The European Nuclear Education Network Association - ENEN

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ABSTRACT

The temporary network, established through the European 5th Framework Programme project ENEN, was given a more permanent character by the foundation of the European Nuclear Education Network Association, a non-profit-making association according to the French law of 1901, pursuing a pedagogic and scientific aim. Its main objective is the preservation and the further development of higher nuclear education and expertise. This objective is realized through the co-operation between the European universities, involved in education and research in the nuclear engineering field, the nuclear research centres and the nuclear industry. The membership of the ENEN Association now consists of 35 universities members and 6 research centres. The paper briefly describes the history and structure of the ENEN Association and elaborates on the objectives and activities of its five committees during its first two years of operation. Supported by the 5th and 6th Framework Programme of the European Community, the ENEN Association established the delivery of the European Master of Science in Nuclear Engineering certificate. In particular, education and training courses have been developed and offered to materialise the core curricula and optional fields of study in a European exchange structure. Pilot editions of those courses and try-outs of training programmes have been successfully organised with a satisfying interest, attendance and performance by the students and the support of nuclear industries and international organisations. The involvement of ENEN in the 6th EC Framework project EUROTRANS will further enlarge its field of activities into a realm of nuclear disciplines. The ENEN Association further contributes to the management of nuclear knowledge within the European Union as well as on a world-wide level, through contacts with its sister Network ANENT in Asia, and by its participation to activities of the World Nuclear University.

1 HISTORY

The ENEN Association has its roots in the Lisbon 2000 European Union summit, which proposed as a major strategic goal for the EU to become the most competitive knowledge-based economy with more and better employment and social cohesion by 2010. With respect to nuclear knowledge specific concerns were expressed in two important studies [1] [2] stating as a conclusion that “Although the number of nuclear scientists and technologists may appear to be sufficient today in some countries, there are indicators that future expertise is at
risk. In most countries, there are now fewer comprehensive, high quality nuclear technology programmes at universities than before. The ability of universities to attract top quality students, meet future staffing requirements of the nuclear industry, and conduct leading-edge research is becoming seriously compromised.”

In the 5th Framework EC programme, the “European Nuclear Engineering Network” project is started in January 2002 to establish the basis for conserving nuclear knowledge and expertise by creating a European Higher Education Area for nuclear disciplines and initiating the implementation of the Bologna declaration in the nuclear curricula. As a first priority a harmonized curriculum for nuclear engineering is developed and agreed on by the partners of the ENEN project. In order to preserve the achievements of the project and to formalize the European Higher Education Area in the nuclear disciplines, the European Nuclear Education Network Association is founded on September 22, 2003, as a non-profit-making association according to the French law of 1901, pursuing a pedagogic and scientific aim. The results and deliverables of the ENEN project are available on the web site http://www.sckcen.be/enen.

2 THE ENEN ASSOCIATION

The general goals of the ENEN Association are defined with respect to the academia as follows:

- To develop a more harmonized approach for education in the nuclear sciences and nuclear engineering in Europe;
- To integrate European education and training in nuclear safety and radiation protection;
- To achieve a better cooperation and sharing of academic resources and capabilities at the national and international level;

and with respect to the end users, such as nuclear industries, regulatory bodies, nuclear applications, etc.

- To create a secure basis of skills and knowledge of value to the European Union;
- To maintain an adequate supply of qualified human resources for design, construction, operation and maintenance of nuclear infrastructures, industries and power plants;
- To maintain the necessary competence and expertise for the continued safe use of nuclear energy and applications of radiation in industry and medicine.

The objectives and structure of the ENEN Association are formulated in the Statutes, following the conclusions and recommendations of 5th Framework ENEN Project, with the Mission of the ENEN Association being the “Preservation and the Further Development of Higher Nuclear Education and Expertise”.

A first series of objectives is formulated, which will have to be revised and renewed as they are achieved in the future. The current objectives are the following:

- To deliver a European Master of Science degree in Nuclear Engineering;
- To encourage and support PhD studies;
- To promote exchange of students and teachers participating in the European Nuclear Education Network;
- To establish a framework for mutual recognition;
- To foster and strengthen relations between universities, nuclear research laboratories, industries and regulatory bodies;
To ensure the quality of nuclear engineering academic education, training and research;
To create incentives and increase career attractiveness for the enrolment of students and young academics in nuclear disciplines.

In order to achieve the objectives, the ENEN Association will facilitate exchanges and cooperation among the academia themselves and strengthen their interactions with research centers, thereby assisting them to attract young and brilliant students by identifying, developing and disseminating new and challenging subjects for research work. Confronted with a lack of interest from students, universities also need to be convinced to recruit new academic members for teaching and research in nuclear disciplines and for maintaining expertise in key nuclear areas. The ENEN Association is therefore developing, promoting and supporting ENEN exchange courses in nuclear disciplines, further by disseminating and supporting the concept of life long learning in the nuclear field, and by facilitating and coordinating the participation of universities to European research projects. The ENEN Association thereby relies on the European Union to promote international cooperation, to support the mobility of teachers, students and researchers, also including central and Eastern Europe. The European Union should also provide a new architecture for a nuclear “European Research Area” in search for excellence and set favorable conditions to create added value through university-industry collaborations.

To the benefit of the End-Users, the ENEN Association intends to conserve the nuclear knowledge and improve access to expertise by developing and establishing databases, web sites and distance learning tools. In a multinational framework it is also mandatory to define the goals and set up the criteria for mutual professional recognition and recruitment throughout the EU. The ENEN Association also provides resources and lecturers for advanced training courses, for professional upgrades and continual training programmes. Further it has a role as an interface between academia and industries to identify, disseminate and support interesting projects and research topics for internships, master theses and PhDs. The role of the European Union is to provide a framework for the quality assurance of the advanced courses and professional training programmes through accreditation and ranking. It is expected to construct a nuclear “European Education and Training Area” under competitive conditions of quality and cost and to develop a framework for mutual recognition of professional training, licensing and recruitment throughout the EU.

The ENEN Association has two kinds of members. The Effective Members, essentially academia, should have a legal status in an EU country or a candidate EU member country, provide high level scientific education in the nuclear field as a full time teaching programme or in combination with research work and use selective admission criteria; the Associated Members should have a legal status in an EU country or a candidate EU member country, have a long term tradition of relations with effective members in the field of research, training or education and commit themselves to support the ENEN Association.

The ENEN association is managed by a Board of Governors, elected by the General Assembly and the work is organised through a Management Committee. The Management committee is constituted by the Secretary General, appointed by the Board of Governors, and the Chairpersons of the five working committees, which are dedicated to specific tasks, as shown in Table 1. Currently the ENEN Association has 41 members, consisting of 35 universities and 6 research centres, of which 28 are Effective Members and 13 are Associated Members. Without members from the industry and with an overwhelming membership of universities, the ENEN Association seems currently mainly oriented to academic activities. Still, as shown below, the training programmes and courses are well attended by young professionals from nuclear industries.

Proceedings of the International Conference “Nuclear Energy for New Europe 2005”
Table 1: Structure of the ENEN Association

<table>
<thead>
<tr>
<th>Advisory Committee</th>
<th>General Assembly</th>
<th>Honorary Members Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Board of Governors</td>
<td>Committee</td>
</tr>
<tr>
<td></td>
<td>Secretary General</td>
<td></td>
</tr>
<tr>
<td>Chairperson</td>
<td>Chairperson</td>
<td>Chairperson</td>
</tr>
<tr>
<td>Committee 1</td>
<td>Committee 2</td>
<td>Committee 3</td>
</tr>
<tr>
<td>Chairperson</td>
<td>Chairperson</td>
<td>Chairperson</td>
</tr>
<tr>
<td>Committee 2</td>
<td>Committee 3</td>
<td>Committee 4</td>
</tr>
<tr>
<td>Teaching &amp; Academic Affairs Committee</td>
<td>Advanced Courses &amp; Research Committee</td>
<td>Quality Assurance Committee</td>
</tr>
<tr>
<td>Chairperson</td>
<td>Chairperson</td>
<td>Chairperson</td>
</tr>
<tr>
<td>Committee 3</td>
<td>Committee 4</td>
<td>Committee 5</td>
</tr>
<tr>
<td>Chairperson</td>
<td>Chairperson</td>
<td></td>
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<tr>
<td>Committee 4</td>
<td></td>
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<tr>
<td>Chairperson</td>
<td></td>
<td></td>
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<tr>
<td>Committee 5</td>
<td></td>
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<tr>
<td>4*+2**</td>
<td>3*+2**</td>
<td>2*+3**</td>
</tr>
<tr>
<td>* Effective Member</td>
<td>** Associated Member</td>
<td></td>
</tr>
</tbody>
</table>

3 THE ENEN COMMITTEES

The work within ENEN is performed by the ENEN Committees. The core of the committees is formed by five to six Effective and Associated members nominated by the Board of Governors. The core calls on any other ENEN member for carrying out specific tasks and producing specific deliverables in the framework of EC supported projects or to fulfil obligations resulting from commitments made by the ENEN Association. The following paragraphs describe the composition, the tasks and some recent achievements of the ENEN Committees.

3.1 Teaching and Academic Affairs Committee (TAAC)

The Teaching and Academic Affairs Committee is formed by the following members:

- Katholieke Universiteit Leuven – Chair (B)
- Ecole Polytechnique Fédérale de Lausanne (CH)
- Universitatea Politehnica București (RO)
- Institute for Safety and Reliability (D)
- HMS Sultan (UK)
- Univerza v Ljubljani (SLO)

TAAC has established and continues to monitor the equivalence and to promote the harmonisation of nuclear engineering education curricula at the ENEN member universities. A reference curriculum consisting of a core package of courses and optional substitute courses in nuclear disciplines has been designed and mutually recognised by the ENEN members. TAAC has designed an information leaflet to attract applications for the ENEN certificate of European Master of Science in Nuclear Engineering (EMSNE). It has developed and implements the bylaws and procedures for receiving and selecting applications and for awarding the EMSNE certificate. TAAC also has the task to promote student and faculty exchanges by encouraging and supporting the organization of international exchange courses and high-quality nuclear engineering courses by the ENEN members. In this framework TAAC produced an information package on 10 established
ENEN exchange courses, 23 proposed exchange courses and 5 master thesis projects at ENEN member institutions. In cooperation with the ENEN Quality Assurance Committee, TAAC awards an International ENEN Course Quality label. All information is posted on the ENEN Web site http://www.enen-assoc.org. Other products of TAAC are available on the web site of the 6th Framework project NEPTUNO http://www.sckcen.be/neptuno and include guidelines, best practices and do-it-yourself kits for the organization of international ENEN exchange courses with examples of flyers and application forms.

3.2 Advanced Courses and Research Committee (AC&RC)

The Advanced Courses and Research is formed by the following members:

- Universidad Politecnica de Madrid – Chair (E)
- Kungl Tekniska Högskolan Stockholm (SE)
- HMS Sultan (UK)
- Studiecentrum voor Kernenergie SCKCEN (B)
- Consortium Interuniversitario CIRTEN (I)

The Advanced Courses and Research Committee ensures the link between ENEN members and research laboratories in the European Community. It establishes exchanges with other networks and, through maintaining tight relations with research centres, universities and industry, it identifies and disseminates topics for internships, master theses and PhDs. AC&RC also encourages and supports student mobility. It defines, designs and organizes advanced courses for students, PhD candidates and young professionals. On the basis of a questionnaire, interests for advanced courses have been identified as listed in Table 2.

Table 2 : Advanced Courses Proposed by ENEN Members

<table>
<thead>
<tr>
<th>Title</th>
<th>Organization</th>
<th>ECTS</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling and Uncertainty in System Thermal Hydraulics</td>
<td>CIRTEN Univ. Pisa</td>
<td>6-8</td>
<td>2006</td>
</tr>
<tr>
<td>Coupled 3D Neutron Kinetics and Thermal Hydraulics; application to Nuclear Reactor Theory</td>
<td>CIRTEN Univ. Pisa</td>
<td>6-8</td>
<td>2006</td>
</tr>
<tr>
<td>System Thermal Hydraulic Code Assessment and Code User Training an Qualification</td>
<td>CIRTEN Univ. Pisa</td>
<td>6-8</td>
<td>2006</td>
</tr>
<tr>
<td>Natural Circulation in Existing Reactors and Innovative Reactor Concepts</td>
<td>CIRTEN Univ. Pisa</td>
<td>6-8</td>
<td>2006</td>
</tr>
<tr>
<td>Radiological Protection</td>
<td>Univ. Manchester</td>
<td>6-8</td>
<td>2 weeks 4/2006</td>
</tr>
<tr>
<td>Safety Aspects of WWER Operation</td>
<td>Univ. Bratislava</td>
<td>15-20</td>
<td></td>
</tr>
<tr>
<td>Eugene Wigner extension: Experimental Training in Reactor Physics on LW critical Assembly</td>
<td>Ustav Jaderného Výzkumu Řež</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>MSc. Nuclear Reactor Design Study (Project)</td>
<td>HMS Sultan</td>
<td>30</td>
<td>4-10 2006</td>
</tr>
</tbody>
</table>

Proceedings of the International Conference “Nuclear Energy for New Europe 2005”
The AC&RC is also in charge of the organization of 10 advanced training courses for PhD students in the framework of the participation of the ENEN Association to the EU 6th Framework Integrated Project EUROTRANS. This project aims at the design and feasibility assessment of an industrial prototype Accelerator Driven System dedicated to the transmutation of long–lived radioisotopes, mainly actinides, after their partitioning from high level waste streams. Seventeen universities from eight countries are represented by the ENEN Association in this project. The training courses will cover the large variety of research topics addressed by the project. In cooperation with TAAC, AC&RC produced recommendations for the organization of advanced courses, for mentoring PhD students and for continued academic education on an international basis. They are available from http://www.sckcen.be/neptuno.

3.3 Training and Industrial Projects Committee (T&IPC)

The Training and Industrial Projects Committee is formed by the following members:

- Institut Jožef Stefan – Chair (SLO)
- Institute for Safety and Reliability (D)
- Institut National des Sciences et Techniques Nucléaires (F)
- Ustav Jaderného Výzkumu Řež (CZ)
- (vacant)

The Training and Industrial Projects Committee identifies the industrial needs for continued professional development and organizes continuous training sessions and courses on different subjects of common interest for ENEN Associated members, regulator bodies and nuclear industries. T&IPC maintains and disseminates a database on third cycle advanced courses and continued professional development sessions. It facilitates and supports professional training, the mobility of professionals and lecturers, assists in accessing large nuclear infrastructures and integrates European industrial and national projects.

The training courses organised in the framework of the NEPTUNO project are listed in Table 3. Open to students as well as to professionals, they were mainly attended by young professionals from a variety of nuclear industries and regulatory bodies inside and outside the European Union.

<table>
<thead>
<tr>
<th>Title</th>
<th>Participants</th>
<th>Countries</th>
<th>Renewal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENEN Training Course on Nuclear Safety INSTN Saclay, April 4-22, 2005</td>
<td>12 (1 student)</td>
<td>AUL, CZ, D, IND, ISR, SLK, SAF, SE</td>
<td>2006 Germany</td>
</tr>
<tr>
<td>ENEN – EUR Training Course on Leveling the Playing ground for New Nuclear Power Plants in Europe Helsinki, June 6-10, 2005</td>
<td>35 (5 students)</td>
<td>B, BUL, CZ, D UK, FIN, I, LIT LUX, NL, RUS, SLK,SE, CH,UKR</td>
<td>To be decided</td>
</tr>
<tr>
<td>ENEN-SUTB-CENS Course on Nuclear Safety of WWER Bratislava, May 2-6, 2005</td>
<td>10 (1 student)</td>
<td>B, BUL, HUN, SLK, SLO, SE</td>
<td>To be decided</td>
</tr>
</tbody>
</table>

Table 3 : Topical Training Courses for Professionals and Students [3]
3.4 Quality Assurance Committee (QAC)

The Quality Assurance Committee is formed by the following members:

- Teknillinen Korkeakoulu Helsinki – Chair (SU)
- Université Catholique de Louvain (B)
- Institut National des Sciences et Techniques Nucléaires (F)
- Budapesti Müszaki és Gazdaságtudományi Egyetem (HU)
- Centrul de Inginerie Tehnologica Objective Nucleare (RO)

The Quality Assurance Committee develops and implements QA processes to be applied in the design and delivery of education and training courses by the ENEN members. It collects information about rules and practices such as selection, training and certification of teachers and proposes a scheme for their harmonisation. The QAC evaluates and monitors the quality of current and newly proposed members of the ENEN Association according to set of agreed criteria. Following the recommendations issued by the QAC, the Board of Governors proposes new membership applications to the General Assembly. The QAC further evaluates courses and awards the International ENEN Course label, in collaboration with the ENEN TAAC.

3.5 Knowledge Management Committee (KMC)

The Knowledge Management Committee is formed by the following members:

- Slovenská Technická Univerzita v Bratislave – Chair (SK)
- Atominstitut der Österreichischen Universitäten (A)
- Interfacultair Reactor Instituut – TU Delft (NL)
- Studiecentrum voor Kernenergie SCKCEN (B)
- Universität Stuttgart (D)

The Knowledge Management Committee identifies and monitors deficiencies in scientific knowledge relevant to nuclear technology and safety. It prepares, maintains and implements an action plan by academia in order to preserve valuable scientific knowledge. KMC ensures efficient use of ICT for the dissemination of knowledge, for supporting teaching and learning, for accessing and maintaining databases and for using of simulators and specialized software. It also publishes books, and produces CDs and DVDs of interest to ENEN members. KMC also has the task to integrate the current different web sites and to operate them as a single ENEN web site and communication system.

An important achievement made within the 6th Framework NEPTUNO project is the NEPTUNO communication system currently operated by the University of Stuttgart under [http://www.neptuno-cs.de](http://www.neptuno-cs.de). It is in full operation since August 2004 and provides the platform for a common knowledge base for nuclear fission. It merges classical database driven information systems with role-based research and education functionalities to a common knowledge system. The system is constructed on a framework that uses a LEGO like approach to build web-based knowledge and communication systems for research and training using basic system components. The basic system components are currently customized to the NEPTUNO needs. Each component can be programmed to have access to other components, for example an on-line course can be supported by a simulation package. The system should
also provide basic support for communication in the nuclear community like addresses, data bases, technologies, E-learning platforms, etc.

One of the components is a well-documented database on nuclear courses and training sessions. In total 746 courses collected from various sources and datasheets are arranged in 4 types - education, training, education and training, others - and in 14 categories covering different nuclear disciplines. In a restricted area of the system, the courses are submitted for confirmation to the organizing institutions, after which they will be released to the public pages of the system as approved courses. Until now 198 courses have been approved in this way. 548 Courses have not yet been approved by the organizing institution, which means they are discontinued, obsolete or not currently supported.

The access to the communication system is designed to allow for different users a role-dependent view on a common data base. Views on the database are optimized to respond to the needs of the role, which can be a teacher, a student, a scientist, etc. In this way the knowledge can be more easily managed, preserved and updated. The information is kept in one place with different access methods depending on the goal to be achieved. Moreover, to the different users in their different roles, the information is consistent.

The communication system intends to support different aspects of Knowledge Management and in particular:

Knowledge Production
- Provide forms for information input e.g. related to nuclear courses, experimental facilities, knowledge centers, etc.
- Provide tools to store, update, select and visualise documents, reports, tables, presentations, videos, media, etc.
- Accept existing databases for reformating and reuse of data

Knowledge Dissemination
- Provide basic tools to support net-based seminars and master theses
- Provide commented hyperlinks to pages in nuclear education and training
- Provide role-based views and access to the content of the system
- Provide reports on selected nuclear applications and fields (e.g. nuclear safety)

Knowledge Exploitation
- Provide optimized role-based view on the content of the system
- Provide methods to analyze the stored information
- Provide access to consistent and updated information
- Put information into context of specific roles and applications
- Allows to combine information from different sources

4 CONCLUSION AND PERSPECTIVES

Barely two years after being founded, the ENEN Association has completed a variety of tasks and delivered appreciated products to the European Higher Education and the European Research Areas, as described in the previous paragraphs. The financial support from the EC provided through the NEPTUNO project has been a substantial contribution to reach those achievements. Although the present working field of the ENEN Association started with, and was limited to academic nuclear engineering education, the Association intends to expand into nuclear disciplines outside nuclear engineering, such as radioprotection, radiochemistry and waste management. The Association also wishes to expand its activities from the
academic and research environment into the industrial and regulatory fields and attract the membership of industrial partners and regulatory bodies. Moving out from basic and advanced academic education, the Association intends to define and harmonize for professional training programmes directed to key functions in nuclear industries, regulatory bodies and nuclear applications, and promote their international mutual recognition. The ENEN association further intends to continue its participation to EC framework projects, in particular in the European Higher Education and European Research Areas. Finally, the ENEN Association will strengthen cooperation with the World Nuclear University and the regional nuclear education networks in Asia, North America and elsewhere, and continue to promote and support their activities. It will be up to the ENEN Association, its structural bodies, committees and their members to take up this challenging programme, which will significantly contribute to the management of nuclear knowledge within the European Union as well as on a world-wide level.

ACKNOWLEDGMENTS

The contributions to the achievements, as described in this paper, as well as the documents produced by the ENEN Association members and by the other partners of the NEPTUNO project, are gratefully acknowledged. The financial support provided by the EC through the 6th Framework programme, the guidance given and the continuing motivation and confidence expressed by the EC representatives towards the ENEN Association is particularly appreciated.

REFERENCES

