The Role of the European Nuclear Education Network Association in the Management of Nuclear Knowledge

Peter P. De Regge, Secretary General
On behalf of the ENEN Association

STARTING POINT

The Lisbon 2000 summit proposed the strategic goal for the European Union to become the most competitive knowledge-based economy with more and better employment and social cohesion by 2010.

"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”.

Quotation taken from

HISTORY and DEVELOPMENT

- 5th Framework EC programme, January 2002
  The “European Nuclear Engineering Network” project:
  - establishes the basis for conserving nuclear knowledge and expertise
  - creates a European Higher Education Area for nuclear disciplines
  - initiates the implementation of the Bologna declaration in the nuclear disciplines
  - Deliverables and results at http://www.sckcen.be/enen/

- The European Higher Education Area is formalised by creating the European Nuclear Education Network, the “ENEN” Association under the French law of 1901, on 22 September 2003

ENEN GENERAL GOALS

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

Towards the End-users (industries, regulatory bodies, applications)
- To create a secure basis of skills and knowledge of value to the EU
- To maintain an adequate supply of qualified human resources for design, construction, operation and maintenance of nuclear infrastructures and plants
- To maintain the necessary competence and expertise for the continued safe use of nuclear energy and applications of radiation in industry and medicine.
ENEN Mission and First Objectives

- **MISSION**
  - the preservation and further development of higher nuclear education and expertise

- **OBJECTIVES**
  - to deliver a certification of European Master of Science 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

Actions towards the Universities

- **Assist universities to attract young and brilliant students by**
  - identifying, developing and disseminating new and challenging subjects for research
  - establishing links and cooperation with research centres

- **Convince universities to recruit new academic members for teaching and research in nuclear disciplines and maintaining expertise in key nuclear areas by**
  - developing, promoting and supporting ENEN exchange courses in nuclear disciplines
  - disseminating and supporting the concept of life long learning in nuclear disciplines
  - facilitate and coordinate the participation of universities to European research projects
Actions towards the Universities

What can be the role of the EU?

- Promote international co-operation, mobility of teachers, students and researchers, including central and eastern Europe
- Provide a new architecture for a nuclear “European Research Area” in search for EU excellence
- Set the conditions to create added value through university-industry collaboration

Actions towards the End users

- Conserve the nuclear knowledge and improve the expertise by developing and establishing databases, web sites and distance learning tools
- Define the goals and set up the criteria for professional recognition and recruitment throughout the EU
- Provide resources and lecturers for advanced training courses, professional upgrades and continual training programmes
- Identify, disseminate and support interesting projects and research topics for internships, master theses and PhDs
Actions towards the End users

What can be the role of the EU?

- Ensure quality assurance of the advanced courses and professional training programmes (accreditation, ranking, etc)
- Construct the nuclear “European Education and Training Area” under competitive conditions of quality and cost
- Develop the framework for mutual recognition of professional training, licensing and recruitment throughout the EU

ENEN Members

- **Effective members**
  - have a legal status in an EU country or a candidate EU member country
  - provide high level scientific education in the nuclear field, as full time teaching or in combination with research work
  - use selective admission criteria
- **Associated members**
  - 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
  - commit themselves to support the ENEN Association
ENEN Members, August 2005

- 35 Universities
- 6 Research Centres

located in 18 European Countries

taking advantage of mutual recognition within the philosophy of the Bologna declaration and of operational exchange schemes for teachers and students (ERAMUS) within the European Union and worldwide (ERASMUS Mundus)

Overview of ENEN Members
ENEN Structure

<table>
<thead>
<tr>
<th>General Assembly Board of Directors (Governing Board)</th>
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</thead>
<tbody>
<tr>
<td>(Management Committee)</td>
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<tr>
<td>Chairman Committee 1</td>
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<tr>
<td>Chairman Committee 5</td>
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<tr>
<td>Secretary General</td>
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</table>

| Teaching and Academic Affairs Committee: 3**+2** |
| Advanced Courses & Research Committee: 3**+2** |
| Training and Industrial Projects Committee: 2**+3** |
| Quality Assurance Committee: 3**+2** |
| Knowledge Management Committee: 3**+2** |

FIVE ENEN COMMITTEES(1)

Teaching and Academic Affairs Committee:

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

Objectives and tasks: Dissemination of Knowledge

- Awarding the European Master of Science in Nuclear Engineering certification.
- Promoting student and faculty exchange by encouraging and supporting the organisation of international exchange courses by ENEN members.
- Promoting the harmonisation of nuclear engineering curricula throughout Europe.
- Supporting the organisation of high-quality nuclear engineering courses by ENEN members.
- Awarding the International ENEN Course label, in collaboration with the ENEN Quality Assurance Committee.
**European Master of Science in Nuclear Engineering**

**Undergraduate Engineering Study (years)** | ENG 3y | ENG 4y | ENG 5y | ENG 5y
---|---|---|---|---
**Engineering (nuclear / non nuclear)** | any | any | Nuclear | Nuclear
**Electives (at least 3)** | 3 | 4 | 5 | 5
**ECTS accumulated to complete** | 210 | 240 | 300 | 300

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<th>3</th>
<th>4</th>
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| Thesis (12-24 ECTS) | 12 | 12 | 12 | 30
| Fixed | 18 | 12 | 6 | 12
| Variable | 30 | 30 | 30 | 12
| Total ECTS to EMNE | 300 | 330 | 360 | 330

**EMSNE Flyer**

The EMSNE programme aims to provide a comprehensive education in nuclear engineering, covering all aspects of the field, from fundamental principles to advanced applications.

**Contact**

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Fax: +39 040 379 3220
Email: info@emsne.org

**European Nuclear Education Network**

The European Nuclear Education Network (ENEN) is an international network of European universities and research centres, aiming to foster excellence in nuclear engineering education. ENEN offers an EMNE Master of Science in Nuclear Engineering. For more information, visit the ENEN website.
### EMSNE Nuclear Core Courses

<table>
<thead>
<tr>
<th>Preferred Nuclear Core Courses</th>
<th>ECTS</th>
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<tbody>
<tr>
<td>Introduction to Reactor Engineering</td>
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<tr>
<td>Reactor Physics</td>
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<tr>
<td>Nuclear Thermal Hydraulics</td>
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<tr>
<td>Safety and Reliability of Nuclear Facilities</td>
<td>6</td>
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<tr>
<td>Reactor Engineering Materials</td>
<td>6</td>
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<tr>
<td>Radiology and Radiation Protection</td>
<td>6</td>
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<tr>
<td><strong>Preferred Nuclear Core Laboratory Course</strong></td>
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<tr>
<td><strong>Nuclear Reactor Engineering Laboratory</strong></td>
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### EMSNE Substitute Core Courses

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<td>Fluid Mechanics</td>
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<td>Reactor Control and Instrumentation</td>
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<td>Nuclear Waste Processing and Disposal</td>
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<tr>
<td>Reactor Kinetics</td>
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<tr>
<td><strong>Substitute Nuclear Core Laboratory Courses</strong></td>
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<tr>
<td><strong>Nuclear and Radiation Physics Laboratory</strong></td>
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<tr>
<td><strong>Plant Simulation Laboratory</strong></td>
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</table>
## EMSNE Related Documents

- ENEN Web site [http://www.enen-associ.org](http://www.enen-associ.org)
  - EMSNE Flyer
  - EMSNE Application Forms
  - EMSNE Bylaws

## Others

- Assessment Guidelines for evaluating Applications

### International Exchange Courses

<table>
<thead>
<tr>
<th>ID</th>
<th>Course Name</th>
<th>Organisation</th>
<th>Domain</th>
<th>Theory</th>
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### Confirmed ENEN Exchange Courses

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### Master Thesis Projects
### Proposed ENEN Exchange Courses

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### ENEN Exchange Course Related Documents

- **NEPTUNO Web site**
  - [http://www.neptuno-cs.de](http://www.neptuno-cs.de)

- **Overview of ENEN International Exchange Courses**
- **Best Practices for International ENEN Exchange Courses**
  - **Do-it-yourself-kit**
  - **Flyers**
  - **Application Forms**
FIVE ENEN COMMITTEES(2)

Advanced Courses and Research Committee

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

Objectives and Tasks:

- Production and Dissemination of Knowledge
  - Ensure the link between ENEN members and research laboratories in the European Community
  - Identify and disseminate topics for internships, master theses and Ph.Ds
  - Encourage and support student mobility
  - Define, design and organise advanced courses for students, Ph.D candidates and young professionals

ENEN Advanced Courses

Topics identified as the result of a questionnaire on needs

- Scaling and Uncertainty in System Thermal Hydraulics
- Coupled 3D Neutron Kinetics and Thermal Hydraulics and Application to Nuclear Reactor Theory
- System Thermal Hydraulic Code Assessment and Code User Training and Qualification
- Natural Circulation in Existing Reactors and Innovative Reactor Concepts
- Radiological Protection
- Safety Aspects of WWER Operation
- Eugene Wigner extension. Experimental Training in Reactor Physics on LW critical Assembly
- MSc Design Study (Project)
- Reactor Physics for Accelerator Driven Systems
- Nuclear Fusion Technology
- International Course on Advanced Thermal Hydraulic
- Advanced Course on Pressure Vessel Aging
ENEN Advanced Courses

Example

- Lecture programme:
  - The basic principles of the course are to provide the student with a thorough understanding of the operation principles of nuclear incineration systems.
  - Review of incineration, plasma incineration, and pyrolysis.
  - Overview of industrial and laboratory applications.
  - Incineration, incineration, and incineration.
  - Inertial confinement fusion and incineration.
  - Inertial confinement fusion and incineration.

Course aims:
- At the end of the two-week course, the student is expected to:
  - Understand the principles of nuclear incineration systems.
  - Understand the operation principles of nuclear incineration systems.
  - Understand the operation principles of nuclear incineration systems.

IP EUROTRANS

Objective
Design and feasibility assessment of an industrial prototype Accelerator Driven System dedicated to transmutation, together with the definition of a design backup solution, to perform Nuclear Incineration of Long-lived Radioisotopes after their partitioning from high level waste streams.

Budget
2005-2008 (EC Contribution)
- Total: 23 Mio €
- Education and Training: 1.8 Mio €
ENEN in IP EUROTRANS

- 17 EU Universities participate to IP EUROTRANS through the ENEN Association
- the ENEN Association
  - Represents them at the EUROTRANS Coordination Committee and other governing bodies
  - Facilitates interaction and cooperation between research scientists and PhD students
  - Organises 10 specialised (advanced) courses on project related topics, involving lectures, scientific visits, joint experiments, and training sessions
- Requirements
  - Universities are full ENEN Members

Universities represented by ENEN in IP EUROTRANS

- Party P13.1: AGH Krakow, University of Science and Technology, Poland
- Party P13.2: TUW, Vienna University of Technology, Austria
- Party P13.3: CIRTEN, Inter University Consortium for Nuclear Technological Research, Italy
- Party P13.4: IAP-FU Frankfurt, J.W. Goethe-Universität, Germany
- Party P13.5: IQS, Institut Quimic de Sarria, Spain
- Party P13.6: KTH Stockholm, Kungl Tekniska Högskolan, Sweden
- Party P13.7: RUB-LEE Ruhr-Universität Bochum, Germany
- Party P13.8: TU Delft, Delft University of Technology, The Netherlands
- Party P13.9: UCL, Université Catholique de Louvain, Belgium
- Party P13.10: ULG, University of Liège, Belgium
- Party P13.11: UNED Madrid, Universidad Nacional de Educación a Distancia, Spain
- Party P13.12: UPM, Universidad Politécnica De Madrid, Spain
- Party P13.13: UPV, Universida Politécnica de Valencia - Instituto de Ingeniería Energética, Spain
- Party P13.14: USIC, Universidade de Santiago de Compostela, Spain
- Party P13.15: USC, Universidad de Sevilla, Spain
- Party P13.16: UU, Uppsala University, Sweden
- Party P13.17: ZSR, Zentrum für Strahlenschutz und Radioökologie, Universität Hannover, Germany
ENEN Advanced Courses
Related Documents

NEPTUNO Web site

- Overview of ENEN Advanced Courses and IP EUROTTRANS courses (in preparation)
- Recommendations on Advanced Courses
- Recommendations on PhD level
- Recommendations on continued academic education

FIVE ENEN COMMITTEES (3)

Training and Industrial Projects Committee

- 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

Objectives and Tasks: Dissemination and Use of Knowledge

- Identify industrial needs for continuous professional development
- Organize continuous training sessions and courses on different subjects of common interest for the affiliated associated members
- Maintain and disseminate a database on third cycle advanced courses and continued professional development sessions
- Facilitate and support professional training, mobility of professionals and access to large nuclear infrastructures
- Integrate European industrial and national projects
ENEN International Seminar on the Nuclear Fuel Cycle 29/11-10/12, 2004

ENEN Training Course on Nuclear Safety
INSTN Saclay, April 4-22, 2005
ENEN – EUR Training Course on Levelling the Playing ground for New Nuclear Power Plants in Europe, Helsinki June 6-10, 2005

Course on Nuclear Safety of WWER Bratislava, May 2-6, 2005
ENEN Training Course Results and Perspectives

- Seminar on Nuclear Fuel Cycle held in Nov-Dec 2004
  - 20 participants – 2 students
  - 2nd edition planned Nov-Dec 2005 (France)
  - 3rd edition planned 2006 (United Kingdom)
- Nuclear Safety Course held April 2005
  - 12 participants – 1 student
  - 2nd edition planned 2006 (Munich, Germany)
- Eugene Wigner course held in 2003, 2004, May 2005
  - 15 - 22 participants – majority of students
  - Annual edition planned (Austria, Hungary, Slovakia, Czech Republic)

ENEN Training Course Results and Perspectives (continued)

- Nuclear Safety for NPP Subcontractors held May 2005
  - 15 participants
  - Results being evaluated
- European Utility Requirements Course 2005
  - Helsinki 6-10 June, 2005
  - 35 participants registered – 5 students
  - Results being evaluated
FIVE ENEN COMMITTEES(4)

Quality Assurance Committee
- Teknillinen Korkeakoulu Helsinki - Chair (SU)
- Université Catholique de Louvain (B)
- Institut national des Sciences et Techniques Nucléaires (F)
- Budapesti Műszaki és Gazdaságtudományi Egyetem (HU)
- Centrul de Inginerie Tehnologica Objective Nucleare (RO)

Objectives and Tasks
- Develop and implement QA processes to be applied in the design and delivery of education and training courses by the ENEN members
- Collect information and harmonise rules for selection, training and certification of teachers
- Evaluate and monitor the quality of current and newly proposed members of the ENEN Association
- Evaluate courses and award the International ENEN Course label, in collaboration with the ENEN Teaching and Academic Affairs Committee

QA Committee Criteria for evaluating applications of ENEN Effective Members

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Requirement</th>
<th>Judgment</th>
<th>Additional Information needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EU location</td>
<td>Satisfied/No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>High-level scientific education in the nuclear field</td>
<td>Specify fields</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Selective admission of students</td>
<td>Yes/No/NA</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>Full time teaching</td>
<td>Standard curriculum or not</td>
<td></td>
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<tr>
<td>3c</td>
<td>Providing the bases for doctoral studies</td>
<td>Yes/No/NA (what is lacking?)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Internationally recognised research</td>
<td>Analysis per department</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Trends of research</td>
<td>List those you recognise as relevant</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Research carried out jointly</td>
<td>Number of staff, researchers, etc. significant or not</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Research in the same geographic location or joint venture</td>
<td>Optimal situation, or room for improvements</td>
<td></td>
</tr>
</tbody>
</table>
FIVE ENEN COMMITTEES (5)

Knowledge Management Committee
- 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)

Objectives and Tasks: Dissemination and Use of Knowledge
- Identify and monitor deficiencies in scientific knowledge relevant to nuclear technology and safety
- Prepare, maintain and implement an action plan by academia in order to preserve valuable scientific knowledge
- Ensure efficient use of ICT for dissemination of knowledge, teaching and learning, databases and use of simulators
- Publish books, produce CDs and DVDs of interest to ENEN members
- Integrate and operate the ENEN web sites and communication systems

NEPTUNO Communication System Status
- Is in full operation since August 2004
- Provides a platform for a common knowledge base for nuclear fission
- Merges classical database driven information systems with role-based research and education functionalities to a common knowledge system
- Needs content to become more useful
- http://www.neptuno-cs.de/
NEPTUNO Communication System
Main Features

- Based 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
- Basic system components customised to NEPTUNO needs
- Each component can be programmed to have access to other components (e.g. an on-line course supported by a simulation package)
- Provides basic support for communication in the nuclear community like addresses, data bases, technologies, E-learning platforms, etc.

Courses in Nuclear Disciplines

- Courses arranged in
  - 4 types
    - education, training, education and training, others
  - 14 categories covering different nuclear disciplines
- Total number of courses
  - 746 collected from various sources and data sheets
- Approved courses confirmed and implemented by the organising institution: 198 courses
- Not (yet) approved nor confirmed: 548 courses
Role-based access to a common knowledge base

- Different users have special role-dependent views on the common data base (e.g. teacher, student, scientist, etc.)
- Views on the database are optimised to respond to the needs of the role
- Knowledge can be easily managed
- Information is kept in one place with different access methods depending on the goal. Information is consistent, preserved and reused

Role-based access in research and training

- Scientist Production
  - P: Scientific data
  - D: Publications
  - E: Colleagues work

- Teacher Dissemination
  - P: Educational objects
  - D: Teaching units
  - E: Scientists work

- Student Exploitation
  - P: Thesis
  - D: Seminar work
  - E: Training
Support of Knowledge Production

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

Support of 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)
Support of Knowledge Exploitation

- Provide optimised role-based view on the content of the system
- Provide methods to analyse 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

ENEN Perspectives

- Expand into nuclear disciplines outside nuclear engineering like radioprotection, radiochemistry, waste management
- Expand activities from the academic and research environment into the industrial and regulatory organisations and attract their membership
- Define, harmonise and promote international mutual recognition of professional training for key functions in nuclear industries, regulatory bodies and nuclear applications
- Participate to EC framework projects, in particular in the European Higher Education and European Research Areas
- Continue to support and strengthen cooperation with the World Nuclear University and the regional nuclear education networks in Asia, North America and elsewhere.
THANK YOU FOR YOUR ATTENTION

AND

WELCOME TO JOIN AND SUPPORT THE

EUROPEAN NUCLEAR EDUCATION NETWORK
ASSOCIATION

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