Developing Competence Based Qualification System in the Nuclear Energy Sector

Mihail Ceclan

1 Introduction

In a changing world, the EU needs to develop a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the Member States deliver high levels of employment, productivity and social cohesion.

Adapting the education and training systems across Europe is crucial for the accomplishment of these objectives. This adaptation should aim to facilitate lifelong learning, mobility and flexible learning pathways, and comply more efficiently with the demands of the labour market. In this context the "Europe 2020" strategy is the EU's growth strategy for the coming decade *[1]*[1].

A strategic framework for European cooperation in education and training (ET 2020) *[2]* was set up in order to achieve the modernization of the education systems at all levels (school, vocational and higher education) and the promotion of lifelong learning.

Developing the competence-based qualification system for the nuclear energy sector is part of achieving the four freedoms of a free market: free movement of goods, services, capitals and workers. In particular, CB-QS addresses the achievement of the 4th freedom: the free movement of the workers.

In this context, ***the challenge is to achieve the EU Single Market as a fully functional free market.*** The EU Single Market is one territory without any internal borders or other regulatory obstacles which accounts for 510 million consumers and 21 million SMEs.

This paper is the continuation of the previous article published in atw-International Journal for Nuclear Power *[3]* and presents the *JRC-IET's* outcomes in the development of the Competence-Based Qualification System for the Nuclear Energy Sector.

Fig. 1.
The European common tools and principles for the modernization of education and training (Source: Cedefop).

2 Methods

Achieving the EU Single Market as a fully functional free market, primarily involves the modernization of the Education and Training (E&T) system in order to generate the *new competences* required by the EU Single Market. The need for modernization of the E&T systems led to the development of the European common tools and principles for modernization of E&T which are presented in **Figure 1**.

All these nine European common tools are based on the key concept of Learning Outcome (LO) and aim to increase transparency and trust. They all emphasize the need for common quality assurance standards as a condition for improved European cooperation in education and training.

Achieving the four freedoms (free movement of goods, services, capitals and workers) is a sine qua non condition for a functional EU Single Market. The current article is addressing the 4th freedom, i.e. the free movement of the workers, which implies the development of the Competence-Based Qualification System.

Developing the Competence-Based Qualification System for the Nuclear Energy Sector means to organize the nuclear qualifications in small independent units called Units of Learning Outcomes (ULOs). ULOs are furnished with Skills (S), Competence (C) and Knowledge (K).

Fig. 2.
The process of competences accumulation and flexible learning pathways (Source: Cedefop).

A ***Learning Outcome (LO)*** is the key concept of all European common tools and principles for the modernization of E&T. The ***Learning Outcome (LO)*** is what an individual knows, understands and is able to do after completion of a learning process, no matter formal, non-formal or informal. In this definition, we distinguish the following three components of a learning outcome: Skills (S), Competence (C) and Knowledge (K).

A ***Unit of Learning Outcomes (ULOs)*** is the smallest part of a qualification that can be assessed, transferred and

[1] The numbers in brackets refer to the references at the end of this document.

validated independently. The structuring of qualifications in small independent parts called ULOs made possible the processes of competences accumulation and lifelong learning (see **Figure 2**). Moreover, the individuals are able to acquire new competences during a mobility abroad and to transfer these in their home country within a flexible learning pathway.

In **Fig. 2**, the competences are represented as bricks and could be accumulated within different learning systems: formal [Initial Vocational Education and Training (I-VET]), non-formal [Learning Mobility Abroad; On-the-Job Training (C-VET)] or informal (Work Experience). As a result of competences accumulation or Knowledge, Skills and Competence (KSC) accumulation, no matter how much time it takes, an individual can upgrade their qualification or achieve a new one.

2.1 Tools for developing the Competence-Based Qualification System

Three of the European common tools and principles for modernization of E&T, illustrated in **Fig. 1**, should be used in order to develop the Competence-Based Qualification System in the Nuclear Energy Sector.

The innovative features of the tools used for developing the Competence-Based Qualification System are described in **Table 1**.

Tools	Innovations	Remarks
ESCO = European classification of Skills, Competences, qualifications and Occupations	The tool for management of the supply and demand of jobs	▪ The Nuclear Energy Sector is currently not visible in ESCO ▪ No nuclear Sectorial Reference sub-group to develop the content for ESCO
EQF = European Qualification Framework	Common framework for EU qualifications; Eight common European reference levels – described in terms of KSC.	Learners, graduates, training providers, employers and National Qualifications Frameworks (NQFs) can use EQF levels to compare qualifications awarded in different countries
ECVET= European Credit system for Vocational Education and Training	Qualifications structured in ULOs & KSC allow flexible career pathways	Qualifications: more transparent & flexible; facilitating the mobility
	Transfer & recognition of the competences acquired abroad; no matter which learning system: formal, non-formal, informal	Increasing the worker's capacity to adapt to the market needs

Tab. 1.
The tools for developing the Competence-Based Qualification System.

The European classification of Skills, Competences, qualifications and Occupations (ESCO) is a database that bridges the communication gap between education and work *[4]*. ESCO's primary objective is to boost online and skill-based job matching by:

- Helping describe qualifications in terms of Knowledge, Skills and Competence/Attitude (KSC/A)
- Getting more people into jobs throughout Europe
- Facilitating the dialogue between the labour market and E&T sector
- Enabling the development of innovative career guidance services
- Allowing employment services to exchange relevant labour market information across borders

The European Qualification Framework (EQF) is a tool that helps comparison between the qualifications systems in Europe 28. There are eight common European reference levels – described in terms of Knowledge (K), Skills (S) and Competences (C) (KSC).

In the context of EQF, knowledge, skills and competences are defined as:

- Knowledge (K) is theoretical and/or factual.
- Skills (S) are cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity). Skills also assume the use of methods, materials, tools and instruments.
- Competence (C) is described in terms of responsibility and autonomy.

Currently all Member States (MS) have harmonized their National Qualification Framework (NQF) with EQF. **Figure 3** shows an example on how Vocational Education and Training (VET) was integrated in the E&T system in UK and on the corespondance between the EQF levels and E&T system.

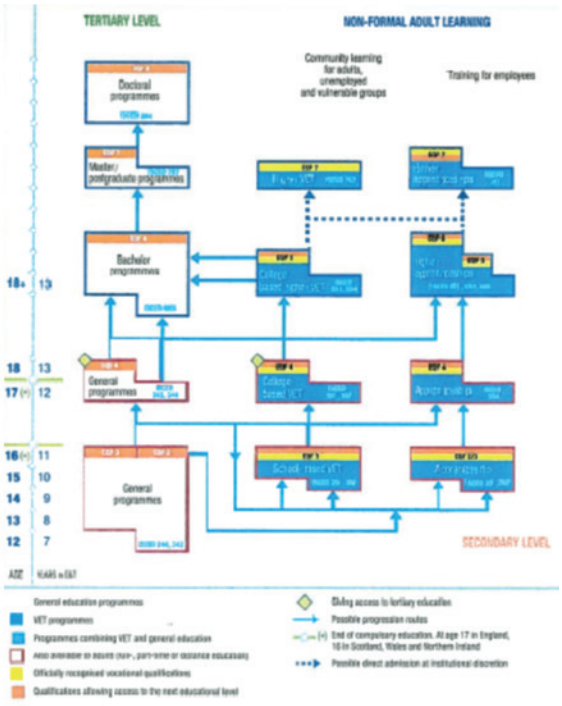

Fig. 3.
VET integration in E&T system in UK (Source: Cedefop and ReferNet UK).

The UK's E&T system has two types of E&T, i.e. general academic and vocational, generating also two types of qualifications.

The general academic qualifications allow access to the next education level. Vocational qualifications allow access to the labour market and/or to the selected first-cycle university programmes at institutional discretion.

On the other hand, the E&T system is structured in two levels. Secondary level corresponds to EQF 2-4 levels and provides both general academic and VET qualifications. Secondary level education is compulsory and ends at the age of 16 to 17 in Scotland/England.

Tertiary level corresponds to EQF 5-8 levels and provides tertiary qualifications.

Vocational education and training (VET) is available at secondary, further and higher education levels. Most VET qualifications are taken at secondary and further education level.

The European Credit system for Vocational Education and Training (ECVET) is a tool that facilitates the free movement of workers in the EU nuclear market.

ECVET is part of the European initiatives for enhanced education and training and was established with the Recommendation in 2009 of the *European Parliament and the Council [5]*, which invited the Member States to start progressive ECVET implementation in the national qualification schemes.

The ECVET implementation in the nuclear energy sector started in October 2009, when the JRC-IET was designed for the implementation and the management of the *European Human Resources Observatory for the Nuclear Energy Sector (EHRO-N) [6]*.

2.2 Methodology for nuclear qualifications design

The prerequisites for starting the process of developing the Competence-Based Qualification System or nuclear qualifications design, are:

- Preparation of the toolbox containing at list three tools: ESCO; EQF and ECVET [all based on the key-concept of Learning Outcomes (LOs)], as alredy described in § 2.1
- The working team should get a deep understanding and mastering of ECVET manifold innovations
- Preparing a customized methodology for the nuclear qualification design

The customized methodology for nuclear qualifications design is focused on the ways to fulfil the ECVET requirements for nuclear qualifications design and on developing the Competence-Based Qualification System.

The methodology for the nuclear qualification design should consider the interactions that occur between the main stakeholders from the *European Nuclear Energy Labor Market (ENELM)*. In order to identify the interactions between individuals (workers and learners) and corporations (employers) we should shape the *ENELM*.

2.2.1 Modelling the European nuclear labour market

The dynamics of the European energy labor market, in particular of the *European Nuclear Energy Labor Market (ENELM)*, is the effect of the interactions between individuals (workers and learners) and corporations (employers) through qualifications and through the exchange of goods and services.

Considering the interactions mentioned above, the *European Nuclear Energy Labor Market* would be modeled as a feedback system, illustrated in **Figure 4**.

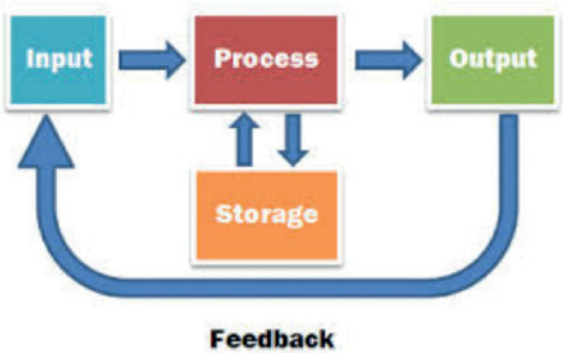

Fig. 4.
The model of the European Nuclear Energy Labor Market.

The main features of the ***European Nuclear Energy Labour Market (ENELM)*** model are:

- **ENELM has five components:** nuclear industry (employers), workers and learners, competent authorities for occupations and qualifications, education and training (E&T) providers, and Nuclear Regulatory Bodies (NRB);
- **ENELM is a Dynamic system:** ENELM's behavior changes over time, often in response to external stimulation or forcing;
- **ENELM is modelled as Feedback system:** the term feedback refers to the connections between the five dynamic components (sub-systems) which are such that each system influences the other and their dynamics are strongly coupled; ENELM is seen as a whole (a black box) which interacts with the environment through the Input, Output and Feedback.

The dynamics of the *European Nuclear Energy Labour Market* are consisting in the feedback between individuals (workers and learners) and corporations (employers) facilitated by some European common tools:

- ESCO for online and skill-based job matching, due to the ECVET qualification structure,
- EQF for comparing qualifications awarded in different countries,
- ECVET for understanding qualifications; for helping identify "skill gaps" against target qualifications; and upgrading the current qualification by recording their learning outcomes, whether acquired through formal, non-formal or informal learning.

In the context of interactions increasing between individuals (workers and learners) and corporations (employers) the development of the Competence-Based Qualification System (CB-QS) is an urgent need.

According to the ECVET approach a qualification has three dimensions: a formal validation of the competence for a work position; personal attributes (KSC) that should match the job requirements, defined in terms of KSC, and the qualification should be structured in Units of Learning Outcomes (ULOs) and in Learning Outcomes (LOs) as illustrated in **Figure 5**.

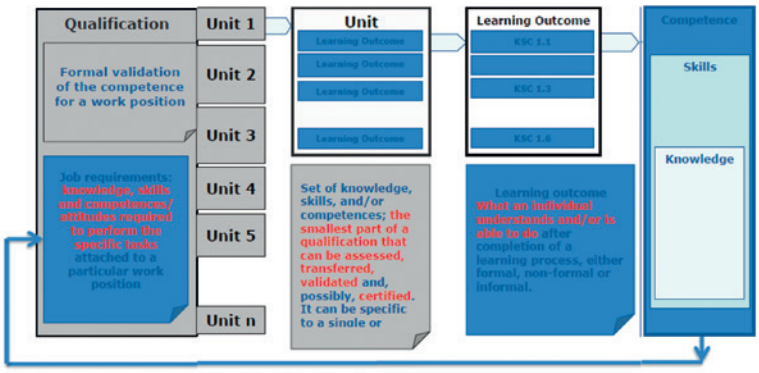

Fig. 5.
Qualification structure based on ECVET approach.

2.2.2 Designing nuclear qualifications

The European Credit system for Vocational Education and Training can help bridge the gap between HR demand and supply in the nuclear market in two ways:

- by developing the Competence-Based Qualification System or by structuring qualifications in Units of Learning Outcomes and KSC;
- by providing the input for the ECVT training programme design (for a given qualification).

The methodology for the nuclear qualifications design encompasses four steps, corresponding to the sections of the Template for nuclear qualification design:

- **Section 1. Basic Concepts Design:** it concerns the design of basic concepts and the source for qualification features and references;
- **Section 2. Metadata of the Qualification in ESCO:** the key features of the concerned qualification to be registered in ESCO;
- **Section 3. Code of the Job** within nuclear taxonomy;
- **Section 4. ECVET Qualification Structure:** Units of Learning Outcomes (ULOs) and S, C/A, K.

Designing Units of Learning Outcomes

Within the design process of Units of Learning Outcomes (ULOs) one should consider the ECVET requirements for ULOs design that are defined in **Table 2**.

The ECVET requirements for ULOs design aim to 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.

No	ECVET requirements
1	Unit of Learning Outcomes (ULOs) = a set of knowledge, skills, and competences that represents the smallest part of a qualification that would be assessed and validated independently
2	The title of the ULOs corresponds to the main functions/role of the job/qualification
3	The number of the ULOs would be between 5-10
4	Choosing the size of the ULO = problem of optimizing the time spent for assessment and validating of the ULOs accumulated by an individual

Tab. 2.
ECVET requirements for ULOs design.

Table 3 presents the "question and answer method" for the design of Units of Learning Outcomes (ULOs) for the Nuclear Power Plant – Control Room Operator (NPP-CRO) qualification.

Designing S, C/A, K

Furthermore, each ULO should be furnished with S, C/A and K. The design of K, S and C/A should follow the ECVET definitions of S, C/A and K according to **Table 4**. In addition, the designer should also consider that in the nuclear sector the qualifications correspond mostly to the upper levels of the EQF descriptors 5-7.

2.3 From qualification design to the training programme

Usually the nuclear ECVET implementation and the Training Programme (TP) design are two consecutive activities, but it is important to understand the interaction between them.

Figure 6 shows that the ECVET system is located upstream from the training programme design. The process of TP design, based on LO, occurs in several steps:

- The ECVET system provides the input for the TP design [ULOs and competences (SCK) associated with the given qualification];
- The first three components of the ECVET system should be in place as a precondition for starting the process of the training programme design
- The TP design occurs in several sequences: the identification of prior learning and the delivery of missing competences from the targeted qualification

According to the road map for ECVET implementation for the nuclear energy sector, the nuclear ECVET system has five components and two additional activities *[7]*. The prerequisite for starting the TP design is that the first three components of the ECVET system should be in place.

Checking questions	Job Description/JD 2.2.02_NPP CRO
What is the main information source?	Senior Reactor Operator/CRO
Question: Are the ULOs in line with the roles and functions of the job? **Answer:** The names of ULOs correspond to the main functions identified for the NPP-CRO. The qualification is transparent and understandable for someone without nuclear background.	Unit 6= Management of abnormal/emergency situation Unit 5=Training programmes for control room crew Unit 4= Team and technical supervision Formal validation of the competence for Senior Reactor Operator/CRO position
Question: Would an ULO be an independent part of the CRO qualification? **Answer:** Each ULO would be an independent part of the NPP-CRO qualification.	Unit 3= Interfacing with other departments Unit 2=Maintenance and testing activities Unit 1= Operation of reactor facility Job requirements: the KSC required to perform the CRO's functions/roles (K,S, C/A defined in the JD 2.02.02; NucT8 and NucT9)

Tab. 3.
Example of Units of Learning Outcomes design for NPP-CRO qualification.

No	ECVET definitions
1	**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.
2	**The component C/A (competence/attitude)** of LO= it refers to the relevant personal and interpersonal attributes (attitudes) required for the function NPP-CRO.
3	**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.

Tab. 4.
ECVET definitions of S, C/A, K.

Fig. 6.
From qualification to training programme design.

The first component (C1) of ECVET system for NES was focused on the identification of the nuclear market needs in terms of human resources. The findings of the nuclear market HR needs will be described in paragraph 3.2.

The second component (C2) of ECVET system for NES was dedicated to the development of a Nuclear Job Taxonomy (NJT). The practical outcomes of the taxonomy are:

- 140 representative jobs were identified within the three phases of NPP life cycle;
- for each job, a job description was put in place, in which job requirements are defined in terms of KSC.

The third component (C3) is dealing with the development of the Competence-Based Qualification System in the NES. The innovations brought by ECVET to the qualification system are:

- Qualifications are structured in ULOs & KSC allowing flexible career pathways;
- These small and independent structure elements of a qualification allow also the transfer and recognition of the competences acquired abroad, no matter the learning system (formal, non-formal, informal);
- Qualifications become more transparent and flexible, facilitating the mobility abroad;
- These features increase the worker's capacity to adapt to the market needs;

By capitalizing the ECVET structure of the qualification, the corresponding ECVET training programme is different from a standard training programme because:

- The first step in the ECVET training programme design is the identification of prior learning of an individual (in ECVET we don't teach what the individuals know);
- The second step in the ECVET training programme design is to develop the list of competences (or KSC) that are missing from the targeted qualification and to deliver only the missing competences (in ECVET we teach only what the individuals don't know);
- As a consequence the ECVET training programme is on average 50 % shorter than a complete training programme being customized to the individual and allowing a flexible career pathway.

3 Results

3.1 European nuclear energy labour market challenges and problems

Nuclear energy is the second primary energy source in the EU and accounts for 27 % of the EU electricity production. Nuclear energy is also a proven source of low carbon **(Table 5)**.

The EU nuclear generation capacity is described in **Table 6**. In EU there is a fleet of 130 nuclear power reactors (NPR), operating in 15 of the 28 MS. The 130 NPR generate 27 % of the electricity in the whole of the EU. Half of the EU's nuclear electricity is produced in France. In addition 53 NPR are operating in non-EU countries: Russia, Switzerland and Ukrain.

Primary source	2013 [%]	2014 [%]	Remarks
Fossil fuels	50	40.5	10% down
Nuclear	27	26.9	proven source of low carbon
Hydro	12	18.5	45-50% h+r by 2030
Renewables	11	14.4	27% by 2030

Tab. 5.
EU electricity production structure.

NPP life cycle and decommissioning activities are critical aspects. The NPP life cycle has three phases: New Built (NB), Operation and Decommissioning. The operating phase ends when it is not economically feasible to operate. Early NPP built in 1960s and 1970s, were designed for an operating life of 30 years, so their operating life has expired. At the end of its operating life an NPP needs to be decommissioned, cleaned up and demolished so that the site is made available for other uses. Due to the particular conditions of the EU the volume of decommissioning activities will increase heavily. EU will decommission 150 NPPs by 2030. EU closures account for about 69 % of the worldwide expected NPP closures by 2030. Most parts of an NPP do not become radioactive. Most of the metal can be recycled. Only about 32 % of the total materials from decommissioning are radioactive materials.

The major challenges within the European nuclear energy labour market for the period 2015 to 2030, are:

- some MS are strongly anti-nuclear after the Fukushima accident;
- electricity markets are often structured in response to populist support for renewables (incentives for green energies, nuclear energy being excluded);
- increasing of the decommissioning activities, EU closures of 150 NPP by 2030.

The increasing of decommissioning works volume generated an HR problem in the EU: a gap of 30 % between HR demand and supply in the nuclear decommissioning.

The solutions for filling up the gap between HR demand and supply in nuclear decommissioning, identified by JRC-IET, are:

- increasing the sector's visibility in ESCO
- hiring individuals from non-nuclear sectors and training them to get a nuclear/decommissioning qualification within the so-called "nuclearization" process
- starting the process of developing CB-QS for decommissioning

3.2 Filling up the gap between HR demand and supply in decommissioning

In answer to the increasing Human Resources (HR) demand in the Nuclear Power Plant (NPP) decommissioning phase, a workshop on Qualifications for Nuclear Decommissioning, was organized *[8]*.

Country	2014 nuclear generation		Reactors operable in June 2015		Reactors under construction in June 2015	
	TWh	% e	No.	MWe net	No.	MWe gross
Belgium	32.1	47.5	7	5943	0	0
Bulgaria	15	31.8	2	1906	0	0
Czech Rep.	29	35.8	6	3904	0	0
Finland	22.6	34.6	4	2741	1	1700
France	418	76.9	58	63130	1	1750
Germany	91.8	15.8	8	10728	0	0
Hungary	14.8	53.6	4	1889	0	0
Lithuania	0	0	0	0	0	0
Netherlands	3.9	4.0	1	485	0	0
Romania	10.8	18.5	2	1310	0	0
Slovakia	14.4	56.8	4	1816	2	942
Slovenia	6.1	37.2	1	696	0	0
Spain	54.9	20.4	7	7002	0	0
Sweden	62.3	41.5	10	9487	0	0
UK	57.9	17.2	16	9373	0	0
EU	833.6	27%	130	120,410	4	4392

Tab. 6.
EU nuclear generation capacity.

The workshop's outcomes in support of filling up the gap between HR demand and supply in the nuclear decommissioning are:

- developing a *Classification of occupations, qualifications and jobs* in nuclear decommissioning as a precondition of nuclear occupations, qualifications registration;
- designing two qualifications based on the ECVET approach: Radiation Protection Expert (RPE) and Radioactive Waste Manager (RWM).

Developing a Classification of occupations, qualifications and jobs in nuclear decommissioning

The precondition for registering the decommissioning occupations and qualifications in ESCO database (and to increase the decommissioning sub-sector visibility in ESCO) was to develop the *Classification of occupations, qualifications and jobs* in nuclear decommissioning. An extract from the classification is presented in **Table 7**.

The *Classification* is a useful tool to get a correlation between the jobs defined by NJT (the starting point of ECVET implementation) and corresponding qualifications and occupations. This way, 45 jobs, 16 qualifications and 10 restricted occupations were identified within the NPP decommissioning phase.

Usually a qualification covers several jobs. In the particular case of Radioactive Waste Manager qualification, it covers three jobs (3.7.01 – 3.7.01) and belongs to the restricted occupation 3.7. Radioactive waste.

In some cases a qualification covers only one job. This is the case of the Radiation Protection Expert (RPE) qualification that covers the job of Radiation Protection (RP) Manager and belongs to the restricted occupation 3.9. Health, safety and environmental professionals.

Decommissioning qualifications design

Applying the customized methodology for nuclear qualifications design, described in §2.2.2, two qualifications were designed: Radiation Protection Expert (RPE) and Radioactive Waste Manager (RWM).

Occupations		Qualifications	Jobs
Broader Occupation	Restricted occupation		
Decommissioning activities	3.7. Radioactive waste	Radioactive Waste Manager	3.7.01. Radioactive Waste Manager
			3.7.02. Radioactive Waste Manager – characterisation
			3.7.03. Radioactive Waste Manager – processing
		Radioactive Waste Worker	3.7.04. Radioactive Waste Worker – characterisation
			3.7.05. Radioactive Waste Worker – processing
			3.7.07. Transport responsible
	3.9. Health, safety and environmental professionals	Radiation Protection Expert	3.9.01. Radiation Protection Manager
		Radiation Protection Officer	3.9.02. Radiation Protection Officer
		Radiation Protection Worker	3.9.03. Radiation Protection Worker
		Industrial Safety and Environment	3.9.04. Industrial Safety Engineer
			3.9.05. Safety Case Expert
			3.9.06. Environmental Expert
			3.9.07. Radioprotection Technician/Officer
1	10	16	45

Tab. 7.
Extract from the Classification of occupations, qualifications and jobs in nuclear decommissioning.

Qualification no 1/Q1: Radiation Protection Expert	Level 6 EQF

List of units of learning outcomes/ULOs:
1. Radiation protection management
2. Incidents, accidents, emergency preparedness and response plans
3. Evaluation and optimization of individual and collective doses
4. Management of health, radiological and environmental risks
5. Team and project management

Unit of learning outcomes No. 1: Radiation Protection Management

Skills	Competences/Attitudes	Knowledge
S.1.1. Define radiation protection priorities in decommissioning activities	C.1.1. Respect and apply national and international legislation	K.1.1. Radiation chemistry
S.1.2. Evaluate safety situation at the site from the radiation protection point of view	C.1.2. Built radiation protection procedures and framework in normal and emergency cases	K.1.2. Nuclear Physics
....	C.1.3. Respect timeschedules	K.1.3. Dosimetry
S.1.9. Optimize radiation protection for transport and storage of radioactive waste	.....	K.1.4. Nuclear safety
	C.1.6. Ensure that safety culture is applied	K.1.5. Relevant national and international legislation and guidelines
		.....
		K.1.15. Geological rad-waste disposal

Assessment criteria:
Knowledge in radiation protection including technology changes
Knowledge about radiation in environment
Knowledge about nuclear facility's SSC (structured Systems and components)
Ability to organize work in radiation protection
Ability for correct interpretation and reporting of radiological parameters
.....
Ability to evaluate and implement corrective measures
Ability to produce the regulatory documentation comply with regulatory requirements
Ability to develop procedures for normal and emergency situation based on risk assessment

Tab. 8.
The ECVET structure of the RPE qualification.

Table 8 presents an extract from the design of the Radiation Protection Expert (RPE) qualification.

The RPE qualification was structured in five ULOs, linked with role/tasks of the job 3.9.1-Radiation Protection Manager, which are the smallest independent parts of the RPE qualification. Moreover within each ULO, SCK were defined that should be assessed individually.

3.3 An ECVET training programme

The workflow for designing an ECVET Training Programme, for the RPE qualification, is illustrated in **Figure 7** and the key aspects are:

- An ECVET Training Programme should be addressed to a qualification or an occupation

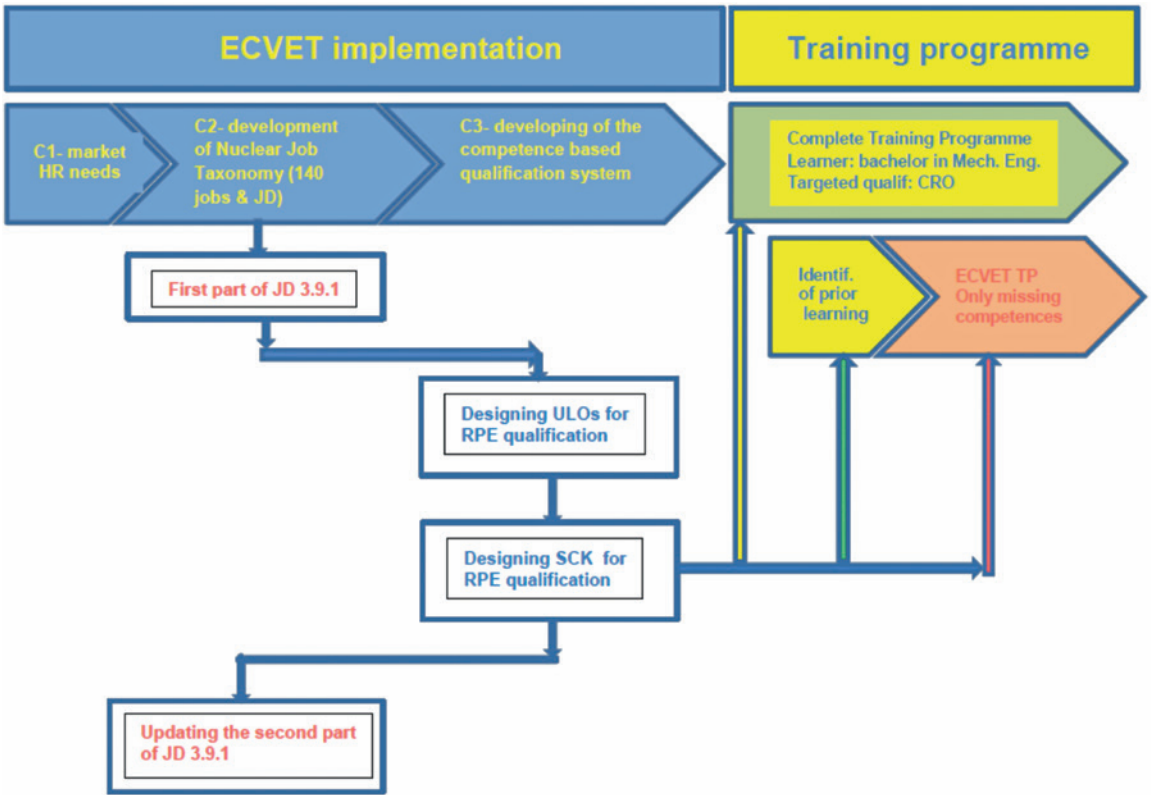

Fig. 7.
The workflow for the ECVET training programme design.

- The ECVET structure of the RPE qualification (illustrated in **Tab. 8**) is the input for the design process of the training programme. It implies that the components C1 to C3 of the ECVET system are in place
- Two types of a Training Programme could be designed:
  a) a complete TP for learners who are debutants in the profession
  b) a customized TP for learners who have work experience even in non-nuclear jobs
- The customized TP for learners who have work experience assumes the identification of prior learning and, in the second step, the competences that are missing from the targeted qualification are defined. This way, the duration of an ECVET training programme is much shorter than a standard training programme.

The main findings of the ECVET training programme for the RPE qualification are:

- The prior learning, identified within the first phase of ECVT TP design, would usually be about 20 to 40 % (depending on the individual background). As a consequence, the ECVET TP does not deliver 20 to 40 % of the complete curricula.
- The ECVET customized TP is designed in the second phase. It is said, that the ECVET customized TP delivers only the missing competences, meaning 80 to 60 % of the complete curricula.
- On average, it is 40 % shorter than a complete training programme being customized to the individual and allowing a flexible career pathway.

Figure 8 has an example on how ECVET can help bridge the gap between the HR demand and supply in the nuclear market, for the case of "nuclearisation" of a former operator in a Fossil Power Plant (FPP) at the NPP CRO qualification.

The main features of the customised ECVET training programme for the NPP Control Room Operator (CRO) qualification are:

- The learner is a former operator of the NPP, having about 50 % of prior learning linked with ULOs 3-5
- The missing competences from the targeted qualifications **(NPP CRO qualification)** are linked with ULOs 1 and 2
- In this context, the first module called "Nuclearization" delivers only nuclear competences and takes four months
- The second module of the TP, "Practical training on simulator", takes 6 months and, in parallel, the candidate gets recognition and validation for competences linked with ULOs 3 and 4
- The third module of the TP, "Working under supervision" takes 6 months and, in parallel, the candidate gets recognition and validation for competences linked with ULOs 5 and 6
- The ECVET TP has a total length of 1 year and 4 months, instead of 3 years, for a complete training programme (when the learner is a bachelor in Mechanical Engineering)

It is obvious that the ECVET TP saves time and is 50 % shorter than a complete TP. This way, ECVET can help bridge the gap between the HR demand and supply.

4 Conclusions

The *JRC* road map for the ECVET implementation has reached the stage of Competence-Based Qualification System development. Three components of the nuclear ECVET are in place [C1 – scanning the HR needs of the nuclear market; C2 – development of the Nuclear Job Taxonomy (NJT); C3 – developing the Competence-Based Qualification System] and the pattern could be customized to the particular conditions of the interested MS.

The Lisbon Workshop (8) emphasized the idea that ECVET can have an added value for the nuclear decommissioning labour market; in particular for the initiative on E&T in decommissioning "Pooling of joint European School" and for ENEN's project *ANNETTE*.

In line with the above needs of the decommissioning sector, the next steps in the nuclear ECVET implementation would be:

- Identifying the decommissioning qualifications which are most likely to develop ECVET training programmes;

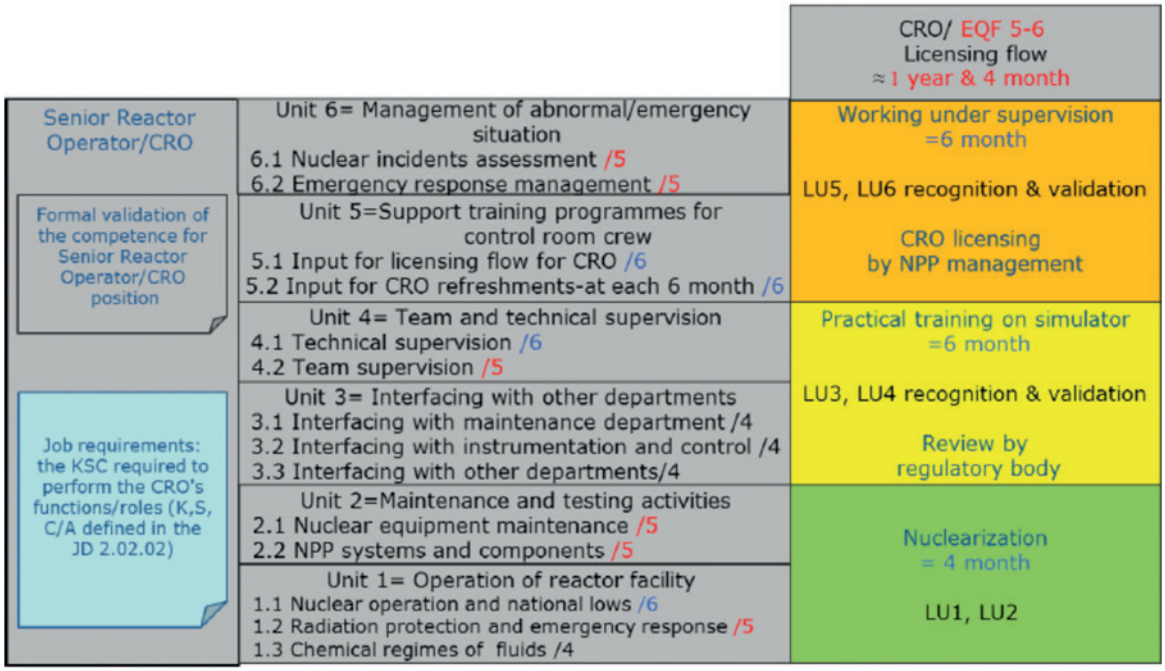

Fig. 8.
The ECVET training programme for the NPP Control Room Operator qualification.

- Speeding up the process of developing the Competence-Based Qualification System for nuclear decommissioning;
- Providing the input for designing the ECVET Training Programmes for the most required decommissioning qualifications.

Aknowledgements

The successful activity of the *Institute for Energy and Transport (IET)* of the *Joint Research Centre (JRC), European Commission (EC)*, in support of the introduction of *ECVET in the Nuclear Energy Sector*, was possible due to the good cooperation, in a complementary way, between *DG RTD*, *DG JRC* and *DG EMPL*. *DG RTD* has supported indirect actions (*EFTS* projects) and DG JRC has driven direct actions. *DG EMPL* offered scientific support and guidance through the *ECVET* Team.

The activity on *ECVET* implementation in the NES was managed by the *ECVET Team* of the *European Human Resources Observatory for the Nuclear Energy Sector (EHRO-N)* during a period of seven years (2009 to 2015).

Abbreviations

CA	Competence/Attitude
CB-QS	Competence-Based Qualification System
CEDEFOP	European Centre for the Development of Vocational Training
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
IET	Institute for Energy and Transport
I-VET	Initial Vocational Education and Training
JRC	Joint Research Centre
KB-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	Life Long 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
TP	Training Programme
TSO	Technical Safety Organisation
ULOs	Unit of Learning Outcomes
VET	Vocational Education and Training

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Author Mihail Ceclan
European Commission
Joint Research Centre
Institute for Energy and Transport
Westerduinweg 3
1755 LE Petten, The Netherlands