practices: clean up of radioactivity (remediation) and plant demolition
K.1.8. Radioactivity and nuclear science and engineering
K.1.9. Management of civil engineering operations
K.1.10. Decommissioning regulation and licensing: site characterization, dismantlement activities, plans for site remediation, detailed plans for final radiation surveys for release of the site, environmental change.
K.1.11. Decommissioning funds and financial mechanism</td></tr>
<tr><td colspan="2">Assessment criteria:</td></tr>
<tr><td>Coordination of all planning, implementing and monitoring activities and projects;
Monitoring on plans and procedures implementation to ensure compliance with project schedules, safety procedures and legislation
Identify types and sources of radioactive waste;</td><td>Associate hazards and environmental impacts and safety considerations with the Nuclear Fuel Cycle;
Manage the risks
Develop licensing procedures and decommissioning strategy(s) (immediate/deferred dismantling)</td></tr>
<tr><td colspan="2">Recommended assessment methods:</td></tr>
<tr><td colspan="2">Practical test, Development of project, Situational judgment test, face to face examination, practical exercise, grid test with multiple choice.</td></tr>
</table>

Unit of learning outcomes No.2: SAFETY AND SECURITY / TU(3.1.1; 3.3.1; 3.8.1)	
Autonomy/Responsibility	
Manage complex activities of applying safety principles and requirement and safety and security management, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.	
Skills	**Knowledge**
S.2.1. Provide training and information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security S.2.2. Analyse and interpret the licensing requirements S.2.3. Identification of safety requirements S.2.4. Apply regulations issued by different authorities S.2.5. Review processes, systems and activities in the facilities S.2.6. Perform appropriate hazard and accident analysis S.2.7. Develop and document the safety function, functional performance requirements and performance criteria S.2.8. Prepare safety basis documents: Conceptual Safety Design Reports, Preliminary Safety Design Reports, Preliminary Documented Safety Analyses, Documented Safety Analyses and Technical Safety Requirements S.2.9. Monitor and control security, safeguard and non-proliferation requirements	K.2.1. National licensing requirements K.2.2. International regulations and standards K.2.3. Radiation protection (ALARA concept, dose commitment to workers and environment, radiation protection methods and tools) K.2.4. Industrial safety K.2.5. Safety culture K.2.6. Waste and transport safety K.2.7. Emergency preparedness K.2.8. Clearance of material and site release K.2.9. Nuclear security, safeguard and non-proliferation K.2.10. Radiological hazard analysis K.2.11. Risk assessment K.2.12. Environmental site remediation
Assessment criteria: Preparation of information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security Apply the regulations issued by different authorities taking into account interdependencies and interfaces	Show compliance of licencing documents with the regulations Perform hazard and accident analysis Prepare safety-related documentation, technical reports
Recommended assessment methods: Practical test, practical exercise, case study, situational judgment test.	

Unit of learning outcomes No. 3: MANAGEMENT / SU(3.1.1)

Autonomy/Responsibility

Manage complex decommissioning projects, taking responsibility for decision-making in unpredictable work or study contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.

Skills	Knowledge
S.3.1. Formulate strategic goals and long-term business plans S.3.2. Enforce policies, procedures, and productivity standards S.3.3. Plan and Schedule working processes S.3.4. Manage personnel - capacity to allocate tasks and organize work S.3.5. Plan, manage and control the budget S.3.6. Manage and control of processes, purchases, documents S.3.7. Manage organisational change S.3.8. Promote safety culture and legal work environment S.3.9. Evaluate information and data S.3.10. Analyse information for management control S.3.11. Organize supplies and control of subcontractors S.3.12. Operate computers using a variety of software S.3.13. Comply with statutory regulations and organizational safety requirements S.3.14. Define objectives and evaluate outcomes S.3.15. Interface with stakeholders, auditors and subcontractors	K.3.1. Business administration K.3.2. Strategic planning, Organizing and Monitoring K.3.3. Project management K.3.4. Resource management K.3.5. Team Management K.3.6. Requirements of integrated management system K.3.7. Site organisation and lifecycle K.3.8. Document management K.3.9. Advanced computer literate K.3.10. Nuclear regulation and licensing

Assessment criteria:

Precision in analysing achievements of organization and formulation directives for further development, Plan the phases and activities of according to strategic priorities Safety culture principles application on site and comply with the regulatory requirements Capability of planning, scheduling and organization of all resources and service Capacities of partnering and teamwork Ability of making appropriate decisions	Management control based on deduction analysis Clarity of specified requirements, description, goals, monitoring and effectiveness of processes under their responsibility Taking responsibility for the process of planning and implementing change in organizations Practice diversity, coaching and mentoring, conflict management Adopt technological developments and take into account market trends

Recommended assessment methods:

Practical test, practical exercise, case study, peer review, essay, situational judgment test.

Unit of learning outcomes No. 4: COMMUNICATION AND PUBLIC RELATIONS/ SU(3.1.1)	
Autonomy/Responsibility	
Manage complex activities of internal communication and PR management, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.	
Skills	**Knowledge**
S.4.1. Draft and provide appropriate information to internal and external stakeholders S.4.2. Prepare, organize, evaluate and follow-up the communication plan S.4.3. Promote cooperative relationships with the stakeholders S.4.4. Conduct public speaking S.4.5. Select and apply the appropriate approaches for information dissemination S.4.6. Control information output and handle incoming requests for information S.4.7. Drive corporate strategy and message development S.4.8. Create, test and improve a crisis communication plan	K.4.1. Communication plan content and workflow K.4.2. Communication strategy application K.4.3. Communication methods and techniques K.4.4. Current trends in digital media/social media communication K.4.5. Crisis management K.4.6. Public relations K.4.7. Occupational sociology K.4.8. Journalism, marketing
Assessment criteria:	
Draft appropriate information for stakeholders Prepare, organize, evaluate and follow-up the communication plan Draft press releases Deliver effective public speech	Appropriate approaches and channels for information dissemination Capacity of networking Conduct a crisis communication plan
Recommended assessment methods:	
Practical test, face to face examination, grid test with multiple choice.	

Unit of learning outcomes No. 5: INTEGRATED MANAGEMENT SYSTEM IN DECOMMISSIONING/ SU(3.1.1)	
Autonomy/Responsibility	
Manage complex activities of implementation, development and improvement of IMS, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.	
Skills	**Knowledge**
S.5.1. Develop process maps and establish the requirements with regards documentation, instructions, management of interfaces, transfer of responsibilities, and key competences S.5.2. Analyse and report information S.5.3. Monitor business process performance and effectiveness S.5.4. Carry out the assessment of the processes and propose improvements S.5.5. Coordinate personnel, policies and processes S.5.6. Oversee and apply complex regulations and procedures S.5.7. Monitor implementation, assessment and improvement of the MS. S.5.8. Ensure that the activities comply with the requirements specified in the MS S.5.9. Manage organizational changes and their impact on safety S.5.10. Promote safety culture	K.5.1. National legislation on management system and international standards (e.g. ISO, IAEA) K.5.2. Processes design K.5.3. Quality assurance, management system and environmental management K.5.4. Management of human and organisational factors K.5.5. Safety culture K.5.6. ICT literacy
Assessment criteria:	
Plan process indicators and monitor business process performance and effectiveness Ensure compliance with complex regulations and procedures Review process flow, develop process maps Focus on excellence and continuous improvement	Analyse data and report information Defining proposals for improvement of processes based on collected data and their analysis
Recommended assessment methods:	
Practical test, Situational judgment test, face to face examination, grid test with multiple choice.	

5.2 Radioactive Waste Management (3.7.1)

<table>
<tr><td colspan="2">Unit of learning outcomes No.1: RADIATION PROTECTION/ TU (3.9.1;2.3.1; 3.7.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex activities, related to radioactive waste management and radiation protection aspects. Take responsibility for decision-making in routine and/or unpredictable work in relation with radiation protection expert. Take responsibility for managing professional development of individuals in radioactive waste management and radiation protection areas.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.1.1. Develop specific provisions and procedures based on regulatory requirements on radioctive waste management
S.1.2. Implement ALARA principle to define optimised radiation protection actions
S.1.3. Confirm work permits
S.1.4. Optimize the occupational radiation protection programme
S.1.5. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation (design, operation or dismantling).
S.1.6. Develop radiation protection procedures and framework in normal and emergency cases
S.1.7. Use radiation control and measurement equipment
S.1.8. Develop technical specifications and procedures
S.1.9. Monitor and maintain a safe working environment
S.1.10. Apply appropriate radiation measurements for preliminary sample sorting
S.1.11. Identify appropriate shielding for radiation sources
S.1.12. Characterise radiation sources and identify appropriate protection strategies</td><td>K.1.1. The main types of ionizing radiation and their effects
K.1.2. Relevant national and international legislation and guidelines
K.1.3. Dose definition, dose types, dose measures, dose constraints and reference levels
K.1.4. Radiation monitoring, workplace monitoring and individual monitoring
K.1.5. Radiation protection programs
K.1.6. ALARA principle and procedures
K.1.7. Health surveillance
K.1.8. Radiological impacts on the environment
K.1.9. Contamination control, decontamination and reduction of sources of radiation
K.1.10. Classification of working areas and access control
K.1.11. Use of protective equipment such as shielding and protective clothing
K.1.12. Storage arrangements for radioactive/contaminated items
K.1.13. Emergency planning and emergency preparedness</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability in developing procedures and specifications
Capabilities in application of the ALARA implementation strategy
Successful management of emergency situations
Effectiveness of implementation of radiation protection programme
Sustainability of safety culture principles application
Compliance with legislation in radiation protection area
Realism of corrective measures evaluation</td></tr>
<tr><td>Recommended assessment methods:
Situational judgement tests
Case studies</td><td>Inteview
Written test
Task solving</td></tr>
</table>

Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES
TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Assume position and responsibility in emergency situations. Manage tasks prompt and reactive on changing situation in emergency case, distinguish and select the adequate data, stress control in emergency situation. Proper and prompt communication and reporting.

Skills	Knowledge
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.6. Mitigate the consequences of accidental situation S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.3. Several accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.6. Health protection K.2.7. Environmental protection K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements

Assessment criteria:

Ability for emergency planning and realisation of emergency plans
Ability to make decision in emergency situations
Adequacy of dose measures and use of radiation control equipment
Ability to evaluate the abnormal situation
Appropriateness of corrective actions
Ability to apply ALARA and safety culture principles
Behaviour in stress situations
Prompt reporting

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.3: TEAM AND PROJECT MANAGEMENT/ TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Taking responsibility for decision-making in daily operations and emergency situations in order to respect time schedule and costs for decommissioning installation. Take responsibility for managing professional development of individuals and groups under their responsibility. Take responsibility in strategic resourse and workforce planning of the department. Manage and lead the team of professionals in radiation protection and waste management area in decommissioning phase.

Skills	Knowledge
S.3.1. Participate in recruitment process S.3.2. Plan initial and continuing specialised training for employees S.3.3. Allocate tasks and assign personnel S.3.4. Prioritise objectives S.3.5. Develop teamwork S.3.6. Anticipate and manage conflicts S.3.7. Evaluate individual and team performance S.3.8. Perform managerial communication S.3.9. Propose activities for building successful teams S.3.10. Promote individuals S.3.11. Respect and apply national and international legislation S.3.12. Promote safety culture, questioning attitude and rigorous and prudent approach S.3.13. Manage project	K.3.1. Organisation of human resources K.3.2. Social regulation K.3.3. Workforce planning and recruitment process K.3.4. Individual and team performance K.3.5. Managerial communication K.3.6. Team coordination and motivation K.3.7. Resolution of conflict K.3.8. Work planning K.3.9. Training solutions K.3.10. Change management K.3.11. Quality Management K.3.12. Integrated Management System (conformity with ISO) K.3.13. General principles of knowledge management K.3.14. General principles of configuration management K.3.15. Project management K.3.16. Budget, time and cost management K.3.17. Organizational changes from operation to decommissioning

Assessment criteria:

Ability to plan, schedule and control daily work activities
Pertinence of workforce planning and adequacy of recruitment activities
Ability to manage financial resources
Proper application of integrated management system
Accurate solutions for solving complex problems in unpredictable and emergency situations
Ability to apply national and international standards
Ability to plan radioactive waste activities in decommissioning project according to strategic priorities
Pertinence of corrective actions to anticipate and reduce stress, and increase individual / team efficiency.
Appropriateness of managerial communication

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

<table>
<tr><td colspan="2">Unit of learning outcomes No.4: Interaction with other nuclear actors/departments – TU (3.9.1;2.3.1; 3.7.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Interact with actors/departments involved in radioactive waste management, decomissioning phase of the NPP project. Taking responsibility for establishing and maintaining relationships with other departments, for participating decision-making in daily operations and emergency situations, for communicating the General Management decisions to the radioactive waste management team.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.4.1. Integrate radwaste management strategy into the decommissioning plan
S.4.2. Integrate radwaste management strategy into the overall management strategy of the plant
S.4.3. Lead performance of complex analyses involving different facility’s systems, structures, components and processes
S.4.4. Perform proper communication in different areas of waste management
S.4.5. Report activities and disseminate information
S.4.6. Coordinate actors in waste management activities
S.4.7. Share knowledge, information and experiences
S.4.8. Analyse and upgrade decommissioning plans</td><td>K.4.1. General plant description and basic technical characteristics of nuclear facilities
K.4.2. Nuclear fuel cycle
K.4.3. Safety systems operation
K.4.4. Radioactive waste treatment systems operation
K.4.5. Applicable codes, regulations and standards for decommissioning phase
K.4.6. Knowledge of plant (site, units’) operational history
K.4.7. Safety Analysis Report (SAR)
K.4.8. Dismantling methods and techniques
K.4.9. Key issues of facilities’ maintenance, surveillance and inspection. Facility modifications
K.4.10. Radiological characterization of the facility
K.4.11. Decontamination techniques for equipment and SSCs
K.4.12. Waste categorisation
K.4.13. Knowledge management</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability to organise and share knowledge, information and experiences
Taking in account professional environment and constraints of design, technological systems and processes
Compliance with safety standards, legislation and company policy
Pertinence of plant key performance indicators
Performance and effectiveness of business processes
Accuracy of reports
Pertinence of decommissioning plans analyse and upgrading</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Interview
Situational judgement tests
Case studies
Task solving
Written exam</td></tr>
</table>

<table>
<tr><td colspan="2">Unit of learning outcomes No.5: DECOMMISSIONING MANAGEMENT / SU (3.7.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Perform and manage tasks in decommissioning activities. Take responsibility for selection of proper decommissioning technologies and procedures. Participation in daily decisions for operations and emergency situations. Communication to the general management. Take responsibility for quality and safety of performed works.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.5.1. Participate and/or organize decommissioning activities
S.5.2. Organise decommissioning work
S.5.3. Prioritise objectives
S.5.4. Use the optimal tools and technology in decommissioning
S.5.6. Evaluate efficiency of decontamination
S.5.7. Monitor waste accumulation and transport</td><td>K.5.1. Waste origin and handlings
K.5.2. Contamination, decontamination
K.5.3. Decontamination technologies and tools
K.5.4. Radioecology and environmental remediation
K.5.5. Partitioning and compacting
K.5.6. Decommissioning procedures
K.5.7. Limits for free release
K.5.8. Prediction and simulating of activation</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability to evaluate waste activity
Performance of decommissioning strategy and program
Ability to organize decommissioning works and activities
Feedback on operational events
Pertinence of decommissioning selected tools and techniques</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Written test,
Interview
Situational judgement test
Problem solving</td></tr>
<tr><td colspan="2">Note:</td></tr>
</table>

Unit of learning outcomes No.6: RADIOACTIVE WASTE MANAGEMENT / BU (2.3.1; 3.7.1)	
Autonomy/Responsibility	
Manage complex activities related to radioactive waste management including handling, treatment and storage. Take responsibility for decisions related to technologies, processes, nuclear and industrial safety as well as impact to environment.	
Skills	**Knowledge**
S.6.1. Evaluate and control the level of contamination and induced activities of radioactive waste S.6.2. Select optimal solution and manage radioactive waste categorisation S.6.3. Manage radioactive waste handling and transport S.6.5. Apply proper criteria for treated waste classification and handling S.6.6. Evaluate and manage collected data about waste characteristics S.6.9. Comply activities with national program in decommissioning S.6.10. Developing waste management program, specifications and procedures S.6.11. Apply appropriate solutions in packaging	K.6.1. Waste characterisation and categorisation K.6.2. Dosimetry K.6.3. Nuclear safety and radiation protection K.6.4. Relevant national and international legislation and guidelines K.6.5. Health protection K.6.6. Environmental protection K.6.7. Nuclear safety culture and human factor K.6.8. Protective clothing and protective equipment K.6.9. Transport, handling and storage of radioactive waste K.6.10. Treatment and long term storage K.6.11. National policy and program in decommissioning K.6.12. Waste conditioning including packaging
Assessment criteria: Characterisation of radioactive waste Handling with radioactive waste Proper use of radiation control equipment Developing specifications and procedures	Evaluation of radiation protection measures Manipulation with active waste Effective shielding measures
Recommended assessment methods: Practical exercises Situational judgement tests Lessons learned Case studies Task solving	

5.3 Preparatory work Management (3.3.1)

<table>
<tr><td colspan="2">Unit of learning outcomes No. 1: MANAGEMENT OF DECOMMISSIONING PROJECTS/
TU (3.1.1; 3.3.1; 3.8.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex decommissioning activities, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.1.1. Coordinate planning, scheduling, implementing and monitoring activities and projects
S.1.2. Manage resources involved in the project
S.1.3. Monitor implementation of plans and procedures to ensure compliance with project schedules, safety procedures and legislation
S.1.4. Perform risk estimation and management and cost control.
S.1.5. Select contractors and establish contracts
S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures
S.1.7. Intervene, analyse, manage and resolve business and technical conflicts between the company and the contractors
S.1.8. Develop procedures and obtain permits (licensing for decommissioning)</td><td>K.1.1. Decommissioning methodology, techniques and strategies
K.1.2. Environmental impact of nuclear power;
K.1.3. Remediation methods;
K.1.4. Risk estimation and management
K.1.5. Management and workflow of the project
K.1.6. Information technology
K.1.7. Nuclear decommission practices: clean up of radioactivity (remediation) and plant demolition
K.1.8. Radioactivity and nuclear science and engineering
K.1.9. Management of civil engineering operations
K.1.10. Decommissioning regulation and licensing: site characterization, dismantlement activities, plans for site remediation, detailed plans for final radiation surveys for release of the site, environmental change.
K.1.11. Decommissioning funds and financial mechanism</td></tr>
<tr><td colspan="2">Assessment criteria:</td></tr>
<tr><td>Coordination of all planning, implementing and monitoring activities and projects;
Monitoring on plans and procedures implementation to ensure compliance with project schedules, safety procedures and legislation
Identify types and sources of radioactive waste;</td><td>Associate hazards and environmental impacts and safety considerations with the Nuclear Fuel Cycle;
Manage the risks
Develop licensing procedures and decommissioning strategy(s) (immediate/deferred dismantling)</td></tr>
<tr><td colspan="2">Recommended assessment methods:</td></tr>
<tr><td colspan="2">Practical test, Development of project, Situational judgment test, face-to-face examination, practical exercise, grid test with multiple choice.</td></tr>
</table>

Unit of learning outcomes No.2: SAFETY AND SECURITY / TU (3.1.1; 3.3.1; 3.8.1)	
Autonomy/Responsibility	
Manage complex activities of applying safety principles and requirement and safety and security management, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.	
Skills	**Knowledge**
S.2.1. Provide training and information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security S.2.2. Analyse and interpret the licensing requirements S.2.3. Identification of safety requirements S.2.4. Apply regulations issued by different authorities S.2.5. Review processes, systems and activities in the facilities S.2.6. Perform appropriate hazard and accident analysis S.2.7. Develop and document the safety function, functional performance requirements and performance criteria S.2.8. Prepare safety basis documents: Conceptual Safety Design Reports, Preliminary Safety Design Reports, Preliminary Documented Safety Analyses, Documented Safety Analyses and Technical Safety Requirements S.2.9. Monitor and control security, safeguard and non-proliferation requirements	K.2.1. National licensing requirements K.2.2. International regulations and standards K.2.3. Radiation protection (ALARA concept, dose commitment to workers and environment, radiation protection methods and tools) K.2.4. Industrial safety K.2.5. Safety culture K.2.6. Waste and transport safety K.2.7. Emergency preparedness K.2.8. Clearance of material and site release K.2.9. Nuclear security, safeguard and non-proliferation K.2.10. Radiological hazard analysis K.2.11. Risk assessment K.2.12. Environmental site remediation
Assessment criteria: Preparation of information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security Apply the regulations issued by different authorities taking into account interdependencies and interfaces	Show compliance of licencing documents with the regulations Perform hazard and accident analysis Prepare safety-related documentation, technical reports

Unit of learning outcomes No. 3: OPERATION, MAINTANANCE AND ENGINEERING SUPPORT / SU (3.3.1)

Autonomy/Responsibility

Manage complex tasks of operation, maintenance and engineering support of decommissioning projects, taking responsibility for decision-making in unpredictable work or study contexts. Take responsibility for managing professional development of individuals and groups involved in decommissioning activities.

Skills	Knowledge
S.3.1. Plan, implement, co-ordinate and monitor operation activities S.3.2. Plan, implement, co-ordinate and monitor maintenance activities S.3.3. Plan, implement, co-ordinate and monitor engineering support activities S.3.4. Provide technical information for operation, activities S.3.5. Provide technical information for maintenance, activities S.3.6. Provide technical information for engineering support activities S.3.7. Draft work instructions related to waste management S.3.8. Understanding of complex regulations and procedures S.3.9. Perform inspection, evaluation and control of works S.3.10. Specify functional requirements S.3.11. Specify design requirements S.3.12. Assess design options S.3.13. Document design modifications S.3.14. Manage equipment delivery S.3.15. Draft technical specification and requirements S.3.16. Use and interpret engineering drawings and documents	K.3.1. Decommissioning methodology K.3.2. Electrical and mechanical installations K.3.3. Radioactive waste treatment systems K.3.4. Process System engineering and design K.3.5. Electrical engineering and design K.3.6. Mechanical engineering and design K.3.7. HVAC engineering and design K.3.8. Fire protection engineering and design K.3.9. Techniques and methodologies of decontamination within scope K.3.10. Engineering principles (i.e. mechanical, electrical, instrumentation and control) K.3.11. Site specific rules and procedures (permit to work, standard operating & maintenance procedures and risk assessment etc.) K.3.12. Equipment and system operating and maintenance instructions K.3.13. Comprehension on technological systems and processes. K.3.14. Documenting of design solutions and design modifications K.3.15. Establish of relevant procedures for management of equipment purchase and delivery.

Assessment criteria:

Appropriate planning, implementation, co-ordination and monitoring of engineering activities on the base of available technical information Ability to draft requirements specifications, technical specifications, reports based of understanding of complex regulations and procedures Appropriate evaluation and control of work; performing inspections and report them

Demonstrate comprehensive knowledge on technological systems and processes.
Documenting of design solutions and design modifications
Establish of relevant procedures for management of equipment purchase and delivery.

Recommended assessment methods:

Practical test, quizzes, grid test with multiple choices, how-to examination.

Unit of learning outcomes No.4: PREPARATORY WORK AND SPENT FUEL/ SU (3.3.1)	
Autonomy/Responsibility	
Manage complex activities, related to nuclear physics and nuclear engineering aspects of decommissioning projects, taking responsibility for decision-making in unpredictable work or study contexts. Take responsibility for managing professional development of individuals and groups depending on their duties.	
Skills	**Knowledge**
S.4.1. Planning, implementing, coordinating and monitoring engineering activities S.4.2. Organize treatment of damaged fuel elements S.4.3. Plan decommissioning site preparation S.4.4. Defining engineering processes S.4.5. Draft technical specifications and working documents related to decommissioning activities and spent fuel management S.4.6. S.4.7. Prepare controlled work areas for decommissioning activities and Design Radiation protection barriers S.4.8. Implement design modifications S.4.9. Identify and analyse radiological incidents S.4.10. Report technical and regulatory data according to standard operating procedures S.4.11. Apply defence in depth principle in design S.4.12. Organise and monitor storage, handling, packaging and transport of spent fuel	K.4.1. Nuclear physics fundamentals K.4.2. Nuclear engineering K.4.3. Nuclear installation systems and components K.4.4. Nuclear safety (criticality, heat generation, radiolysis) K.4.5. Radiation fundamentals K.4.6. Nuclear standards K.4.7. Decommissioning techniques K.4.8. Chemical Engineering and Waste Management K.4.9. Radioactive waste handling and storage K.4.10. Inspection of spent fuel assemblies and special conditioning of damaged elements K.4.11. Spent fuel management, including damaged fuel elements K.4.12. Spent fuel transport (preparation of packaging,)
Assessment criteria: Interpret engineering drawings and documents Define engineering processes Ability to plan and monitor engineering activities applying applicable methods Planning of decommissioning site preparation	Planning and managing of safe transport and storage of spent fuel
Recommended assessment methods: Grid test with multiple choices, quizzes, practical exercise, peer review, face to face examination.	

5.4. Radiation Protection Expert (3.9.1)

<table>
<tr><td colspan="2">Unit of learning outcomes No.1: RADIATION PROTECTION/ TU (3.9.1;2.3.1; 3.7.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex activities, related to radioactive waste management and radiation protection aspects. Take responsibility for decision-making in routine and/or unpredictable work in relation with radiation protection expert. Take responsibility for managing professional development of individuals in radioactive waste management and radiation protection areas.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.1.13. Develop specific provisions and procedures based on regulatory requirements on radioactive waste management
S.1.14. Implement ALARA principle to define optimised radiation protection actions
S.1.15. Confirm work permits
S.1.16. Optimize the occupational radiation protection programme
S.1.17. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation (design, operation or dismantling).
S.1.18. Develop radiation protection procedures and framework in normal and emergency cases
S.1.19. Use radiation control and measurement equipment
S.1.20. Develop technical specifications and procedures
S.1.21. Monitor and maintain a safe working environment
S.1.22. Apply appropriate radiation measurements for preliminary sample sorting
S.1.23. Identify appropriate shielding for radiation sources
S.1.24. Characterise radiation sources and identify appropriate protection strategies</td><td>K.1.2. The main types of ionizing radiation and their effects
K.1.14. Relevant national and international legislation and guidelines
K.1.15. Dose definition, dose types, dose measures, dose constraints and reference levels
K.1.16. Radiation monitoring, workplace monitoring and individual monitoring
K.1.17. Radiation protection programs
K.1.18. ALARA principle and procedures
K.1.19. Health surveillance
K.1.20. Radiological impacts on the environment
K.1.21. Contamination control, decontamination and reduction of sources of radiation
K.1.22. Classification of working areas and access control
K.1.23. Use of protective equipment such as shielding and protective clothing
K.1.24. Storage arrangements for radioactive/contaminated items
K.1.25. Emergency planning and emergency preparedness</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability in developing procedures and specifications
Capabilities in application of the ALARA implementation strategy
Successful management of emergency situations
Effectiveness of implementation of radiation protection programme
Sustainability of safety culture principles application
Compliance with legislation in radiation protection area
Realism of corrective measures evaluation</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Situational judgement tests
Case studies
Interview
Written test
Task solving</td></tr>
</table>

Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES /
TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Assume position and responsibility in emergency situations. Manage tasks prompt and reactive on changing situation in emergency case, distinguish and select the adequate data, stress control in emergency situation. Proper and prompt communication and reporting.

Skills	Knowledge
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.6. Mitigate the consequences of accidental situation S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.3. Several accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.6. Health protection K.2.7. Environmental protection K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements

Assessment criteria:

Ability for emergency planning and realisation of emergency plans
Ability to make decision in emergency situations
Adequacy of dose measures and use of radiation control equipment
Ability to evaluate the abnormal situation
Appropriateness of corrective actions
Ability to apply ALARA and safety culture principles
Behaviour in stress situations
Prompt reporting

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.3: TEAM AND PROJECT MANAGEMENT/ TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Taking responsibility for decision-making in daily operations and emergency situations in order to respect time schedule and costs for decommissioning installation. Take responsibility for managing professional development of individuals and groups under their responsibility. Take responsibility in strategic resourse and workforce planning of the department. Manage and lead the team of professionals in radiation protection and waste management area in decommissioning phase.

Skills	Knowledge
S.3.1. Participate in recruitment process S.3.2. Plan initial and continuing specialised training for employees S.3.3. Allocate tasks and assign personnel S.3.4. Prioritise objectives S.3.5. Develop teamwork S.3.6. Anticipate and manage conflicts S.3.7. Evaluate individual and team performance S.3.8. Perform managerial communication S.3.9. Propose activities for building successful teams S.3.10. Promote individuals S.3.11. Respect and apply national and international legislation S.3.12. Promote safety culture, questioning attitude and rigorous and prudent approach S.3.13. Manage project	K.3.1. Organisation of human resources K.3.2. Social regulation K.3.3. Workforce planning and recruitment process K.3.4. Individual and team performance K.3.5. Managerial communication K.3.6. Team coordination and motivation K.3.7. Resolution of conflict K.3.8. Work planning K.3.9. Training solutions K.3.10. Change management K.3.11. Quality Management K.3.12. Integrated Management System (conformity with ISO) K.3.13. General principles of knowledge management K.3.14. General principles of configuration management K.3.15. Project management K.3.16. Budget, time and cost management K.3.17. Organizational changes from operation to decommissioning

Assessment criteria:

Ability to plan, schedule and control daily work activities
Pertinence of workforce planning and adequacy of recruitment activities
Ability to manage financial resources
Proper application of integrated management system
Accurate solutions for solving complex problems in unpredictable and emergency situations
Ability to apply national and international standards
Ability to plan radioactive waste activities in decommissioning project according to strategic priorities
Pertinence of corrective actions to anticipate and reduce stress, and increase individual / team efficiency.
Appropriateness of managerial communication

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.4: Interaction with other nuclear actors/departments – TU (3.9.1;2.3.1; 3.7.1)	
Autonomy/Responsibility	
Interact with actors/departments involved in radioactive waste management, decommissioning phase of the NPP project. Taking responsibility for establishing and maintaining relationships with other departments, for participating decision-making in daily operations and emergency situations, for communicating the General Management decisions to the radioactive waste management team.	
Skills	**Knowledge**
S.4.1. Integrate radwaste management strategy into the decommissioning plan S.4.2. Integrate radwaste management strategy into the overall management strategy of the plant S.4.3. Lead performance of complex analyses involving different facility's systems, structures, components and processes S.4.4. Perform proper communication in different areas of waste management S.4.5. Report activities and disseminate information S.4.6. Coordinate actors in waste management activities S.4.7. Share knowledge, information and experiences S.4.8. Analyse and upgrade decommissioning plans	K.4.1. General plant description and basic technical characteristics of nuclear facilities K.4.2. Nuclear fuel cycle K.4.3. Safety systems operation K.4.4. Radioactive waste treatment systems operation K.4.6. Applicable codes, regulations and standards for decommissioning phase K.4.7. Knowledge of plant (site, units') operational history K.4.8. Safety Analysis Report (SAR) K.4.9. Dismantling methods and techniques K.4.10. Key issues of facilities' maintenance, surveillance and inspection. Facility modifications K.4.11. Radiological characterization of the facility K.4.12. Decontamination techniques for equipment and SSCs K.4.13. Waste categorisation K.4.14. Knowledge management
Assessment criteria: Ability to organise and share knowledge, information and experiences Taking in account professional environment and constraints of design, technological systems and processes Compliance with safety standards, legislation and company policy	Pertinence of plant key performance indicators Performance and effectiveness of business processes Accuracy of reports Pertinence of decommissioning plans analyse and upgrading
Recommended assessment methods: Interview Situational judgement tests Case studies Task solving Written exam	

Unit of learning outcomes No.5: EVALUATION AND OPTIMISATION OF INDIVIDUAL AND COLLECTIVE DOSES / BU (3.9.1; 2.3.1)

Autonomy/Responsibility

Manage complex activities concerning evaluation of individual and collective exposures (internal and external). Take responsibility for radiation protection actions implemented with respect to ALARA principle, regulation and rules. Advice other teams on radiation protection issues concerning decommissioning project.

Skills	Knowledge
S.5.1. Monitor decommissioned areas S.5.2. Evaluate dose rates and radioactive contamination S.5.3. Evaluate the radiation situation S.5.4. Evaluate problems regarding radiation protection and dosimetry S.5.5. Ensure the maintenance of radiation protection instruments and materials S.5.6. Optimise radiation protection methods and techniques for decommissioning S.5.7. Provide information about radiological situation S.5.8. Analyse historical radiologic data of the dismantling installation S.5.9. Analyse and upgrade decommissioning plans S.5.10. Comply with legal requirements of radiation protection and dosimetry in national regulations and rules S.5.11. Recommend personal and collective protective equipment	.5.1. Measurement of radioactive characteristics .5.2. Detectors for radiation monitoring .5.3. Dosimetry (limits and norms) .5.4. Radiation protection measures and technics .5.5. Statistical assessment of data .5.6. Modelling and simulation codes applied in dosimetry .5.7. ALARA principles .5.8. Nuclid vectors identification .5.9. Stochastic approach in radiation impact .5.10. Biological impacts of radiation doses

Assessment criteria:

Ability to manage operational dosimetry data (cartography, computer modelling…).
Ability to determine supervised and controlled areas.
Pertinence of identification, quantification, and assessment of ionising radiations source term in decommissioned installation.
Ability to identify, quantify and select optimal radiation protection action with respect to ALARA procedure

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.6: Management of health, radiological and environmental risks / BU (3.9.1; 2.3.1)

Autonomy/Responsibility

Perform and manage complex tasks to ensure compliance with national and international regulations and standards concerning management of health, radiological and environmental risks. Take responsibility for actions related to health in relation with medical service, radiological and environmental risks.

Skills	Knowledge
S.6.1. Evaluate health and radiological risks S.6.2. Evaluate environmental risks S.6.3. Apply risks assessment methods in decommissioning S.6.4. Provide internal information about risks assessment S.6.5. Undertake corrective measures S.6.6. Harmonise health and regulatory requirements S.6.7. Propose and implement corrective and preventive actions related to radiological and/or conventional risks S.6.8. Inform and/or train work teams to global approach "Health Safety Environment" S.6.9. Participate in workplace studies with related health, safety and medical department S.6.10. Create and use of health, radiological, and environmental databases	K.6.1. Risks assessment and management K.6.2. Health and environmental standards, codes and guidelines K.6.3. Biological acceptance of irradiation K.6.4. Health protection K.6.5. Environmental protection K.6.6. Radiation protection measures and technics K.6.7. Human behaviour related to health, radiological, and environmental risks K.6.8. Individual and collective protective equipment K.6.9. Management of health, radiological, and environmental data K.6.10. Train the trainers methodology

Assessment criteria:

Ability to identify, quantify, assess and implement actions for safety hazards and risks

Effective reporting to the company management related to health, radiological and environmental risks

Abilily to lead measures and procedures on health effects and risk assessment and management methods for nuclear installation in decommissioning.

Pertinence of individual and collective protective measures

Pertinence of data management

Efficiency of training

Recommended assessment methods:

Interview

Situational judgement tests

Case studies

Task solving

Written exam

5.5 Management of maintenance in decommissioning (3.8.1.)

<table>
<tr><td colspan="2">Unit of learning outcomes No. 1: MANAGEMENT OF DECOMMISSIONING PROJECTS / TU (3.1.1; 3.3.1; 3.8.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex decommissioning activities, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.1.1. Coordinate planning, scheduling, implementing and monitoring activities and projects
S.1.2. Manage resources involved in the project
S.1.3. Monitor implementation of plans and procedures to ensure compliance with project schedules, safety procedures and legislation
S.1.4. Perform risk estimation and management and cost control.
S.1.5. Select contractors and establish contracts
S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures
S.1.7. Intervene, analyse, manage and resolve business and technical conflicts between the company and the contractors
S.1.8. Develop procedures and obtain permits (licensing for decommissioning)</td><td>K.1.1. Decommissioning methodology, techniques and strategies
K.1.2. Environmental impact of nuclear power;
K.1.3. Remediation methods;
K.1.4. Risk estimation and management
K.1.5. Management and workflow of the project
K.1.6. Information technology
K.1.7. Nuclear decommission practices: clean-up of radioactivity (remediation) and plant demolition
K.1.8. Radioactivity and nuclear science and engineering
K.1.9. Management of civil engineering operations
K.1.10. Decommissioning regulation and licensing: site characterization, dismantlement activities, plans for site remediation, detailed plans for final radiation surveys for release of the site, environmental change.
K.1.11. Decommissioning funds and financial mechanism</td></tr>
<tr><td colspan="2">Assessment criteria:
Coordination of all planning, implementing and monitoring activities and projects;
Monitoring on plans and procedures implementation to ensure compliance with project schedules, safety procedures and legislation
Identify types and sources of radioactive waste;
Associate hazards and environmental impacts and safety considerations with the Nuclear Fuel Cycle;
Manage the risks
Develop licensing procedures and decommissioning strategy(s) (immediate/deferred dismantling)</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Practical test, Development of project, Situational judgment test, face to face examination, practical exercise, grid test with multiple choices.</td></tr>
</table>

Unit of learning outcomes No.2: SAFETY AND SECURITY / TU (3.1.1; 3.3.1; 3.8.1)	
Autonomy/Responsibility	
Manage complex activities of applying safety principles and requirement and safety and security management, taking responsibility for decision-making in unpredictable work contexts. Take responsibility for managing professional development of individuals and groups under their responsibility.	
Skills	**Knowledge**
K.2.1. Provide training and information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security K.2.2. Analyse and interpret the licensing requirements K.2.3. Identification of safety requirements K.2.4. Apply regulations issued by different authorities K.2.5. Review processes, systems and activities in the facilities K.2.6. Perform appropriate hazard and accident analysis K.2.7. Develop and document the safety function, functional performance requirements and performance criteria K.2.8. Prepare safety basis documents: Conceptual Safety Design Reports, Preliminary Safety Design Reports, Preliminary Documented Safety Analyses, Documented Safety Analyses and Technical Safety Requirements K.2.9. Monitor and control security, safeguard and non-proliferation requirements	K.2.1. National licensing requirements K.2.2. International regulations and standards K.2.3. Radiation protection (ALARA concept, dose commitment to workers and environment, radiation protection methods and tools) K.2.4. Industrial safety K.2.5. Safety culture K.2.6. Waste and transport safety K.2.7. Emergency preparedness K.2.8. Clearance of material and site release K.2.9. Nuclear security, safeguard and non-proliferation K.2.10. Radiological hazard analysis K.2.11. Risk assessment K.2.12. Environmental site remediation
Assessment criteria: Preparation of information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security Apply the regulations issued by different authorities taking into account interdependencies and interfaces Show compliance of licencing documents with the regulations Perform hazard and accident analysis Prepare safety-related documentation, technical reports	
Recommended assessment methods: Practical test, practical exercise, case study, situational judgment test.	

Unit of learning outcomes No.3: FACILITY MAINTENANCE/ SU (3.8.1)	
Autonomy/Responsibility	
Manage complex activities and projects, related to maintenance of specific nuclear facilities during decommissioning phase, taking responsibility for decision-making in unpredictable work or study contexts. Take responsibility for managing professional development of individuals and groups depending on their duties.	
Skills	**Knowledge**
S.3.1. Select the maintenance strategy(s) S.3.2. Select the maintenance technique(s) S.3.3. Design the maintenance program S.3.4. Search for new equipment and technology S.3.5. Conducting regular site visits to ensure optimal maintenance performance S.3.6. Oversee the installation, repair and maintenance of structures, systems and components S.3.7. Manage hazardous chemical and radioactive wastes	K.3.1. Plant systems including machines, mechanical systems, electrical systems, buildings and structures K.3.2. Mechanical and electrical maintenance K.3.3. Radioactive materials and waste fundamentals – characterization, processing, disposal, transportation K.3.4. Maintenance strategies: i.e.: reactive (RM), preventive (PM), predictive (PdM), proactive centered maintenance (PCM) K.3.5. Maintenance techniques: i.e.: condition monitoring (CM), reliability centered maintenance (RCM), Failure Modes & Effects Analysis (FMEA), Failure Modes, Effects, and Criticality Analyses (FMECA), Root Cause Failure Analysis (RCFA),Computerized Maintenance Management System (CMMS), Taxonomy
Assessment criteria: Design of maintenance strategies Apply maintenance techniques Supervision of maintenance work	Understanding of specific maintenance approaches, methods and techniques.
Recommended assessment methods: Grid test with multiple choices, in-video quizzes, practical exercise, peer review.	

5.6. Management of Radioactive Waste &RP (2.3.1)

<table>
<tr><th colspan="2">Unit of learning outcomes No.1: RADIATION PROTECTION/ TU (3.9.1;2.3.1; 3.7.1)</th></tr>
<tr><th colspan="2">Autonomy/Responsibility</th></tr>
<tr><td colspan="2">Manage complex activities, related to radioactive waste management and radiation protection aspects. Take responsibility for decision-making in routine and/or unpredictable work in relation with radiation protection expert. Take responsibility for managing professional development of individuals in radioactive waste management and radiation protection areas.</td></tr>
<tr><th>Skills</th><th>Knowledge</th></tr>
<tr><td>S.1.1. Develop specific provisions and procedures based on regulatory requirements on radioactive waste management
S.1.2. Implement ALARA principle to define optimised radiation protection actions
S.1.3. Confirm work permits
S.1.4. Optimize the occupational radiation protection programme
S.1.5. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation (design, operation or dismantling).
S.1.6. Develop radiation protection procedures and framework in normal and emergency cases
S.1.7. Use radiation control and measurement equipment
S.1.8. Develop technical specifications and procedures
S.1.9. Monitor and maintain a safe working environment
S.1.10. Apply appropriate radiation measurements for preliminary sample sorting
S.1.11. Identify appropriate shielding for radiation sources
S.1.12. Characterise radiation sources and identify appropriate protection strategies</td><td>K.1.1. The main types of ionizing radiation and their effects
K.1.2. Relevant national and international legislation and guidelines
K.1.3. Dose definition, dose types, dose measures, dose constraints and reference levels
K.1.4. Radiation monitoring, workplace monitoring and individual monitoring
K.1.5. Radiation protection programs
K.1.6. ALARA principle and procedures
K.1.7. Health surveillance
K.1.8. Radiological impacts on the environment
K.1.9. Contamination control, decontamination and reduction of sources of radiation
K.1.10. Classification of working areas and access control
K.1.11. Use of protective equipment such as shielding and protective clothing
K.1.12. Storage arrangements for radioactive/contaminated items
K.1.13. Emergency planning and emergency preparedness</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability in developing procedures and specifications
Capabilities in application of the ALARA implementation strategy
Successful management of emergency situations
Effectiveness of implementation of radiation protection programme
Sustainability of safety culture principles application
Compliance with legislation in radiation protection area
Realism of corrective measures evaluation</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Situational judgement tests
Case studies
Interview
Written test
Task solving</td></tr>
</table>

Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES /
TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Assume position and responsibility in emergency situations. Manage tasks prompt and reactive on changing situation in emergency case, distinguish and select the adequate data, stress control in emergency situation. Proper and prompt communication and reporting.

Skills	Knowledge
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.6. Mitigate the consequences of accidental situation S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.3. Several accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.6. Health protection K.2.7. Environmental protection K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements

Assessment criteria:

Ability for emergency planning and realisation of emergency plans
Ability to make decision in emergency situations
Adequacy of dose measures and use of radiation control equipment
Ability to evaluate the abnormal situation
Appropriateness of corrective actions
Ability to apply ALARA and safety culture principles
Behaviour in stress situations
Prompt reporting

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.3: TEAM AND PROJECT MANAGEMENT/ TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Taking responsibility for decision-making in daily operations and emergency situations in order to respect time schedule and costs for decommissioning installation. Take responsibility for managing professional development of individuals and groups under their responsibility. Take responsibility in strategic resource and workforce planning of the department. Manage and lead the team of professionals in radiation protection and waste management area in decommissioning phase.

Skills	Knowledge
S.3.1. Participate in recruitment process S.3.2. Plan initial and continuing specialised training for employees S.3.3. Allocate tasks and assign personnel S.3.4. Prioritise objectives S.3.5. Develop teamwork S.3.6. Anticipate and manage conflicts S.3.7. Evaluate individual and team performance S.3.8. Perform managerial communication S.3.9. Propose activities for building successful teams S.3.10. Promote individuals S.3.11. Respect and apply national and international legislation S.3.12. Promote safety culture, questioning attitude and rigorous and prudent approach S.3.13. Manage project	K.3.1. Organisation of human resources K.3.2. Social regulation K.3.3. Workforce planning and recruitment process K.3.4. Individual and team performance K.3.5. Managerial communication K.3.6. Team coordination and motivation K.3.7. Resolution of conflict K.3.8. Work planning K.3.9. Training solutions K.3.10. Change management K.3.11. Quality Management K.3.12. Integrated Management System (conformity with ISO) K.3.13. General principles of knowledge management K.3.14. General principles of configuration management K.3.15. Project management K.3.16. Budget, time and cost management K.3.17. Organizational changes from operation to decommissioning

Assessment criteria:

Ability to plan, schedule and control daily work activities
Pertinence of workforce planning and adequacy of recruitment activities
Ability to manage financial resources
Proper application of integrated management system
Accurate solutions for solving complex problems in unpredictable and emergency situations
Ability to apply national and international standards
Ability to plan radioactive waste activities in decommissioning project according to strategic priorities Pertinence of corrective actions to anticipate and reduce stress, and increase individual / team efficiency.
Appropriateness of managerial communication

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

Unit of learning outcomes No.4: Interaction with other nuclear actors/departments
TU (3.9.1;2.3.1; 3.7.1)

Autonomy/Responsibility

Interact with actors/departments involved in radioactive waste management, decomissioning phase of the NPP project. Taking responsibility for establishing and maintaining relationships with other departments, for participating decision-making in daily operations and emergency situations, for communicating the General Management decisions to the radioactive waste management team.

Skills	Knowledge
S.4.1. Integrate radwaste management strategy into the decommissioning plan S.4.2. Integrate radwaste management strategy into the overall management strategy of the plant S.4.3. Lead performance of complex analyses involving different facility's systems, structures, components and processes S.4.4. Perform proper communication in different areas of waste management S.4.5. Report activities and disseminate information S.4.6. Coordinate actors in waste management activities S.4.7. Share knowledge, information and experiences S.4.8. Analyse and upgrade decommissioning plans	K.4.1. General plant description and basic technical characteristics of nuclear facilities K.4.2. Nuclear fuel cycle K.4.3. Safety systems operation K.4.4. Radioactive waste treatment systems operation K.4.5. Applicable codes, regulations and standards for decommissioning phase K.4.6. Knowledge of plant (site, units') operational history K.4.7. Safety Analysis Report (SAR) K.4.8. Dismantling methods and techniques K.4.9. Key issues of facilities' maintenance, surveillance and inspection. Facility modifications K.4.10. Radiological characterization of the facility K.4.11. Decontamination techniques for equipment and SSCs K.4.12. Waste categorisation K.4.13. Knowledge management

Assessment criteria:

Ability to organise and share knowledge, information and experiences
Taking in account professional environment and constraints of design, technological systems and processes
Compliance with safety standards, legislation and company policy
Pertinence of plant key performance indicators
Performance and effectiveness of business processes
Accuracy of reports
Pertinence of decommissioning plans analyse and upgrading

Recommended assessment methods:

Interview
Situational judgement tests
Case studies
Task solving
Written exam

<table>
<tr><td colspan="2">Unit of learning outcomes No.5: EVALUATION AND OPTIMISATION OF INDIVIDUAL AND COLLECTIVE DOSES/ BU (3.9.1 ; 2.3.1)</td></tr>
<tr><td colspan="2">Autonomy/Responsibility</td></tr>
<tr><td colspan="2">Manage complex activities concerning evaluation of individual and collective exposures (internal and external). Take responsibility for radiation protection actions implemented with respect to ALARA principle, regulation and rules. Advice other teams on radiation protection issues concerning decommissioning project.</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>S.5.1. Monitor decommissioned areas
S.5.2. Evaluate dose rates and radioactive contamination
S.5.3. Evaluate the radiation situation
S.5.4. Evaluate problems regarding radiation protection and dosimetry
S.5.5. Ensure the maintenance of radiation protection instruments and materials
S.5.6. Optimise radiation protection methods and techniques for decommissioning
S.5.7. Provide information about radiological situation
S.5.8. Analyse and upgrade decommissioning plans
S.5.9. Comply with legal requirements of radiation protection and dosimetry in national regulations and rules
S.5.10. Recommend personal and collective protective equipment</td><td>K.5.1. Measurement of radioactive characteristics
K.5.2. Detectors for radiation monitoring
K.5.3. Dosimetry (limits and norms)
K.5.4. Radiation protection measures and technics
K.5.5. Statistical assessment of data
K.5.6. Modelling and simulation codes applied in dosimetry
K.5.7. ALARA principles
K.5.8. Nuclid vectors identification
K.5.9. Stochastic approach in radiation impact
K.5.10. Biological impacts of radiation doses</td></tr>
<tr><td colspan="2">Assessment criteria:
Ability to manage operational dosimetry data (cartography, computer modelling…).
Ability to determine supervised and controlled areas.
Pertinence of identification, quantification, and assessment of ionising radiations source term in decommissioned installation.
Ability to identify, quantify and select optimal radiation protection action with respect to ALARA procedure</td></tr>
<tr><td colspan="2">Recommended assessment methods:
Interview
Situational judgement tests
Case studies
Task solving
Written exam</td></tr>
</table>

Unit of learning outcomes No.6: Management of health, radiological and environmental risks / BU (3.9.1; 2.3.1)

Autonomy/Responsibility

Perform and manage complex tasks to ensure compliance with national and international regulations and standards concerning management of health, radiological and environmental risks. Take responsibility for actions related to health in relation with medical service, radiological and environmental risks

Skills		Knowledge	
S.6.1.	Evaluate health and radiological risks	K.6.1.	Risks assessment and management
S.6.2.	Evaluate environmental risks	K.6.2.	Health and environmental standards, codes and guidelines
S.6.3.	Apply risks assessment methods in decommissioning	K.6.3.	Biological acceptance of irradiation
S.6.4.	Provide internal information about risks assessment	K.6.4.	Health protection
S.6.5.	Undertake corrective measures	K.6.5.	Environmental protection
S.6.6.	Harmonise health and regulatory requirements	K.6.6.	Radiation protection measures and technics
S.6.7.	Propose and implement corrective and preventive actions related to radiological and/or conventional risks	K.6.7.	Human behaviour related to health, radiological, and environmental risks
S.6.8.	Inform and/or train work teams to global approach "Health Safety Environment"	K.6.8.	Individual and collective protective equipment
S.6.9.	Participate in workplace studies with related health, safety and medical department	K.6.9.	Management of health, radiological, and environmental data
S.6.10.	Create and use of health, radiological, and environmental databases	K.6.10.	Train the trainers methodology

Assessment criteria:

Ability to identify, quantify, assess and implement actions for safety hazards and risks

Effective reporting to the company management related to health, radiological and environmental risks

Ability to lead measures and procedures on health effects and risk assessment and management methods for nuclear installation in decommissioning.

Pertinence of individual and collective protective measures

Pertinence of data management

Efficiency of training

Recommended assessment methods:

Interview

Situational judgement tests

Case studies

Task solving

Written exam

Unit of learning outcomes No.7: RADIOACTIVE WASTE MANAGEMENT/ BU (2.3.1; 3.7.1)	
Autonomy/Responsibility	
Manage complex activities related to radioactive waste management including handling, treatment and storage. Take responsibility for decisions related to technologies, processes, nuclear and industrial safety as well as impact to environment.	
Skills	Knowledge
S.7.1. Evaluate and control the level of contamination and induced activities of radioactive waste S.7.2. Select optimal solution and manage radioactive waste categorisation S.7.3. Manage radioactive waste handling and transport S.7.4. Apply proper techniques for optimal storage of waste S.7.5. Apply proper criteria for treated waste classification and handling S.7.6. Evaluate and manage collected data about waste characteristics S.7.7. Ensure radiation protection support for waste manipulation and storage S.7.8. Evaluate radiation situation in decontamination, handling, transport and storage process S.7.9. Comply activities with national program in decommissioning S.7.10. Developing waste management program, specifications and procedures S.7.11. Apply appropriate solutions in packaging	K.7.1. Waste characterisation and categorisation K.7.2. Dosimetry K.7.3. Nuclear safety and radiation protection K.7.4. Relevant national and international legislation and guidelines K.7.5. Health protection K.7.6. Environmental protection K.7.7. Nuclear safety culture and human factor K.7.8. Protective clothing and protective equipment K.7.9. Transport, handling and storage of radioactive waste K.7.10. Treatment and long term storage K.7.11. National policy and program in decommissioning K.7.12. Waste conditioning including packaging
Assessment criteria: Accurate characterisation of radioactive waste Respect rules of radioactive waste handling and transport Proper use of radiation control equipment Pertinence of specifications and procedures proposals	Ability to approve radiation protection measures Compliance with international and national legislation
Recommended assessment methods: Written test Interview Situational judgement tests Case studies Task solving	

Annex 6: The description of learning modules within the targeted qualifications

6.1 Radioactive Waste Management *(3.7.1)*

Unit of learning outcomes No.1: RADIATION PROTECTION/ TU(3.9.1;2.3.1; 3.7.1)		
M1.1: Radiation sources and tools for registration - TM		**Remarks/limits/ advices**
S.1.1. Develop specific provisions and procedures based on regulatory requirements on radioactive waste management S.1.6. Develop radiation protection procedures and framework in normal and emergency cases S.1.12. Characterise radiation sources and identify appropriate protection strategies	K.1.1. The main types of ionizing radiation and their effects K.1.2. Relevant national and international legislation and guidelines K.1.3. Dose definition, dose types, dose measures, dose constraints and reference levels K.1.10.Classification of working areas and access control	Basic experience in nuclear installation is recommended.
M1.2: Control and measurement in radiation protection - TM		**Remarks/limits/ advices**
S.1.7. Use radiation control and measurement equipment S.1.8. Develop technical specifications and procedures S.1.9. Monitor and maintain a safe working environment S.1.10. Apply appropriate radiation measurements for preliminary sample sorting	K.1.4. Radiation monitoring, workplace monitoring and individual monitoring K.1.9. Contamination control, decontamination and reduction of sources of radiation	Prerequisite: M1.1
M1.3: Radiation protection implementation - TM		**Remarks/limits/ advices**
S.1.2. Implement ALARA principle to define optimised radiation protection actions S.1.3. Confirm work permits S.1.4. Optimize the occupational radiation protection programme S.1.5. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation S.1.11. Identify appropriate shielding for radiation sources	K.1.5. Radiation protection programs K.1.6. ALARA principle and procedures K.1.7. Health surveillance K.1.8. Radiological impacts on the environment K.1.11 Use of protective equipment such as shielding and protective clothing K.1.12 Storage arrangements for radioactive/contaminated items K.1.13 Emergency planning and emergency preparedness	Prerequisite: M1.2 Experience from radiation protection is expected.

Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES / TU(3.9.1;2.3.1; 3.7.1)		
M2.1: Nuclear safety fundamentals and safety assessment - TM		**Remarks/limits/advices**
S.2.6. Mitigate the consequences of accidental situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.3. Severe accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements	Basic skills and knowledge. Defense in depth is embedded in K.2.4 Determistic and probabilistic safety analysis is embedded in K.2.15
M2.2: Emergency measures - TM		**Remarks/limits/advices**
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.6. Health protection K.2.7. Environmental protection K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control	Prerequisite: M2.1

Unit of learning outcomes No.3: TEAM AND PROJECT MANAGEMENT/ TU(3.9.1;2.3.1; 3.7.1)	
M3.1: Recruitment and work organisation - TM	
S.3.1. Participate in recruitment process S.3.3. Allocate tasks and assign personnel S.3.4. Prioritise objectives S.3.10. Perform managerial communication	K.3.1. Organisation of human resources K.3.2. Social regulation K.3.3. Recruitment process K.3.6. Managerial communication K.3.9. Work planning K.3.14. Organizational changes from operation to decommissioning K.3.16. Policies and key issues of facilities' maintenance, surveillance and inspection. Facility modifications; basics of configuration management
M3.2 :Team coaching - TM	
S.3.5. Develop teamwork S.3.6. Propose activities for building successful teams S.3.2. Plan training S.3.7. Anticipate and manage conflicts S.3.11. Promote safety culture and learning attitude towards safety S.3.8. Evaluate individual and team performance S.3.9. Promote individuals	K.3.4. Individual and team performance K.3.7. Team coordination and motivation K.3.8. Resolution of conflict K.3.10. Training solutions K.3.5. Change management K.3.12 Quality Management K.3.13 Knowledge Management
M3.3 : Project management - TM	
S.3.12. Monitor project	K.3.5. Project management K.3.14 Budget, time and cost management

Unit of learning outcomes No.4: INTERACTION WITH OTHER NUCLEAR ACTORS/DEPARTMENTS TU(3.9.1;2.3.1; 3.7.1)	
M4.1: INTERACTION WITH OTHER NUCLEAR ACTORS/DEPARTMENTS	
S.4.1. Integrate radwaste management strategy into the decommissioning plan S.4.2. Integrate radwaste management strategy into the overall management strategy of the plant S.4.3. Lead performance of complex analyses involving different facility's systems, structures, components and processes S.4.4. Perform proper communication in different areas of waste management S.4.5. Report activities and disseminate information S.4.6. Coordinate actors in waste management activities S.4.7. Share knowledge, information and experiences S.4.8. Analyse and upgrade decommissioning plans	K.4.1. General plant description and basic technical characteristics of nuclear facilities K.4.2. Nuclear fuel cycle K.4.3. Safety systems operation K.4.4. Radioactive waste treatment systems operation K.4.5. Applicable codes, regulations and standards for decommissioning phase K.4.6. Knowledge of plant (site, units) operational history K.4.7. Safety Analysis Report (SAR) K.4.8. Dismantling methods and techniques K.4.9. Key issues of facilities' maintenance, surveillance and inspection ; facility modifications K.4.10. Radiological characterization of the facility K.4.11. Decontamination techniques for equipment and SSCs K.4.12. Waste categorisation

Unit of learning outcomes No.5: DECOMMISSIONING MANAGEMENT/ SU (3.7.1.)		
M5.1: Decommissioning management		**Remarks/limits/advices**
S.5.1. Participate and/or organize decommissioning activities S.5.2. Organise decommissioning work S.5.3. Prioritise objectives S.5.4. Use the optimal tools and technology in decommissioning S.5.5. Evaluate efficiency of decontamination S.5.6. Monitor waste accumulation and transport	K.5.1. Waste origin and handlings K.5.2. Contamination, decontamination K.5.3. Decontamination technologies and tools K.5.4. Radioecology and environmental remediation K.5.5. Partitioning and compacting K.5.6. Decommissioning procedures K.5.7. Limits for free release K.5.8. Prediction and simulating of activation	This module will be merge with "decommissioning of nuclear installations" related to Unit " Management of decommissioning projects – TU"

Unit of learning outcomes No.6: RADIOACTIVE WASTE MANAGEMENT/ BU(3.7.1 ; 2.3.1)		
M6.1: Handling and transport radioactive waste		**Remarks/limits**
S.6.1. Evaluate and control the level of contamination and induced activities of radioactive waste S.6.2. Select optimal solution and manage radioactive waste categorisation S.6.3. Manage radioactive waste handling and transport S.6.5 Apply proper criteria for treated waste classification and handling S.6.6. Evaluate and manage collected data about waste characteristics S.6.9. Comply activities with national program in decommissioning S.6.10. Developing waste management program, specifications and procedures S.6.11. Apply appropriate solutions in packaging	K.6.1. Waste characterisation and categorisation K.6.2. Dosimetry K.6.3. Nuclear safety and radiation protection K.6.5. Health protection K.6.6. Environmental protection K.6.7. Nuclear safety culture and human factor K.6.8. Protective clothing and protective equipment K.6.9. Transport, handling and storage of radioactive waste K.6.12. Waste conditioning including packaging	
M6.2: Storage radioactive waste		
S.6.4. Apply proper techniques for optimal storage of waste S.6.7. Ensure radiation protection support for waste manipulation and storage S.6.8. Evaluate radiation situation in decontamination, handling, transport and storage process	K.6.4. Relevant national and international legislation and guidelines K.6.10. Treatment and long term storage K.6.11. National policy and program in decommissioning	M7.1 is recommended as a prerequisite

6.2 Preparatory work Management (3.3.1)

Unit 1: MANAGEMENT OF DECOMMISSIONING PROJECTS/ TU (3.1.1; 3.3.1; 3.8.1)	
M1.1: Project Management	
S.1.1. Coordinate planning, scheduling, implementing and monitoring activities and projects S.1.2. Manage resources involved in the project S.1.4. Perform risk estimation and management and cost control. S.1.5. Select contractors and establish contracts S.1.7. Intervene, analyse, manage and resolve business and technical conflicts between the company and the contractors	K.1.4. Risk estimation and management K.1.5. Management and workflow of the project K.1.6. Information technology K.1.12. Decommissioning funds and financial mechanism
M1.2: Decommissioning of nuclear instalations	
S.1.3. Monitor implementation of plans and procedures to ensure compliance with safety procedures and legislation S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures S.1.8. Develop procedures and obtain permits (licensing for decommissioning)	K.1.1. Decommissioning methodology, techniques and strategies K.1.2. Environmental impact of nuclear power; K.1.3. Remediation methods; K.1.7. Nuclear decommission practices: clean up of radioactivity (remediation) and plant demolition K.1.8. Radioactivity and nuclear science and engineering K.1.9. Management of civil engineering operations K.1.10. Decommissioning regulation and licensing: site characterization, dismantlement activities, plans for site remediation, detailed plans for final radiation surveys for release of the site, environmental change.

Unit 2: SAFETY AND SECURITY / TU (3.1.1; 3.3.1; 3.8.1)		
M2.1: Safety and risk analysis		**Remarks/limits**
S.2.4. Apply regulations issued by different authorities S.2.7. Perform appropriate hazard and accident analysis	K.2.2. National and international regulations and standards K.2.4. Industrial safety K.2.11. Risk assessment	Safety culture is about attitude that is why Safety culture should be emphasized in each unit of a qualification in the A/R box and not as a training module.
M2.2: Nuclear and radiological safety		
S.2.1. Provide training and information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security S.2.2. Analyse and interpret the licensing requirements S.2.3. Identification of safety requirements S.2.6. Review processes, systems and activities in the facilities S.5.8. Develop and document the safety function, functional performance requirements and performance criteria S.2.10. Prepare safety basis documents: Conceptual Safety Design Reports, Preliminary Safety Design Reports, Preliminary Documented Safety Analyses, Documented Safety Analyses and Technical Safety Requirements	K.2.1. National licensing requirements K.2.6. Waste and transport safety K.2.7. Emergency preparedness K.2.8. Clearance of material and site release K.2.12. Environmental site remediation K.2.3. Radiation protection (ALARA concept, dose commitment to workers and environment, radiation protection methods and tools) K.2.10. Radiological hazard analysis	
M2.3: Security		
S.2.11. Monitor and control security, safeguard and non-proliferation requirements	K.2.9. Nuclear security, safeguard and non-proliferation	

Unit 3: OPERATION, MAINTANANCE AND ENGINEERING SUPPORT/ SU 3.3.1	
M3.1: Operation	
S.3.1. Plan, implement, co-ordinate and monitor operation activities S.3.5. Provide technical information for operation, activities	K.3.1. Decommissioning methodology K.3.2. Electrical and mechanical installations K.3.3. Radioactive waste treatment systems K.3.4. Process System engineering and design K.3.5. Electrical engineering and design K.3.6. Mechanical engineering and design K.3.7. HVAC engineering and design K.3.8. Fire protection engineering and design K.3.10. Engineering principles (i.e. mechanical, electrical, instrumentation and control) K.3.11. Site specific rules and procedures (permit to work, standard operating & maintenance procedures and risk assessment etc.)
M3.2: Maintenance	
S.3.2. Plan, implement, co-ordinate and monitor maintenance activities S.3.6. Provide technical information for maintenance, activities	K.3.1. Decommissioning methodology K.3.2. Electrical and mechanical installations K.3.3. Radioactive waste treatment systems K.3.4. Process System engineering and design K.3.5. Electrical engineering and design K.3.6. Mechanical engineering and design K.3.7. HVAC engineering and design K.3.8. Fire protection engineering and design K.3.9. Techniques and methodologies of decontamination within scope K.3.10. Engineering principles (i.e. mechanical, electrical, instrumentation and control) K.3.11. Site specific rules and procedures (permit to work, standard operating & maintenance procedures and risk assessment etc.) K.3.12. Equipment and system operating and maintenance instructions
M3.3: Engineering support	
S.3.3.Plan, implement, co-ordinate and monitor engineering support activities S.3.6.Provide technical information for engineering support activities S.3.7.Draft work instructions related to engineering support S.3.7.Specify functional requirements S.3.8.Understanding of complex regulations and procedures S.3.9.Perform inspection, evaluation and control of works S.3.11.Specify design requirements S.3.12.Assess design options S.3.13.Document design modifications S.3.15.Draft technical specification and requirements S.3.16. Use and interpret engineering drawings and documents	K.3.1. Decommissioning methodology K.3.2. Electrical and mechanical installations K.3.3. Radioactive waste treatment systems K.3.4. Process System engineering and design K.3.5. Electrical engineering and design K.3.6. Mechanical engineering and design K.3.7. HVAC engineering and design K.3.8. Fire protection engineering and design K.3.10. Engineering principles (i.e. mechanical, electrical, instrumentation and control)
Remark: The knowledge listed for operation, maintenance and engineering support should be adapted to the particularities of each activity.	
Unit 4: PREPARATORY WORK AND SPENT FUEL/ SU 3.3.1	
M4.1: Spent fuel	
S.4.1. Organize treatment of damaged fuel elements S.4.2. Defining engineering processes S.4.3. Draft technical specifications and working documents related to decommissioning activities and spent fuel management S.4.4. Identify and analyse radiological incidents S.4.5. Report technical and regulatory data according to standard operating procedures S.4.6. Organise and monitor storage, handling, packaging and transport of spent fuel	K.4.1. Nuclear physics fundamentals K.4.6. Nuclear standards K.4.10.Inspection of spent fuel assemblies and special conditioning of damaged elements K.4.11. Spent fuel management, including damaged fuel elements K.4.12. Spent fuel transport (preparation of packaging,) K.4.4. Nuclear safety (criticality, heat generation, radiolysis)
M4.2: Preparatory work on the decommissioning site	
S.4.7. Planning, implementing, coordinating and monitoring engineering activities S.4.8. Plan decommissioning site preparation S.4.9. Prepare controlled work areas for decommissioning activities and Design Radiation protection barriers S.4.10. Implement design modifications S.4.11. Apply defense in depth principle in design	K.4.2. Nuclear engineering K.4.5. Radiation fundamentals K.4.3. Nuclear installation systems and components K.4.7. Decommissioning techniques K.4.8. Chemical Engineering and Waste Management K.4.9. Radioactive waste handling and storage

6.3 Radiation Protection Expert (3.9.1)

Unit of learning outcomes No.1: RADIATION PROTECTION/TU(3.9.1;2.3.1; 3.7.1)		
M1.1: Radiation sources and tools for registration - TM		**Remarks/limits**
S.1.1. Develop specific provisions and procedures based on regulatory requirements on radioactive waste management S.1.6. Develop radiation protection procedures and framework in normal and emergency cases S.1.12. Characterise radiation sources and identify appropriate protection strategies	K.1.1. The main types of ionizing radiation and their effects K.1.2. Relevant national and international legislation and guidelines K.1.3. Dose definition, dose types, dose measures, dose constraints and reference levels K.1.10. Classification of working areas and access control	Basic experience in nuclear installation is recommended.
M1.2: Control and measurement in radiation protection - TM		**Remarks/limits**
S.1.7. Use radiation control and measurement equipment S.1.8. Develop technical specifications and procedures S.1.9. Monitor and maintain a safe working environment S.1.10. Apply appropriate radiation measurements for preliminary sample sorting	K.1.4. Radiation monitoring, workplace monitoring and individual monitoring K.1.9. Contamination control, decontamination and reduction of sources of radiation	Prerequisite: M1.1
M1.3: Radiation protection implementation - TM		**Remarks/limits**
S.1.2. Implement ALARA principle to define optimised radiation protection actions S.1.3. Confirm work permits S.1.4. Optimize the occupational radiation protection programme S.1.5. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation S.1.11. Identify appropriate shielding for radiation sources	K.1.5. Radiation protection programs K.1.6. ALARA principle and procedures K.1.7. Health surveillance K.1.8. Radiological impacts on the environment K.1.11. Use of protective equipment such as shielding and protective clothing K.1.12. Storage arrangements for radioactive/contaminated items K.1.13. Emergency planning and emergency preparedness	Prerequisite: M1.2 Experience from radiation protection is expected.
Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES/ TU(3.9.1;2.3.1; 3.7.1)		
M2.1: Nuclear safety fundamentals and safety assessment		**Remarks/limits**
S.2.6. Mitigate the consequences of accidental situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.3. Severe accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements	Basic skills and knowledge. Defense in depth is embedded in K.2.4 Determistic and probabilistic safety analysis is embedded in K.2.15
M2.2: Emergency measures		**Remarks/limits**
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.6. Health protection K.2.7. Environmental protection K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control	Prerequisite: M2.1

Unit of learning outcomes No.3: TEAM AND PROJECT MANAGEMENT / TU(3.9.1;2.3.1; 3.7.1)	
M3.1: Recruitment and work organisation	
S.3.1. Participate in recruitment process S.3.3. Allocate tasks and assign personnel S.3.4. Prioritise objectives S.3.10. Perform managerial communication	K.3.1. Organisation of human resources K.3.2. Social regulation K.3.3. Recruitment process K.3.6. Managerial communication K.3.9. Work planning K.3.14. Organizational changes from operation to decommissioning K.3.16. Policies and key issues of facilities' maintenance, surveillance and inspection. Facility modifications; basics of configuration management
M3.2 :Team coaching	
S.3.5. Develop teamwork S.3.6. Propose activities for building successful teams S.3.2. Plan training S.3.7. Anticipate and manage conflicts S.3.11. Promote safety culture and learning attitude towards safety S.3.8. Evaluate individual and team performance S.3.9. Promote individuals	K.3.4. Individual and team performance K.3.7. Team coordination and motivation K.3.8. Resolution of conflict K.3.10. Training solutions K.3.5. Change management K.3.12 Quality Management K.3.13 Knowledge Management
M3.3 : Project management	
S.3.12. Monitor project	K.3.5. Project management K.3.14 Budget, time and cost management

Unit of learning outcomes No.4: INTERACTION WITH OTHER NUCLEAR ACTORS/DEPARTMENTS - TM	
M4.1: INTERACTION WITH OTHER NUCLEAR ACTORS/DEPARTMENTS	
S.4.1. Integrate radwaste management strategy into the decommissioning plan S.4.2. Integrate radwaste management strategy into the overall management strategy of the plant S.4.3. Lead performance of complex analyses involving different facility's systems, structures, components and processes S.4.4. Perform proper communication in different areas of waste management S.4.5. Report activities and disseminate information S.4.6. Coordinate actors in waste management activities S.4.7. Share knowledge, information and experiences S.4.8. Analyse and upgrade decommissioning plans	K.4.1. General plant description and basic technical characteristics of nuclear facilities K.4.2. Nuclear fuel cycle K.4.3. Safety systems operation K.4.4. Radioactive waste treatment systems operation K.4.5. Applicable codes, regulations and standards for decommissioning phase K.4.6. Knowledge of plant (site, units) operational history K.4.7. Safety Analysis Report (SAR) K.4.8. Dismantling methods and techniques K.4.9. Key issues of facilities' maintenance, surveillance and inspection ; facility modifications K.4.10. Radiological characterization of the facility K.4.11. Decontamination techniques for equipment and SSCs K.4.12. Waste categorisation K.4.13. Knowledge management

Unit of learning outcomes No.5: EVALUATION AND OPTIMISATION OF INDIVIDUAL AND COLLECTIVE DOSES / BU (3.9.1; 2.3.1)	
M5.1: EVALUATION AND OPTIMISATION OF INDIVIDUAL AND COLLECTIVE DOSES	
S.5.1. Monitor decommissioned areas S.5.2. Evaluate dose rates and radioactive contamination S.5.3. Evaluate the radiation situation S.5.4. Evaluate problems regarding radiation protection and dosimetry S.5.5. Ensure the maintenance of radiation protection instruments and materials S.5.6. Optimise radiation protection methods and techniques for decommissioning S.5.7. Provide information about radiological situation S.5.8. Analyse and upgrade decommissioning plans S.5.9. Comply with legal requirements of radiation protection and dosimetry in national regulations and rules S.5.10. Recommend personal and collective protective equipment	K.5.1. Measurement of radioactive characteristics K.5.2. Detectors for radiation monitoring K.5.3. Dosimetry (limits and norms) K.5.4. Radiation protection measures and technics K.5.5. Statistical assessment of data K.5.6. Modelling and simulation codes applied in dosimetry K.5.7. ALARA principles K.5.8. Radionuclide vectors identification K.5.9. Stochastic approach in radiation impact K.5.10. Biological impacts of radiation doses

Unit of learning outcomes No.6: MANAGEMENT OF HEALTH, RADIOLOGICAL AND ENVIRONMENTAL RISKS / BU (3.9.1; 2.3.1)	
M6.1: Management of health, radiological and environmental risks	
S.6.1. Evaluate health and radiological risks S.6.2. Evaluate environmental risks S.6.3. Apply risks assessment methods in decommissioning S.6.4. Provide internal information about risks assessment S.6.5. Undertake corrective measures S.6.6. Harmonise health and regulatory requirements S.6.7. Propose and implement corrective and preventive actions related to radiological and/or conventional risks S.6.8. Inform and/or train work teams to global approach "Health Safety Environment" S.6.9. Participate in workplace studies related to health, safety and medical department S.6.10. Create and use of health, radiological, and environmental databases	K.6.1. Risks assessment and management K.6.2. Health and environmental standards, codes and guidelines K.6.3. Biological acceptance of irradiation K.6.4. Health protection K.6.5. Environmental protection K.6.6. Radiation protection measures and technics K.6.7. Human behaviour related to health, radiological, and environmental risks K.6.8. Individual and collective protective equipment K.6.9. Management of health, radiological, and environmental data K.6.10. Train the trainers methodology

6.4 Management of maintenance in decommissioning *(3.8.1.)*

Unit 1: MANAGEMENT OF DECOMMISSIONING PROJECTS/ TU (3.1.1; 3.3.1; 3.8.1)	
M1.1: Project Management	
S.1.1. Coordinate planning, scheduling, implementing and monitoring activities and projects S.1.2. Manage resources involved in the project S.1.4. Perform risk estimation and management and cost control. S.1.5. Select contractors and establish contracts S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures S.1.7. Intervene, analyse, manage and resolve business and technical conflicts between the company and the contractors	K.1.4. Risk estimation and management K.1.5. Management and workflow of the project K.1.6. Information technology K.1.12. Decommissioning funds and financial mechanism
M1.2: Decommissioning of nuclear instalations	
S.1.3. Monitor implementation of plans and procedures to ensure compliance with safety procedures and legislation S.1.6. Develop decommissioning project specifications, scopes-of-work, and prepare tender procedures S.1.8. Develop procedures and obtain permits (licensing for decommissioning)	K.1.1. Decommissioning methodology, techniques and strategies K.1.2. Environmental impact of nuclear power; K.1.3. Remediation methods; K.1.7. Nuclear decommission practices: clean up of radioactivity (remediation) and plant demolition K.1.8. Radioactivity and nuclear science and engineering K.1.9. Management of civil engineering operations K.1.10. Decommissioning regulation and licensing: site characterization, dismantlement activities, plans for site remediation, detailed plans for final radiation surveys for release of the site, environmental change.
Unit 2: SAFETY AND SECURITY/ TU (3.1.1; 3.3.1; 3.8.1)	
M2.1: Safety and risk analysis	
S.2.4. Apply regulations issued by different authorities S.2.7. Perform appropriate hazard and accident analysis	K.2.2. National and international regulations and standards K.2.4. Industrial safety K.2.10. Risk assessment
M2.2: Nuclear and radiological safety	
S.2.1. Provide training and information about the special procedures as emergency, potential risks on workers' health, nuclear safety and security S.2.2. Analyse and interpret the licensing requirements S.2.3. Identification of safety requirements S.2.6. Review processes, systems and activities in the facilities S.5.8. Develop and document the safety function, functional performance requirements and performance criteria S.2.10. Prepare safety basis documents: Conceptual Safety Design Reports, Preliminary Safety Design Reports, Preliminary Documented Safety Analyses, Documented Safety Analyses	K.2.1. National licensing requirements K.2.3. Radiation protection (ALARA concept, dose commitment to workers and environment, radiation protection methods and tools) K.2.6. Waste and transport safety K.2.7. Emergency preparedness K.2.8. Clearance of material and site release K.2.12. Environmental site remediation K.2.11. Radiological hazard analysis
M2.3: Security	
S.2.11. Monitor and control security, safeguard and non-proliferation requirements	K.2.8. Nuclear security, safeguard and non-proliferation

Unit 3: FACILITY MAINTENANCE/ SU 3.8.1	
M3.1: Development of maintenance programs	
S.3.1. Select the maintenance strategy(s) S.3.2. Select the maintenance technique(s) S.3.3. Design the maintenance program S.3.4. Search for new equipment and technology	K.3.6. Maintenance strategies: i.e.: reactive (RM), preventive (PM), predictive (PdM), proactive centered maintenance (PCM) K.3.7. Maintenance techniques: i.e.: condition monitoring (CM), reliability centered maintenance (RCM), Failure Modes & Effects Analysis (FMEA), Failure Modes, Effects, and Criticality Analyses (FMECA), Root Cause Failure Analysis (RCFA), Computerized Maintenance Management System (CMMS), Taxonomy
M3.2: Conducting maintenance	
S.3.5. Conducting regular site visits to ensure optimal maintenance performance S.3.6. Oversee the installation, repair and maintenance of structures, systems and components	K.3.1. Plant systems including machines, mechanical systems, electrical systems, buildings and structures K.3.3. Mechanical and electrical maintenance
M3.3: Waste management	
S.3.7. Manage hazardous chemical and radioactive wastes	K.3.4. Radioactive materials and waste fundamentals – characterization, processing, disposal, transportation

6.5 Management of Radioactive Waste &RP (2.3.1)

Unit of learning outcomes No.1: RADIATION PROTECTION TU (3.9.1;2.3.1; 3.7.1)		
M1.1: Radiation sources and tools for registration - TM		**Remarks/limits**
S.1.1. Develop specific provisions and procedures based on regulatory requirements on radioactive waste management S.1.6. Develop radiation protection procedures and framework in normal and emergency cases S.1.12. Characterise radiation sources and identify appropriate protection strategies	K.1.1. The main types of ionizing radiation and their effects K.1.2. Relevant national and international legislation and guidelines K.1.3. Dose definition, dose types, dose measures, dose constraints and reference levels K.1.10 Classification of working areas and access control	Basic experience in nuclear installation is recommended.
M1.2: Control and measurement in radiation protection - TM		**Remarks/limits**
S.1.7. Use radiation control and measurement equipment S.1.8. Develop technical specifications and procedures S.1.9. Monitor and maintain a safe working environment S.1.10. Apply appropriate radiation measurements for preliminary sample sorting	K.1.4. Radiation monitoring, workplace monitoring and individual monitoring K.1.9. Contamination control, decontamination and reduction of sources of radiation	Prerequisite: M1.1
M1.3: Radiation protection implementation - TM		**Remarks/limits**
S.1.2. Implement ALARA principle to define optimised radiation protection actions S.1.3. Confirm work permits S.1.4. Optimize the occupational radiation protection programme S.1.5. Define and/or apply principle strategies of a radiation protection programme during various phases of a nuclear installation S.1.11. Identify appropriate shielding for radiation sources	K.1.5. Radiation protection programs K.1.6. ALARA principle and procedures K.1.7. Health surveillance K.1.8. Radiological impacts on the environment K.1.11 Use of protective equipment such as shielding and protective clothing K.1.12 Storage arrangements for radioactive/contaminated items K.1.13 Emergency planning and emergency preparedness	Prerequisite: M1.2 Experience from radiation protection is expected.

Unit of learning outcomes No.2: ACCIDENTS AND EMERGENCY ISSUES TU (3.9.1;2.3.1; 3.7.1)		
M2.1: Nuclear safety fundamentals and safety assessment		**Remarks/limits**
S.2.6. Mitigate the consequences of accidental situation S.2.12. Implement protective actions for incidental and accidental conditions S.2.13. Participate in accident event analysis S.2.14. Identify root causes S.2.15. Classify events (INES) S.2.16. Implement corrective measures	K.2.3. Severe accident management K.2.4. Nuclear safety approaches, principles and requirements K.2.5. Relevant national and international legislation and guidelines K.2.8. Nuclear safety culture and human factor K.2.9. Nuclear facility components and systems K.2.14. International Nuclear Event Scale (INES) K.2.15. Safety assessment requirements	Basic skills and knowledge. Defense in depth is embedded in K.2.4 Determistic and probabilistic safety analysis is embedded in K.2.15
M2.2: Emergency measures		**Remarks/limits**
S.2.1. Ensure execution of emergency plans S.2.2. Identify and detect emergency or hazards S.2.3. Monitor radiation situation in emergency case S.2.4. Preparing emergency plans S.2.5. Prepare emergency exercises S.2.7. Protect personnel in restricted areas as well as on site S.2.8. Provide correct and prompt information to organisations and public S.2.9. Evaluate radiation situation in emergency case S.2.10. Predict next development of emergency case S.2.11. Rate abnormal situation	K.2.1. Emergency preparedness K.2.2. Emergency planning K.2.6. Health protection K.2.7. Environmental protection K.2.10. Radiation ecology K.2.11. Contamination and decontamination K.2.12. Protective clothing and protective equipment K.2.13. Classification of area and access control	Prerequisite: M2.1

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