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# PETRUS-III PROJECT

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## Implementation report

*Guidelines, recommendations and template*

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### **ABSTRACT:**

The PETRUS professional development (PD) program aims to bring together vocational training on nuclear waste management and formal academic training provided by the partner higher educational institutes. Combination of vocational training and professional work experience to academic qualifications has been applied for long in France as a part of VAE-system. Also in Finland academic studies can include practical training to some extent. Preparation professional reports can be included as individual and independent research and credited based on their extent and preparation time consumed. In addition, the European Crediting system for Vocational Education and Training (ECVET) has been created to promote transnational mobility primarily within the European Union and to facilitate lifelong learning. Consequently, ECVET systems are strongly supported as tools for implementing e.g. E&T activities by Euratom in the nuclear sector, where maintenance of the competences of labor force in critical nuclear technologies are becoming difficult to sustain in the near future.

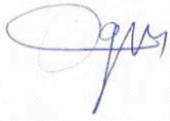
Comparison of guideline documents for ECVET-programs and quality assurance guidelines for evaluation of educational programs in Finland indicate that the deliverable documents of WP 1 and WP 2 of Petrus III-project will comprise the key inputs to the accreditation documents. The learning agreement model (D1.1) will be essential for the accreditation evaluation. Deliverables D1.2-D1.5. also describe the role of different end-users in the planning of the contents of the program and selection thematic areas as well as the learner profiles including the criteria for accepting the students. Other relevant information for the evaluation of the administrative efficiency and transparency as a part of the quality control include theD2.2., the Model for linking ECVET and ECTS credits and D2.3, the description of the Prototype of the planned program (D2.3). The Memorandum of Understanding (D1.6) drafted in WP1 will be a document confirming the basis for mutual trust. It will describe the special arrangements for credit transfer or learners, identify actors their duties of competent institutions including the participating universities and stakeholder companies playing a role in different procedures of implementation. Attachments of MoU can give the list of courses provided by different universities and training organizers that should be included as partners.

European institutes of higher education are expected to implement QA/QC-procedures that involve frequent examination and internal evaluation of resources, processes, outputs, and outcomes and apply external accreditation of their educational programs. The Self-evaluation report prepared as

the deliverable 2.4 has been prepared by modifying the self-evaluation guideline document applied in Aalto University as a part of the self-assessment and accreditation (external auditing) of its Bachelor's programs. In the preparation, an assumption was made that the development of and maintenance of resource-demanding and overlapping QA/QC-procedures specific for an ECVET-program will not be necessary in partner universities. Instead, the educational institutes should commit themselves in the MOU to the implementation of QA/QC as required from the institutes of higher education in Europe and frequent reporting of the outcomes internal and external evaluation to the management group of the PD-program and partner universities using the D2.4 as a guideline document.

The second task of W2 has been to delineate a methodology to facilitate linkage between ECTS and ECVET credits. In PETRUS project the different units were associated the estimates of "typical teaching hours in university MSc-programs" in Deliverable D1.3. These hours are 75 , 60 and 90 totaling 225 hours of teaching (i.e. lectures). Using these hours as a measure of the relative weights of the three PETRUS ECVET units (D1.4 and D 1.5) can be estimated to be correspondingly 33, 27 and 40 % of the total qualification. A flexible approach is proposed where the responsibility of the applicant to provide all relevant documents and certifications in a form of a portfolio so that the consistency of achieved learning outcomes in relation to the delineated professional competence profile can be estimated and the workloads can be associated to the accomplished units so that their extent can be estimated in terms of ECTS-credits, if a recognition of a formal academic degree will be requested.

## Signatures

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## Abbreviations

<b>PD</b>	Professional development
<b>KSC</b>	Knowledge, skills and competences (attitudes)
<b>ECTS</b>	European Credit Transfer and Accumulation System
<b>ECVET</b>	European Credit system for Vocational Education and Training
<b>VAE</b>	Awarding academic credit for experience
<b>MoU</b>	memoranda of understanding
<b>ENQA</b>	European Network for Quality Assurance in Higher Education
<b>IAEA</b>	International Atomic Energy Association
<b>IGD-TP</b>	The European Technology Platform for Implementing Geological Disposal .
<b>CMET</b>	Working Group on the Competence Management, Educational and Training of IGD-TP

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## 1. Background and societal need for Petrus-collaboration

Monitoring and studies carried out since 2009 by the European Human Resource Observatory in the Nuclear Energy Sector (EHRO -N) indicate that maintenance of the competences in critical nuclear technologies are becoming difficult to sustain in the near future. The demography of those working in the industry, research and academia indicates that given the aging workforce profile there is the danger of competence being deteriorated and ultimately lost. Strategies has to be developed to attract young people, retrain staff and attract experts from other industries. For such a strategy there is need for knowledge partnerships between government, industry, educational and training providers and science and research communities. To address the gap in the required expert resources within the nuclear industry sector, improved management of knowledge, skills competences (KSC) will be essential.

Estimated skills of the workforce needed in the nuclear sector can be essentially obtained by “nuclearization” of people with suitable educational background in engineering or sciences (see e.g. D1.4 of Petrus III-project and references there in). This means that an essential entrance path for professional into nuclear sector in general and into nuclear waste sector will be through professional development rather than graduation from specialized higher level educational programs in nuclear technology.

Concerning competence management in nuclear waste management particularly, organization of sufficient training of experts will meet additional challenges. European countries have progressed to different stages in their waste management programs. Some have started developing conceptual models and initial preparations for site-selections. Others construct the geological disposal facilities. Consequently, different requirements for the competences needed in the near future. Furthermore geological conditions for conceptual models and disposal site selections vary substantially. Also the number of experts needed will be relatively small in any country addressing the potential benefits that educational co-operation can provide both for the nuclear waste organizations that need competent employers and for academic institutions that probably would have limited resources to maintain small, highly specialized educational programs regardless of their societal importance.

Consequently, the PETRUS professional development (PD) program aims to bring together vocational training on nuclear waste management and formal academic training provided by the partners comprising higher educational institutes.

In PETRUS III –project the effective implementation of the PD-program targeting in qualification in Master’s level has been in the focus of work packages 1 and 2 lead by partner universities from France (WP1) and Finland (WP 2) representing countries with previous experience in combination of professional training and academic educational programs. The combination of vocational training and professional work experience to academic qualifications has been applied for long in France as a part of VAE-system. Also in Finland academic studies can include practical training to some extent. Preparation professional reports can be

included as individual and independent research and credited based on their extent and preparation time consumed.

In addition, the European Crediting system for Vocational Education and Training (ECVET) has been created to promote transnational mobility primarily within the European Union and to facilitate lifelong learning. Consequently, ECVET systems are strongly supported as tools for implementing e.g. E&T activities by Euratom.

## 2. Planned approach for implementation

Preparation of the practical implementation of the professional development programme targeting qualification at the academic Masters level addressed in the first two work packages of the PETRUS III-project. Another objective of WP1 and WP2 has been to define, how the training provision leading to high-level qualifications could be configured to meet the end-users demand for skills linked to associate professional occupations. Therefore, a template for learning agreements has been prepared in WP1 to provide model, how competency build up could be integrated to human mobility and different forms of training ranging from academic or professional training courses, and self-studies, internships, or learning by doing at practical work (D.1.1) and a model guidelines how recording of acquired credits could be organized (D1.2).

Starting from the outcomes of the previous project, a “Competency- Based Curriculum” has been elaborated for a professional profile of a safety engineer in the field of geological disposal (D1.3). This professional profile defines the key roles and functions of such professionals in terms of knowledge i.e. cognitive competence (K), skills or technical and functional competence (S) and competence or attitude with behavioral and personal competence (C). Subsequently, a modular qualification structure following the principles of an ECVET-system have been delineated in deliverables D1.4 and D1.5.

The required learning outcomes and associated KSC:s (D1.4) were compiled to three sets that were called units in order to follow the ECVET-terminology. Therefore, each unit represents a set of knowledge, skills and competencies and comprise a part of the qualification that can be transferred, validated and possibly certified. The description of this system has been given as a deliverable D1.5 of the project.

The first unit comprises a set of KSC: s that are typically included to hydrogeology training at a master’s level in universities. The KSC:s specific to the principles and knowledge base of radioactive waste disposal and to the safety and performance analysis for radioactive waste disposal comprise the units two and three, respectively. To support work load estimation and credit transfer, the units are associated to an indicative number of typical hours used in university teaching on those topics in the master’s level (See also chapter 2.2).

### 2.1. Documents for the Accreditation process

Accreditation of an educational program is an example of a continuous quality assurance process where operations and services carried out by educational institutes will be frequently evaluated by an external body or agency to determine if applicable standards are met. The PETRUS PD programme aims to apply ECVET-principles as instruments for mutual recognition and enables integration of existing academic training to this process.

As described in the Accreditation procedures report (D2.1), comparisons of European standards for higher education institutes committed to the Bologna-process and principles and standards of ECVET programs indicate that they share similar key principles. Furthermore, due to the similar requirements for the implementation of vocational and academic training programs, the accreditation procedures and standards set for higher educational institutes can be apparently utilized in the Petrus PD program.

Comparison of guideline documents for ECVET-programs and quality assurance guidelines for internal and external evaluation of educational programs in Finland (D.2.1) also indicate that the deliverable documents of WP 1 and WP 2 of Petrus III-project will comprise the key inputs to the accreditation documents. The learning agreement model (D1.1) will be essential for the accreditation evaluation. Deliverables D1.2-D1.5. also describe the role of different end-users in the planning of the contents of the program and selection thematic areas as well as the learner profiles including the criteria for accepting the students, which all comprise relevant pieces of information for the accreditation process. Other relevant information is needed for evaluation of the administrative efficiency and transparency for quality control include the Model for linking ECVET and ECTS credits (D2.2) and the description of the Prototype of the planned program (D2.3). The Memorandum of Understanding (D1.6) drafted in WP1 will be a document confirming the basis for mutual trust. It will describe the special arrangements for credit transfer or learners, identify actors their duties of competent institutions including the participating universities and stakeholder companies playing a role in different procedures of implementation. Attachments of MoU can give the list of courses provided by different universities and training organizers that should be included as partners.

European institutes of higher education committed to the Bologna-process are already expected to implement QA/QC-procedures that involve frequent examination and internal evaluation of resources, processes, outputs, and outcomes and apply external accreditation of their educational programs. The Self-evaluation report prepared as the deliverable 2.4 has been prepared by modifying the self-evaluation guideline document applied in Aalto University as a part of the self-assessment and accreditation (external auditing) of its Bachelor's programs. In the preparation, an assumption was made that the development of and maintenance of resource-demanding and overlapping QA/QC-procedures specific for an ECVET-program will not be necessary in partner universities. Instead, the educational institutes should commit themselves in the MOU to the implementation of QA/QC as required from the institutes of higher education in Europe and frequent reporting of the outcomes internal and external evaluation to the management group of the PD-program and partner universities using the D2.4 as a guideline document.

## 2.2.Credit transfer mechanism

The PETRUS professional development program aims to bring together vocational training on nuclear waste management and formal academic training provided by the partner higher educational institutes. The objective is to provide qualification that can be achieved through both formal academic and Professional Development pathways and which can be mutually recognized

by the nuclear waste management's stakeholders and participating academic institutions. For this purpose, the second task of W2 has been to delineate a methodology to facilitate linkage between ECTS and ECVET credits.

The principles of an ECVET include the documentation of the qualification system that is considered to provide the KSC- base for the entry route to professional practice. The KSCs needed for qualification must be linked with expected learning outcomes defined as statements of what a learner is expected to know, understand and/or be able to do at the end of a period of learning. The qualification is described in terms of "units" of learning outcomes. Units can be associated with a certain number of "credit points" in order to provide an illustration of the relative weight of the unit and associated learning outcomes in the over-all qualification.

The *European Credit Transfer and accumulation System* (ECTS) is applied in academic education within the European Higher Education Area. As a standard European students are expected to earn 30 ECTS credits per semester and 60 ECTS credits per academic year. Studies of one academic year is equivalent to 60 credits (ECTS) involve about 1600 hours of full-time work. Therefore, one ECTS-credit corresponds to approximately 27 h of studies (including both contact teaching and individual and independent self-studies). The Bachelor's degree consists of 180 credits (ECTS) and the Master's degree of 120 credits (ECTS). In many universities the MSc-candidates are required to include a written thesis work the extent of which corresponds typically but not exclusively to 30 cr (about a half a year of full time work).

Tools and approaches for smooth integration of ECTS and ECVET crediting systems have been attempted in previous projects such as the EU-financed BETWIN-project. The approach developed in BE-TWIN appears at first glance rather simple approach and was applied as a starting point.

According to BETWIN-approach project, the total number of ECVET points should be first allocated to a qualification as a whole and subsequently subdivided and allocated to each unit according to its relative importance within the qualification. In PETRUS project the different units were associated the estimates of "typical teaching hours in university MSc-programs" in Deliverable D1.3. These hours are 75 , 60 and 90 totaling 225 hours of teaching (i.e. lectures). Using these hours as a measure of the relative weights of the three PETRUS ECVET units (D1.4 and D 1.5) can be estimated to be correspondingly 33, 27 and 40 % of the total qualification.

In order to be in line with the ECTS system, 60 points should be allocated to the learning outcomes expected to be achieved in a year of formal full time vocational education and training. Subsequently, it would be apparently simple to consider ECVET points equal to the ECTS-credits. The units would therefore correspond to 40 cr, 32 and 48 ECTS credits (or ECVET points). A more detailed credit allocation to learning outcomes and associated knowledge, skills and competences would be possible based on data given in D1.3.

However, for the first the strict adherence to linking procedures similar to those proposed in BETWIN-project would apparently require substantial harmonization of the terminology and possibly endless comparison of past and present course descriptions in different partner universities before the course outcomes could be clearly linked to the distinguished learning outcomes providing the foreseen qualification. Such harmonization would be beyond the objectives of the Petrus III-project or would not directly serve the objectives of EURATOM (van Goethem, 2012) considering essentially ECVET-programs as instruments of mobility and life-long learning.

Secondly, the BETWIN approach does not work very well when students with variable educational background are going to be nuclearized. E.g. civil engineers may have developed a strong competence on using e.g. numerical methods in structural mechanics or other field while a geoscientific knowledge while the conceptual understanding of the geological and hydrogeological processes can be limited. For a geologist specializing to radioactive waste management the situation may be opposite. Furthermore, learners can accumulate required units for a given qualification programme over time and in different learning situations (e.g. modular courses, practical training). E.g. problem based learning over a certain topic can result in deeper level of learning in terms of relevant skills and competences than a lecture course with same number of lecture hours but on relying exclusively on individual studies such as individual reading of a text book. The work load required from the student can be different and calls for flexibility in the credit allocation and consideration of the previous learning achievements. The required EQL-levels identified in D1.3 are also somewhat flexible also suggesting that flexibility in recognition criteria and procedures as adequate for credit transfer would be appropriate.

Therefore, a more flexible approach is proposed where the responsibility of the applicant to provide all relevant documents and certifications in a form of a portfolio that

- Can be used to verify that the described training can be linked to the delineated learning outcomes and KSC:s and that the foreseen learning outcomes have been achieved.
- Can be used to assess the workload and EQL-level can be estimated, and particularly credited in terms of ECTS-system so that the integration of the ECVET-based education can be done at the academic institute providing the MSc-degree
- The studies and learning achievements are in line with the delineated competence based curriculum and the requirements of Master's degree in terms of ECTS-program (including e.g. a thesis).

### 3. Notes for the Implementation program

The approach would utilize existing practise in Finland and in the Aalto University where credits can be associated to practical training, written reports, learning diaries based on existing guidelines following certain rules. However, if a Master's degree will be targeted, a substantial part of the education must be carried out in Aalto or other IHE-level institute that is an official partner of an international program. The student must be also enrolled into those institutes.

However, the procedures should be carefully reviewed, and defined accurately in the Memorandum of Understanding in which the ECVET-partnership will be established. Particular attention should be paid to attach the MoU with sufficiently specific terms how learning outcomes relevant to ECVET-program that have been achieved outside of the formal academic training activities can be related to ECTS-credits. Suggestions based on Finnish experiences have been given in D2.4. Integration of vocational and academic training would be carried out as a committee evaluation and decision based on a portfolio where the applicant has compiled the achievements of learning outcomes and relevant KSC:s is presented to a committee similar to French VAE-procedure. The committee will then decide if the documents presented in the portfolio show work that merits partial credit towards a particular degree.

The implementation of the program in practice requires that Aalto University is willing to take the leading role of the organization. Before a commitment can be expected, the proposed administrative procedures and the set of prepared documents must be reviewed technically and legally by the university administration and by the national educational authority, National Board of Education. In the organizational changes of Aalto the curriculum of engineering geology and applied geophysics has been substantially streamlined and staff resources reduced. Provision of foreseen background competence for the students will be difficult. Compilation of a course combination that could be used in the program will require inter-departmental collaboration and possible modification of the course contents. Also the role of the consortium partners and their willingness to participate should be confirmed. Tailoring of the program with the course offered in different institutes will be necessary. Particularly relevant courses for geological disposal include those given by organizations such as IAEA and other EU Euratom-projects such as ENETRAP III.

Tailoring the study program and utilization of the courses by the students will require a comprehensive review and description of potential courses and their schedules and by the participating universities. Inclusion of relevant training outside the participating academic institutions and planning of studies in a point of view of a potential student would be strongly supported by developing a Software for Target-Oriented Personal Syllabus.