

# **THE EUROPEAN NUCLEAR EDUCATION NETWORK AND ITS ACTIONS IN FAVOUR OF EDUCATION, TRAINING, INFORMATION AND TRANSFER OF EXPERTISE**

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## **ABSTRACT**

The European Nuclear Education Network (ENEN) Association is a non-profit organization established by the consortium of the EU 5th Framework Programme (FP) "ENEN" project in 2003. The ENEN Association started as a network of universities and research centers involved in education and training in nuclear engineering in EU countries and is presently involved in the challenging role of coordinating E&T in the nuclear fields in Europe.

The main objective of ENEN is, in fact, the preservation and further development of expertise in the nuclear fields by higher education and training. Its members are now universities, research centers and industrial bodies established in European Countries; in addition, MoUs have been signed with several institutions and networks beyond the borders of European Union, thus reaching the number of more than 60 members.

The objective of this paper is to provide an up to date view of the actions and plans of the Association in pursuing its missions.

## **1. Introduction**

Among the motivations to establish ENEN in 2003, there was the worrying situation created at the time by the lack of attractiveness of nuclear careers in Europe for young generations of engineers, researchers and teachers. Periods of lower popularity of nuclear energy consequent to the occurrence of reactor accidents have several negative consequences on maintaining a stable transfer of knowledge, skills and attitudes (or competencies) in the field. Some reflections on this aspect are reported hereafter.

Public opinion does not recognize or even denies that the risk provided by the whole nuclear fuel cycle is generally well below the one coming from other industrial applications or from daily personal choices, such as the use of own transportation means that are responsible for high yearly death tolls in many European countries. Though it is proven by systematic risk assessment studies, the safety of nuclear reactors results in a possibly too exoteric concept for a common perception of risks and dangers mainly driven by mass media resonance. As a matter of fact the sentence that an "accident anywhere is and accident everywhere" has hardly a counterpart in any industrial application other than the nuclear energy field, making of it a singular subject of discussion that is very difficult to promote in public debates in the lack of a scientifically based attitude.

In such an environment, nuclear industry faces difficulties in expanding and developing with the necessary continuity new products, resulting in phases of market starvation in which it is quite difficult to attract new talents to the nuclear field. The experience of the years before the Fukushima accident, often referred to as "nuclear renaissance", shows instead that when attractiveness is provided by considerable plans for hiring new personnel in industry, also in replacement of retiring professionals, crowds of gifted students enroll in the uni-

versity courses related to nuclear matters and often achieve optimum results in education and job placement. On the other hand, in those periods it is unavoidably discovered that the capability of universities and training centers to provide the requested manpower has become dramatically lower than the momentary high request, thus creating a rush to “nuclearisation” of non-nuclear educated personnel by “ad-hoc” courses.

This unstable behavior, in which offer and demand of nuclear-competent or nuclear-aware personnel do not match with each other, results in a waste of resources and in a lack of effectiveness in the development of the opportunities offered by nuclear energy. Such oscillations, in fact, sometimes occur with a timing that makes easily offer and demand to be out of phase for a while, with long periods in which the low request of personnel puts at risk the existence of university and training center courses in nuclear matters. By the way, offering courses needs to develop and maintain knowledge, skills and attitudes of teachers, instructors and facilitators, a process whose duration can be measured in decades.

Some recent analyses propose this situation within quite clear contours.

*“The nuclear science and engineering community in the EU is beset with numerous challenges that threaten nuclear power’s role as a clean and abundant source of reliable energy. These range from growing disinterest in higher education among young and upcoming scientists and engineers to a nuclear workforce that is rapidly ageing and not being replaced. The result is likely to be a lack of future generations to operate, promote and expand the nuclear power sector, as well as the loss of trained experts with the necessary knowledge and technical competencies to build, operate, and decommission current and future nuclear facilities safely.” (François WEISS, 2012 Interdisciplinary Study, benefits and limitations of nuclear fission for a low-carbon economy, Topic 4: Education and Training).*

The need to maintain and further develop the workforce in the nuclear field is therefore perpetual and might be even stronger, although perhaps less explicit, in the periods of lower public enthusiasm for nuclear energy.

*“An extrapolation to 2050 of the ‘20 % nuclear’ scenario indicates that 100-120 units should be built in Europe.” (María Teresa DOMÍNGUEZ, 2012 Interdisciplinary Study, benefits and limitations of nuclear fission for a low-carbon economy, Topic 2: SET Plan)*

*“Even countries that have phase-out policies still have active nuclear programmes associated with generation and ultimately decommissioning.” (Gustaf LÖWENHIELM, 2012 Interdisciplinary Study, benefits and limitations of nuclear fission for a low-carbon economy, Topic 3: Research and Development).*

The accident occurred at the Fukushima Daichi nuclear power station five years ago is presently causing again a situation of lower enthusiasm for nuclear careers in some countries of Europe, in similarity with what was experienced in 2003 when the ENEN Association was established. Notwithstanding the reassuring conclusions reached by recent reports (e.g., those by WHO and UNSCEAR) about the negligible consequences of the radiological impact from the reactor accident on population health, not even the nearly 20,000 casualties occurred because of the earthquake and the tsunami convince that reactor accidents are often more favourable than natural disasters or other man-made accidents.

While a due global reflection has been already made worldwide to learn from the Fukushima accident the necessary technical lesson in terms of safety culture, it is again for the European Nuclear Education Network the time to be engaged in favour of maintaining competencies in the nuclear field. Good reasons for this action are at least the following:

- it is necessary to maintain in Europe capabilities that can allow competing with the ones of the areas in which nuclear energy is more actively developed, in order not to lose the excellence and competitiveness reached in the past;
- it is necessary to convince about the need of nuclear in the energy mix that will fuel the development in the next decades, especially considering the need for decarbonisation of the energy sector;

- nuclear energy, by the way, is not only nuclear power generation: its vast potential must be then exploited in several sectors (e.g., the medical one) in which education must be preserved;
- it is necessary to try a better coordination of education and training activities in order to promote useful synergies among the fields of nuclear engineering and safety, radiation protection, waste management and geological disposal, as well as nuclear fusion.

Fusion, in particular, requires nowadays competencies developed in the field of fission to complete its process of “nuclearisation”, i.e., bringing laboratory experiments to the industrial scale. In order to create a tighter interaction, an MoU has been signed in February 2015 between ENEN and FuseNet, the network for education in the field of fusion energy, owing to the several interfaces established between the two fields.

Basing on this background, the present paper reports a summary of the activities in which the ENEN Association is presently engaged, highlighting the efforts being spent in favour of its missions in the post Fukushima era.

## 2. Own activities of ENEN

Also as a product of previous European Projects, initiatives have been established for promoting mutual recognition and establishing certifications at the MSc and the PhD levels.

Among them, the European Master of Science in Nuclear Engineering (EMSNE) Certification represents an important achievement, which has among others resulted in a remarkable number of Alumni. This certification released by ENEN requires that an engineer graduated with at least 300 ECTS has gone through a curriculum containing at least 60 ECTS of core nuclear matters, including the thesis work, of which at least 20 ECTS have been obtained in a stage abroad at an ENEN institution. This latter feature provides the “European” or “International” character of the studies (international, when the host institution is out of Europe, but connected with ENEN through an MoU).

In 2015 the engineers who have received the certification have been 26. The related Diplomas were awarded during a Ceremony held in the beautiful atmosphere of the IAEA Vienna International Center, as a side event of the 59<sup>th</sup> IAEA General Conference (Figure 1). For 2016, 29 candidates have been already proclaimed at the General Assembly of ENEN, held in Geel at the Headquarters of JRC-IRMM.



Figure 1. Group picture at the EMSNE Award Ceremony held at IAEA in September 2015

Another relevant own activity of ENEN is the PhD event and prize, whose last edition was celebrated at the International Congress on Advances in Nuclear Power Plants (ICAPP) 2015 in Nice, France, 5-6 May, 2015.



Figure 2. Group picture at the PhD Event held at the ICAPP Conference in May 2015

In this event, doctoral students present their activities and results to a Jury selected among ENEN members and compete for prizes consisting in financial support for dissemination of their activities at major conferences of the nuclear sector. Also this initiative has become a successful tradition and in October 2016 it will be held at the ENC Conference in Warsaw.

### 3. Ongoing European Projects

The coordination of and the participation in several EU projects represented milestones in the activity of ENEN, allowing to further promote the involvement of its Members in favor of common missions. By the way, the tight interaction with European institutions, led to the recognition of the value of the Association by the European Council in 2008 and to the participation in a hearing of a European Parliament Commission related the new “safety directive” in 2014.

The presently ongoing projects span over a range of challenging activities which qualify more and more the Association in its service to European citizens.

#### **NUSHARE**

NUSHARE is a FP7 project implementing a European Education, Training and Information initiative proposed by the cabinets of the Commissioner for Research and Innovation and of the Commissioner for Energy after the Great East Japan Earthquake and Tsunami on 11 March 2011 (Fukushima). Its main objective is to develop and implement education, training and information programmes strengthening the competences required for achieving excellence in nuclear safety culture. Three main target groups have been identified, for which specific courses have been developed: TG1) Policy decision makers and opinion leaders at the level of governments, parliaments, international organisations, scientific communities, journalists; TG2) Staff members of Nuclear Regulatory Authorities and Technical Safety Organisations (TSOs); TG3) Electric utilities, systems suppliers, and providers of nuclear services at the level of responsible personnel, in particular managers.

The recent involvement in the project of the European Nuclear Society, of INBex and of the World Federation of Science Journalists is bringing more momentum to the ongoing actions, initially carried out only by CEA-INSTN, ENSTTI, Universidad Politecnica de Madrid, Tecnatom and ISaR, under the Coordination of ENEN.



Figure 3. Roll-up collecting the logos of ongoing ENEN activities and projects

### **ENEN RU-II**

This project, coordinated by ENEN, is the ideal continuation of the ENEN RU project, which was held in past years, and has the purpose to build on the results achieved at the time to set up joint Education and Training courses with Russian institutions, namely CICET and MEPHI-NRNU. The project is gathering the interest of participants and useful exchanges have been already performed or are being planned. In addition MoUs for student exchanges are being signed by the involved Universities.

### **PETRUS-III**

It is a project coordinated by the Université de Lorraine whose objective is to promote Education and Training (E&T) in the field of geological disposal of radioactive waste. The role of ENEN in the project is to support the development of certifications applicable in the field of geological disposal, also making use of the experience gained with EMSNE, and to provide long term sustainability to the PETRUS Consortium, which will be hosted within the Association to find a legal frame in which its actions can continue in the future.

In addition to the above projects approved under FP7, ENEN is also participating or coordinating two new Horizon 2020 projects.

### **CORONA-II**

This project, coordinated by the Kozloduy NPP, is aimed to enhance the safety of VVER nuclear installations through further improvement of the training capabilities necessary for building up the required personnel competencies. The role of ENEN in this frame will be to provide sustainability to the related training academy in the long term.

## ANNETTE

This project (Advanced Networking for Nuclear Education and Training and Transfer of Expertise), coordinated by ENEN, is aimed at promoting a better level of coordination among the different actors in the nuclear Education and Training fields. As it can be noted in Figure 4, the coordination work package represents the major action under which the project will be conducted, while it adhered to the explicit suggestion of the Euratom call to prepare courses for Continuous Professional Development in the frame of a “Master” and of Summer Schools. The project was launched recently and the initial attention to the development of new courses was integrated by a specific attention to the adoption of e-learning tools, considering also the possibility to prepare Massive Open Online Courses (MOOCs) in nuclear matters. Transfer of expertise will be performed not only by setting up the courses, but also by preparing textbooks and/or multimedia (generational transfer) and planning personnel exchanges in industry in different countries (cross-border transfer). Education and Training and Information actions are also included, specifically concerning nuclear safety culture, to provide support and further development to the actions going on within the NUSHARE project.

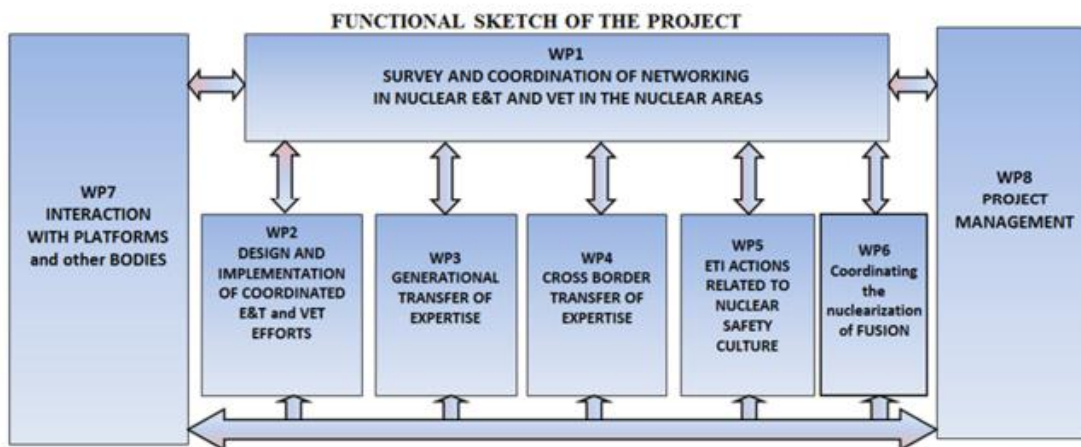


Figure 4. Work packages in the ANNETTE Project

As it can be noted, WP6 relates to the mentioned “nuclearisation” of fusion, involving the proposal of courses in which the engineering competencies from the field of fission can be usefully integrated in the ongoing development of fusion machines. All the actions are aimed to be developed in strict cooperation with stakeholders and end-users, being the technological platforms and the other bodies interested in the development of courses, course material and coordination activities in E&T.

## EACEA EUJEP 2

The EUJEP project is financed by EACEA and allows for exchanges of students and teachers between ENEN Members and a group of Universities (TokyoTech and Fukui and Kyoto Universities), together with JAEA. This project represents a very good opportunity for students of both sides to enrich their culture about different geographical areas and spend a fruitful period of study and research abroad.

## 4. A new level and new roles

### New level in coordination

With the participation in the presently ongoing projects, the European Nuclear Education Network is achieving a new level in its service in the fields of nuclear education and training. Proposing coordination in the frame of ANNETTE represents a major step; several times the need was felt to avoid gaps and superposition in nuclear E&T activities led by neighboring working groups and the present initiative, born after checking the availability to join or support ENEN in this effort by the most important actors in the field, will try to achieve a better tightness and harmonization.

### **Better connection between course providers and stakeholders**

The worth of ANNETTE will be also in the attempt to deepen the dialogue between course providers (e.g., academia and research centers) and stakeholders (e.g., industry and platforms). Though the availability of a rather comprehensive offer of courses has been already considered at the time of preparing the proposal, for necessary realism in setting up the Consortium, this offer may be adapted in its detailed learning outcomes in an open dialogue with stakeholders. It is expected that this renewed cooperation will be profitable for developing the content of planned courses and also for establishing a systematic channel of exchanges that will suggest joint actions and better coordinated efforts in the future. In this regard, ANNETTE will be a workbench for establishing these improved contacts between course providers and stakeholders that is expected to make emerging all the challenges and the opportunities involved in this endeavor.

### **Long term sustainability of European projects**

One of the roles of ENEN emerged in different ongoing and concluded projects is to offer long term sustainability to actions that would otherwise remain unexploited after project completion. It is the case, for instance, of the TRASNUSAFE project, aimed to design, develop and validate training schemes on nuclear safety culture for professionals operating at a high level of managerial responsibility in the industrial and the medical sectors, whose courses are being now inherited by ENEN. A specific MoU has been signed between ENEN and the TRASNUSAFE consortium in this regard, in order to leave to the Association the job of yearly advertising and organizing the courses, through a specific Working Group.

Similarly, also the actions planned within the PETRUS-III and the CORONA-II project represent attempts to provide sustainability to projects that will have a long term wake for their useful products. ENEN can play this role of becoming the home for such initiatives.

### **Transnational certifications**

In similarity with the role played through the EMSNE, ENEN can host or facilitate the development of transnational certifications that can be released to different categories of professionals to testify for the acquisitions of knowledge, skills and competencies. This can be achieved by the involvement within ENEN of groups of experts that will recognize the acquisition of the related credits (in agreement with the ECVET system, in particular) according to specific bylaws. Discussions occurred in recent times showed a strong interest for this kind of certifications that, being initially released just on the basis of common agreement, might later become a standard. Though these actions represent clear challenges, it must be recognized that similar processes are already going on in EU projects and that there is already a realistic basis for proposing them.

## **5. Conclusions**

The European Nuclear Education Network is nowadays the result of 13 years of work performed by its Members and its Staff. The actions described herein testify for the vitality of the Association, even in a difficult period for the studies in the nuclear fields.

By the way, it is exactly in these difficult periods that the worth of the existence of an Association like ENEN is mostly felt: maintaining and developing education and training in the nuclear fields represents an action whose value can be appreciated just when the Association has to perform as a flywheel in preserving the momentum that education and training actions must possess in the long term, in order to avoid loss of competences. The new roles of the Association described in the previous section represent partly achieved objectives, partly challenging ones whose achievement requires a higher level of cooperation within the Association and with stakeholders.

In a nutshell, ENEN represents achievements already in place and provides a platform for many opportunities being vital for the sustainable future of the nuclear power. An example is the long-term consolidation and strengthening of the nuclear E&T activities in the EU and its member countries, which will only succeed through a vigorous support of all nuclear stakeholders.