

# European approaches and initiatives for Nuclear Education & Training and Knowledge Management

ATOMEXPO 2010

in Moscow, Russian Federation, 7 June 2010

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European Nuclear Education Network Association



# Contents

1. What is ENEN
2. Achievements since 2003
3. European projects

# 1. What is ENEN

# STARTING POINT

A study conducted by OECD/NEA – July 2000

“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”.

“Reflection Paper” prepared in 2000 by the CCE-FISSION Working Group on Nuclear Education, Training and Competence.

“Nuclear Education and Training: Cause for Concern?” OECD / Nuclear Energy Agency, ISBN 92-64-18521-6.

# DEVELOPMENT 2002- UNDER EUROPEAN COMMISSION



1. European Commission – EURATOM  
5th Framework programme **ENEN project**  
in January 2002 – December 2003
2. European Commission – EURATOM 6<sup>th</sup>  
Framework programme **NEPTUNO project**  
in January 2004 – December 2005

# What is ENEN

## The European Nuclear Education Network Association

- A non-profit organization established in September 2003 under the French law of 1901
- For the continuity of achievements through the past Euratom-EC projects on nuclear E&T
- Headquarters is located near Paris, CEA Centre in Saclay, France



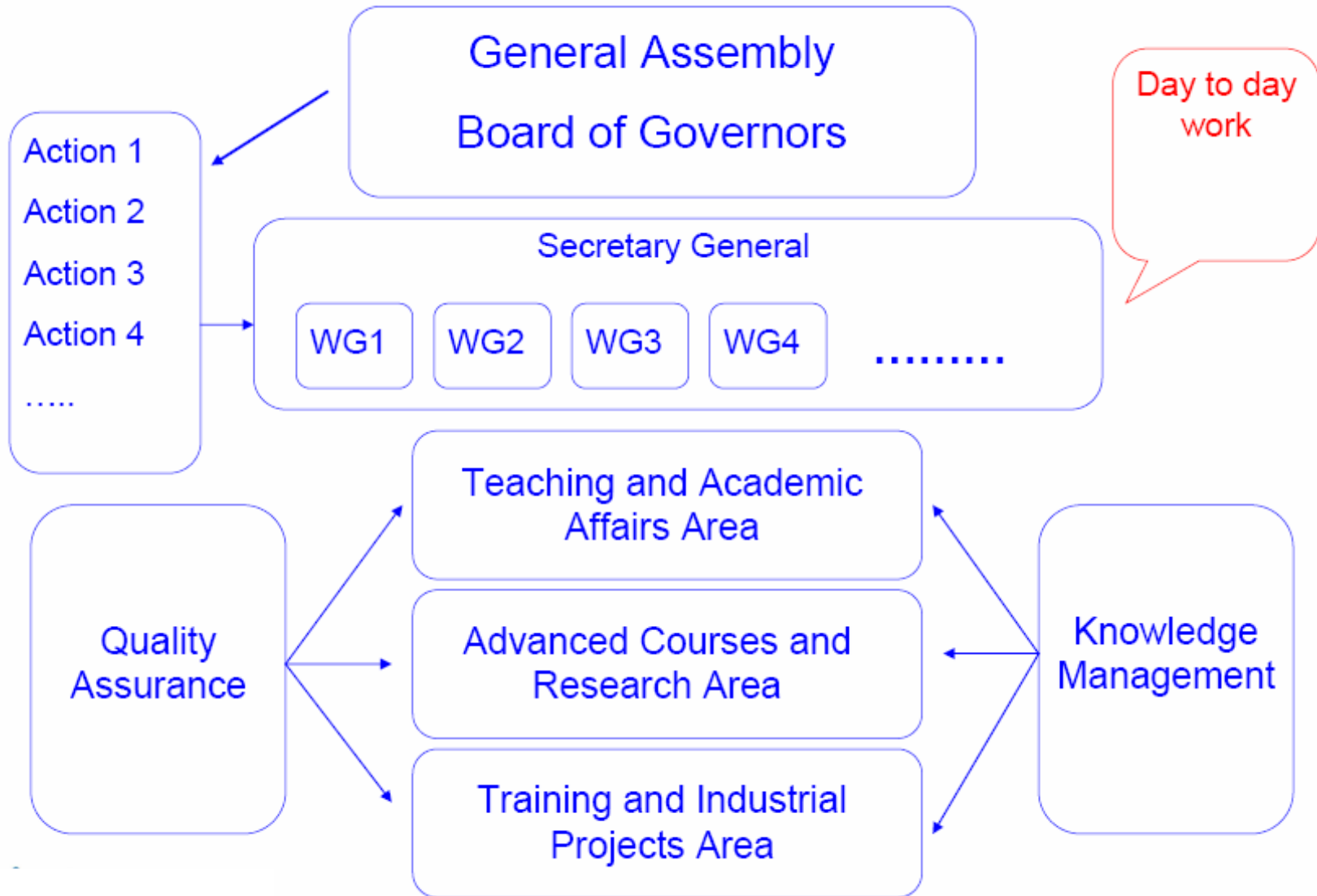
# ENEN Objectives

The main objective is the preservation and further development of expertise in the nuclear fields by **higher** education and training

*It should be achieved by...*

- Support to the Universities (exchange of students, lecturers, materials and information etc.)
- Making a bridge between the Universities and the End-users (industries, regulatory bodies, research centre, universities etc.)

# ENEN Structure



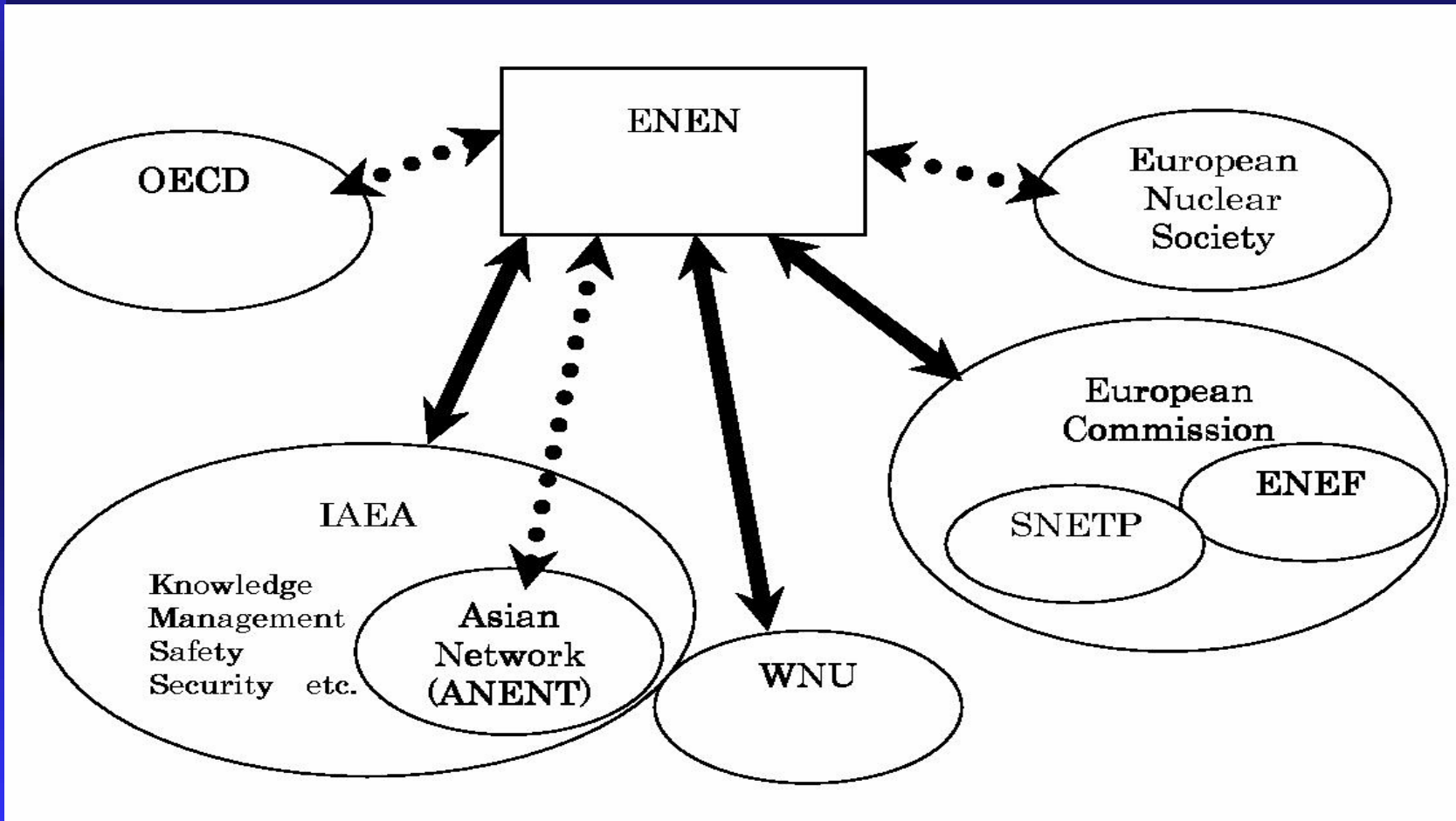


# ENEN Members in May 2010

- 52 Universities
- 7 Research Centres
- 1 Multinational Company  
located in 18 European Countries
- MoU concluded with
  - European Nuclear Society
  - North West University, Potchefstroom, South Africa
  - Moscow Engineering Physics Institute, Russian Federation
  - Centre Institute for Continuing Education and Training, Russian Federation, Russian Federation
  - Tokyo Institute of Technology, Japan
  - Japan Atomic Energy Agency, Japan
  - IAEA for the cooperation with the Asian Network (ANENT)
  - Kharkiv “Karazin” National University, Ukraine
- Memberships/cooperation under discussion with
  - European Commission Joint Research Centre
  - University Network of Excellence in Nuclear Engineering, Canada etc.

**+ Project partners  
beyond  
ENEN membership**

# European and International Cooperation



# EU Council, 1-2 December 2008



*Adopted the conclusions which refers explicitly to the ENEN and to other FP6/FP7 initiatives originated by the ENEN*

- The Council **welcomes** the existence within the European Union of coordinated teaching and training leading to qualifications in the nuclear field, provided notably by the ENEN.
- The Council hopes that, with the help of the EU, ENEN and its members will **continue to develop the coordination** of nuclear education and training in Europe.
- The Council insists that **the appropriate conditions** must be created for mutual recognition of nuclear professional qualifications throughout the European Union.
- The Council encourages the Member States and the Commission to establish a "review of professional qualifications and skills" in the nuclear field for the European Union, which would give **an overall picture** of the current situation and enable appropriate solutions to be identified and implemented.

## 2. Achievements since 2003

# 2-1. Master level

## New Master in France (in English)

### FRANCE

Starting September 2008

- A new program for Master of Science degree in Nuclear Engineering
- Offered jointly by Paris XI – Orsay University and CEA-INSTN
- 8 modules' course, over 7 months equivalent to 40 ECTS, courses are taught in English
- Master's research project will generally be at University, CEA research centres or Industry equivalent to 20 ECTS

The brochure for the Master Nuclear Engineering program features the logos of Université Paris-Sud 11 and instn. It is titled 'Master Nuclear Engineering' and includes several sections: 'Objectives' (Education of Engineers and Researchers), 'Careers Opportunities' (Engineer in nuclear industry, Researcher), 'Main Educational Topics' (Nuclear Physics, Neutronics, Particle Propagation, Thermal hydraulics, Nuclear Materials, Modelisation and calculation codes, Nuclear Reactor Design and Operation), 'Admission Prerequisites' (Master 1 or equivalent, Engineering schools), and contact information. A vertical timeline on the right side shows the evolution of nuclear engineering from 'First generation' (1940) to 'Systems of future GEN IV' (2020+), with 'Present reactors GEN II' (1980) and 'Advanced reactors GEN III' (2010) in between. The brochure also mentions 'Teaching in English language' and 'Subject to accreditation'.

*Scholarship available for non-European students.* 13



# 2-1. Master level

## International Exchange Courses



### Editions

2003

2004

2005

2006

2008

**„Eugene Wigner” Training  
Course for Reactor Physics  
Experiments 2008**  
with special emphasis to enhance  
Research Reactor Safety

### Organising institutions

Budapest University of Technology and Economics (BME) <i>Hungary</i>	
Slovak University of Technology in Bratislava (STUB) <i>Slovak Republic</i>	
Vienna University of Technology, Atominstitut (AI) <i>Austria</i>	
Czech Technical University in Prague (CTU) <i>Czech Republic</i>	

# 2-1. Master level

## International Exchange Courses



21 days

6 ECTS

### Content of the course

#### LECTURES (Slovak University of Technology, Bratislava)



The theoretical lectures will be held in the lecture halls of Slovak University of Technology, Bratislava /STUB/ (Slovak Republic).

The detailed program and the timetable will be published later on the webpage of the Wigner Course (see on the bottom of this leaflet). The programs of the previous years can be consulted to have a hint what kinds of lectures are to be expected

**TECHNICAL VISIT** to Jaslovské Bohunice NPP, and radwaste treatment center

#### EXPERIMENTS (Czech Technical University in Prague)



*View into the VR-1 reactor in Prague*

- Measurements of reactivity by various methods
- Study of nuclear reactor dynamics
- Digital control and safety systems of the research reactors and reactor operation

#### EXPERIMENTS (Vienna University of Technology, Atominstitut)



- Fission chambers (FC), compensated ionisation chambers (CIC), self-powered (SP) detectors
- Reactor power calibration and temperature coefficient of reactivity
- Criticality experiment
- Demonstration of a prompt critical power excursion



*Group of students at the reactor in Vienna*

#### EXPERIMENTS (Budapest Univ. of Technology and Economics)



- Determination of the distribution and of the absolute value of the thermal neutron flux by activation method
- Measurement of delayed neutron parameters and determination of uranium concentration
- Measurement of void coefficient and the reactivity worth of neutron absorbers



*Cerenkov radiation in the reactor core in Budapest*

[http://www.reak.bme.hu/Wigner\\_Course](http://www.reak.bme.hu/Wigner_Course)

[http://www.reak.bme.hu/Wigner\\_Course](http://www.reak.bme.hu/Wigner_Course)

## 2-1. Master level

# European MSc in Nuclear Engineering

- “ENEN Certificate” recognised among ENEN Members
- Common reference curricula established under the European Commission – EURATOM 5<sup>th</sup> FP **ENEN project** and 6<sup>th</sup> FP **NEPTUNO project**
- ECTS (European Credit Transfer and Accumulation System) introduced since 1989
- Master program at home university + Experiences in other country
- To promote and facilitate the mobility of students and teachers
- Implemented since 2005



European Master of  
Science in Nuclear  
Engineering  
ENEN Certification

Nuclear Education by  
the European Nuclear Education Network





# EMSNE Certificates Ceremony 2007



Student receiving the ENEN EMSNE certificate during ENS conference on E&T NESTet Budapest May 4-8, 2008

## 2-1. Master level

### Possible expansion of EMSNE in 2010

Revision of the EMSNE is currently under discussion in order to cover other nuclear disciplines as EMSND

- Radiological Protection, Radiochemistry, Radioecology (under FP6 **ENEN II project**)
- Radioactive Waste, Geological Disposal (under **ENEN II project**)
- European Master in Radiation Protection (EMRP, led by CEA/INSTN Grenoble)
- Needs for Safeguards and Nuclear Security (support to IAEA, EC JRC Ispra, ESARDA) etc.

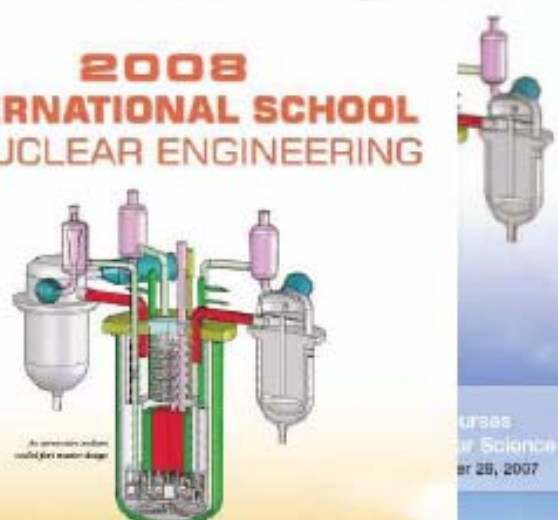
# 2-2. PhD level Advanced Course



- **Course 1** Reactor Core Physics: Deterministic and Monte Carlo Methods  
*from September 1st to September 5*
- **Course 2** Materials for Reactor Fuels and Structures  
*from September 8 to September 12*
- **Course 3** LWR and FR Thermal-Hydraulics, Fuel Design, Safety and Risk Assessment  
*from September 15 to September 19*
- **Course 4** LWR Core Physics and Fuel Management  
*from September 22 to September 26*
- **Course 5** Experimental Validation and Calibration of Numerical Simulation Models  
*from September 29 to October 3*
- **Course 6** Reactor Kinetics and Dynamics  
*from October 6 to October 10*
- **Course 7** Neutronics Experiments and Simulations  
*from October 13 to October 17*
- **Course 8** Reactor Dismantling and Waste Management  
*from October 20 to October 24*
- **Course 9** Fuel Cycle Back-End and Reprocessing  
*From October 27 to October 30*

**2007  
INTERNATIONAL SCHOOL  
IN NUCLEAR ENGINEERING**


**2008  
INTERNATIONAL SCHOOL  
IN NUCLEAR ENGINEERING**





An innovative solution  
with 600 water loops

SACLAY, France

9 Doctoral-level Courses  
in Advanced Nuclear Science  
From September 1<sup>st</sup> to October 30, 2008



www.instn.cea.fr



## 2-2. PhD level

### FP6 EUROTRANS project



- **Integrated Project EUROTRANS (FP6)** in 2005-2010
- 17 Universities participated under the ENEN umbrella
- ENEN organises / facilitates lectures, scientific visits, joint experiments, and specialised training in 10 advanced courses (Internal Training Courses)
  - ITC6 “Core design and reactor safety analysis” in Madrid, Spain, 2-5 April 2008 14 PhD students
  - ITC9 “Accelerator-driven Transmutation System for European and Asian Young Scientists and Engineers” in Tokai Mura, Japan, 1-4 December 2009 47 Asian and 10 EU PhD students
- Juan Antonio Rubio - Paul Govaerts ENEN – EUROTRANS Prize for the **Best Doctoral Dissertation** within the Project in 2010



## 2-2. PhD level

# Annual ENEN PhD Event

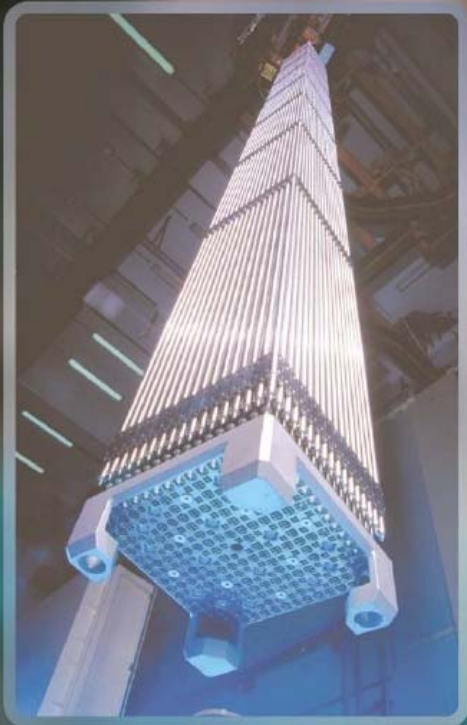


- Half- or one-day event during an international conference
- 8-14 PhD students
- ENEN Prize
- ENEN Alumni
  - ◆ 1st at International Youth Conference on Energetics 2007 in Budapest, Hungary, 1 June 2007
  - ◆ 2nd at International Youth Nuclear Congress (IYNC) in Interlaken, Switzerland, 23 September 2008 in collaboration with the EC JRC
  - ◆ 3rd at International Youth Conference on Energetics 2009 in Budapest, Hungary, 4-7 June 2009
  - ◆ 4<sup>th</sup> at European Nuclear Conference in Barcelona, Spain, 2 June 2010



# 2-3. For young professionals Training Courses

## INTERNATIONAL SEMINAR ON NUCLEAR FUEL CYCLE 2008

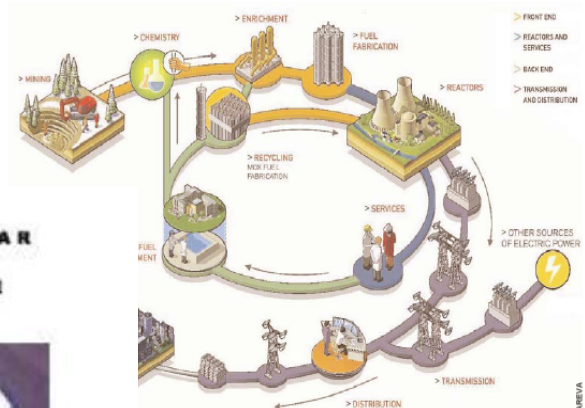


FRANCE

June 23rd - July 4th 2008



## INTERNATIONAL SEMINAR ON NUCLEAR FUEL CYCLE



## INTERNATIONAL SEMINAR ON NUCLEAR FUEL CYCLE

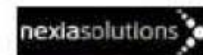


UNITED KINGDOM

19<sup>th</sup> - 30<sup>th</sup> November 2007



Nuclear Department, HMS SULTAN  
DCMT, Defence Academy



FRANCE

NOVEMBER 20<sup>th</sup> - DECEMBER 1<sup>st</sup>, 2006



## 2-3. For young professionals EFTS projects starting in 2009

- Projects on Euratom Fission Training Schemes will start in 2009
- The objective is to establish a common certificate for professionals at the European level
  - ✓ ENEN III on Nuclear Engineering
  - ✓ ENETRAP II on Radiation Protection
  - ✓ PETRUS II on Waste Management and Disposal
  - ✓ TRASNUSAFE on Nuclear Safety Culture

***European MSc for Education;  
What for Training??***

# 2-4. Knowledge Management ENEN Website and Database



## ➤ ENEN Website

<http://www.enen-assoc.org>

## ➤ NEPTUNO Database (Aug 2004-)

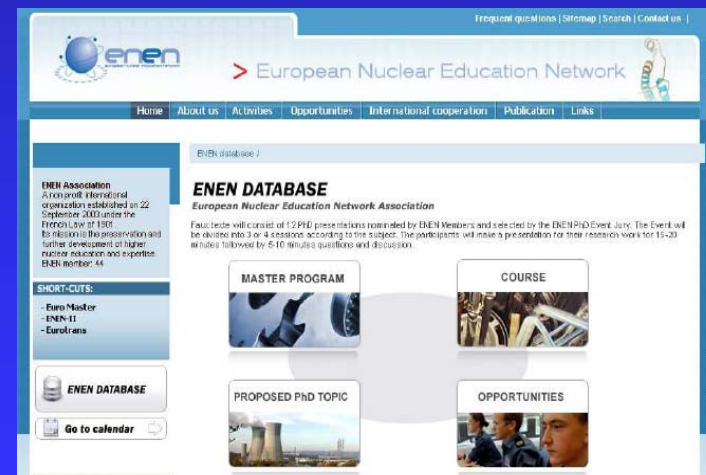
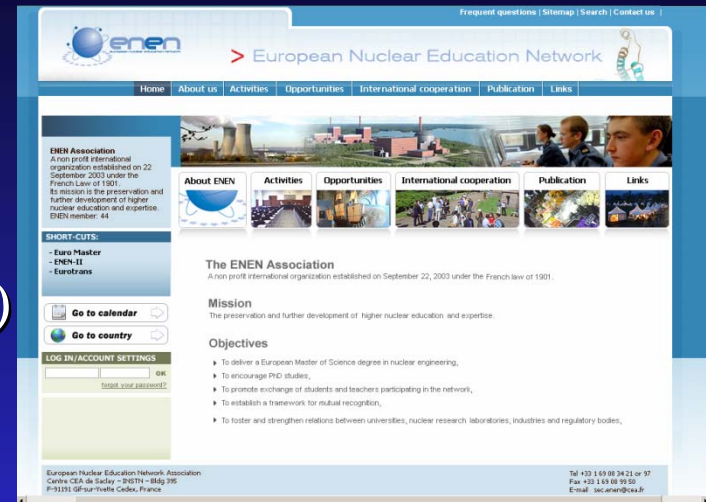
<http://www.neptuno-cs.de/>

E&T courses by ENEN Members

## ➤ A *new* ENEN Database (to be opened soon)

- E&T courses
- Master program
- PhD topics
- Opportunities (scholarship, fellowship, internship, job opportunities)

provided by ENEN Members and Partners



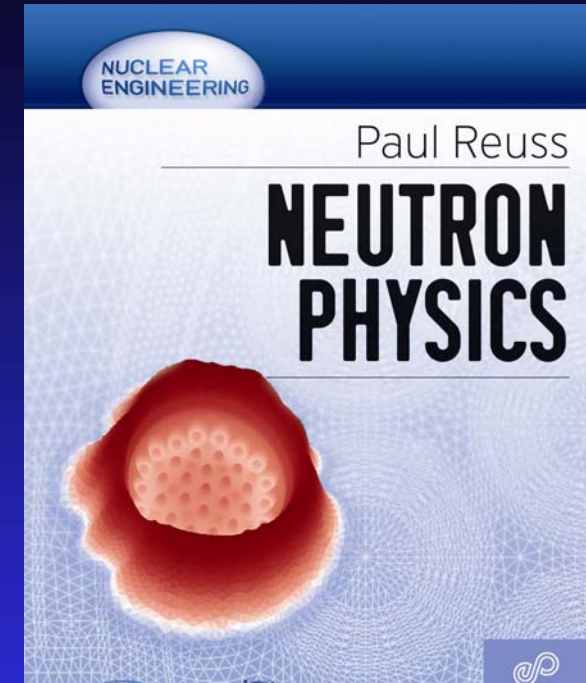


# 2-4. Knowledge Management

## ENEN publication



- First text book published under ENEN as a deliverable of ENEN II project
  - ◆ 18 chapters, 670 pages including exercises and solutions
  - ◆ mainly for students, young professionals and researchers
- CD-ROM including multimedia presentations for the general public



### INTRODUCTION TO NUCLEAR ENERGY

**The nuclear fuel cycle**

The nuclear fuel cycle deserves a special mention, because its possible variations and particularities are of special interest. The cycle is referred to the whole process followed since the Uranium mineral is extracted in the mines to when the radioactive waste coming from fission in power plants is correctly administered.

The collage includes: a uranium mine, a yellow uranium enrichment cascade, a fuel fabrication plant, a reactor core, and a waste management facility. A diagram on the right shows the full cycle with labels for 'Uranium', 'Enrichment', 'Fuel fabrication', 'Reactor', 'Spent fuel', and 'Waste management'. A page number '79 / 136' is visible in the bottom right corner.

Index

Figure 51, 52, 53, 54, 55, 56 and 57 - Images of the nuclear fuel cycle

## 2-5. ENEN Event

### Dialogue btw ENEN and the End-Users

1. Special Event “Industry Views on International Cooperation in Nuclear Education and Training” in Prague, 6 March 2008 (EDF, E.ON, Suez-Tractebel, Westinghouse, FORATOM)
2. Post-FISA 2009 Workshop “Integration of nuclear education and training: common needs, EU vision and implementation instruments” in Prague, 25 June 2009 (Areva, EDF, Posiva, SCKCEN, CEA, EPFL, Russia, China, USA etc.)



3. 2<sup>nd</sup> Special Event “Needs and strategies on Education & Training for increasing Nuclear Power Production” in Ljubljana, Slovenia, 4 March 2010 (ENEL, EC JRC, IAEA, Safety Authority)

# 2-5. ENEN Event

## Annual pan-European Recruitment Event

- In Brussels
  - 4-5 December 2009
  - to be held on 3-4 December 2010
- Supported by the EC and the ENEN
- Expected to participate in
  - European major industries
  - 200 students over EU and Russian Federation
- Contents
  1. Workshop/panel discussion
  2. Interviews for job opportunities, internship and fellowships



The poster for the AtomiCareers in Europe event features a blue background with a stylized atomic symbol and a map of Europe. The text is in white and orange. The top right corner has the 'careers in europe group' logo and website. The main title is 'AtomiCareers in Europe' in orange. Below it, the text reads 'The most exclusive pan-European recruitment event in the Global Nuclear Industry'. A central orange box lists event details. The bottom of the poster has an orange banner with the website and logos of participating companies and organizations.

careers in europe group  
www.careersineurope.com

\* Brussels 4 - 5 December 2009  
**AtomiCareers in Europe**

The most exclusive pan-European recruitment event in the Global Nuclear Industry

AtomiCareers in Europe is more than an ordinary recruiting event:

- Have in depth face-to-face interviews with leading international recruiters at this exclusive invitation-only event
- Attend workshops on nuclear related topics developed by participating companies
- Network with top managers, recruiters, nuclear associations and candidates from all over Europe
- Free accommodation and travel support for 200 candidates

Apply before October 31<sup>st</sup>  
[www.careersineurope.com](http://www.careersineurope.com)

Partners:

# 3. European projects

# Ongoing European projects

- Euratom Fission Training Schemes (EFTS)
  - ✓ ENEN III on Nuclear Engineering
  - ✓ ENETRAP II on Radiation Protection
  - ✓ PETRUS II on Waste Management and Disposal
  - ✓ TRASNUSAFE on Nuclear Safety Culture
- Bilateral
  - ✓ EUJEP with Japan
  - ✓ ETNET with China
  - ✓ ENEN-RU with Russian Federation

# 3-1. EFTS project (since 2009)

## ENEN-III Project on Nuclear Engineering

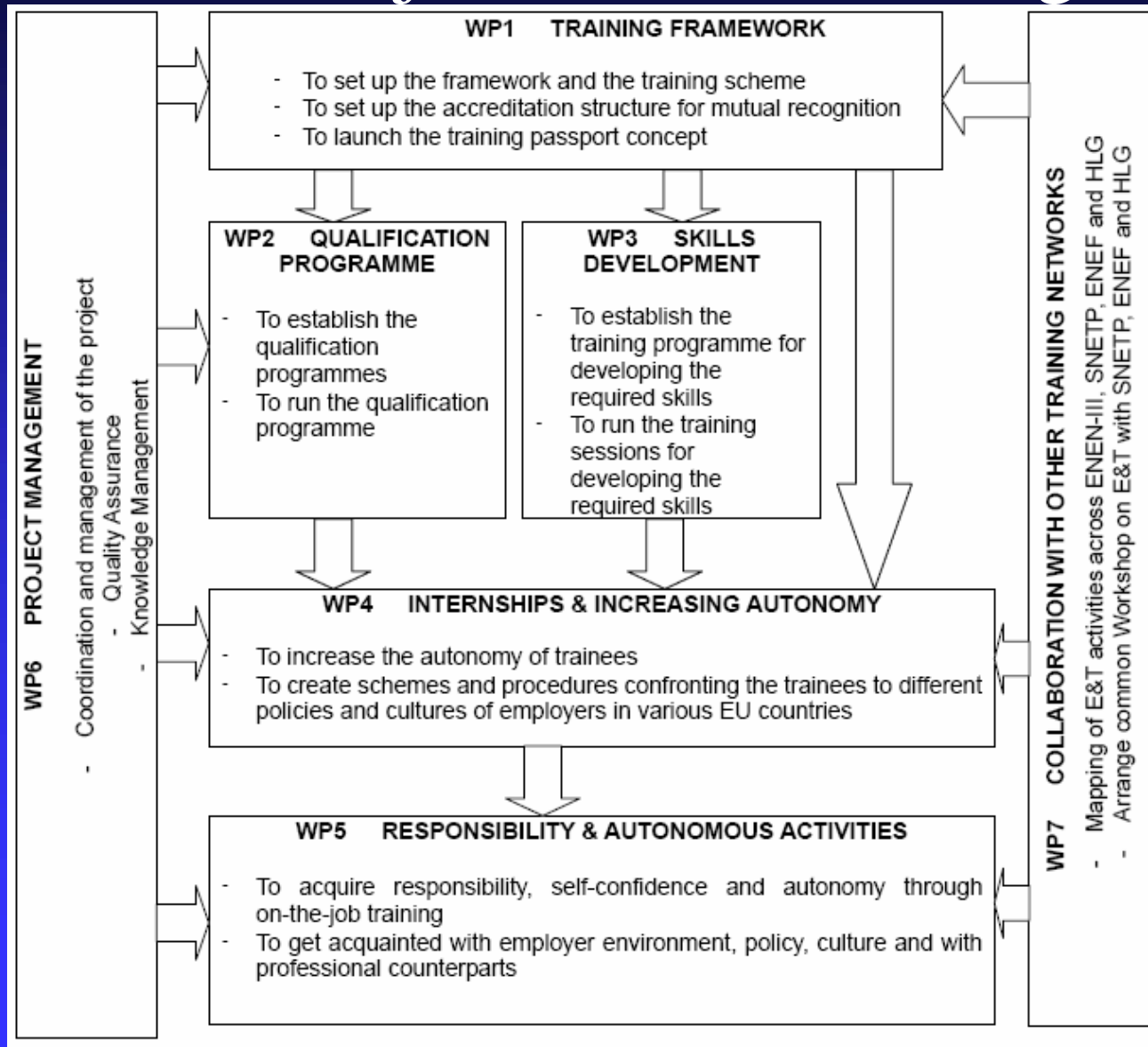


- Three-year project: 2009 - 2012
- Four training schemes
  - Basic Nuclear Topics for Non-Nuclear Engineers
  - Design Challenges for Generation III NPP
  - Construction Challenges for Generation III NPP
  - Design Challenges for Generation IV Reactors
- Coordinated by the ENEN Association
- 19 Partners in 12 countries  
ENEN, SCKCEN, UCL, AALTO, LUT, INSTN,  
AREVA, ISAR, BME, CIRTEN, DUT, UPB, UL,  
JSI, TECNATOM, UPM, UPC, (HMS SULTAN)



# 3-1. EFTS project (since 2009)

## ENEN-III Project on Nuclear Engineering



## 3-2. Bilateral – EU and Japan

### EUJEP Project (since 2009)

- Objective : Foster, organise and implement exchanges of European and Japanese Master level students with mutual recognition of credits.
- Partners:  
EU: ENEN (F), INSTN (F), EMN (F), UPB (RO)  
SUTB (SK)  
JAPAN: TokyoTech, Kyoto U, JAEA
- Planned Mobility of students :  
EU 30 students for a total of 154 months  
Japan 30 students for a total of 180 months
- Planned mobility of faculty staff  
EU 10 faculty staff for a total of 19 weeks  
Japan 8 faculty staff for a total of 8 weeks



# 3-2. Bilateral – EU and China

## ECNET Project (under preparation)



- Objective: to define a common basis to allow effective cooperation between the European and Chinese networks for nuclear E&T
- Partners:
  - EU: ENEN (F), SCKCEN(B), INSTN (F), INPL (F), KIT (G), CIRTEN (I), UPM (E), ICL (UK)
  - China: Tsinghua U, North China Electric Power U, South-West U of Science and Technology, Harbin Engineering U, Shanghai Jiao Tong U, China National Nuclear Corp/Graduate School and Xi'an Jiao Tong U
- Work packages
  - Needs and strategies of long-term cooperation
    - WP1:** In Nuclear Engineering
    - WP2:** In Radiation Protection
    - WP3:** In Waste Management and Disposal
    - WP4:** Recognition of credit systems
    - WP5:** E&T facilities, laboratories and equipments
    - WP6:** Project management

## 3-2. Bilateral – EU and Russian Fed. ENEN-RU Project (to be launched)



- Objective: to define a common basis to allow effective cooperation between the European and Russian networks for nuclear E&T
- 500 000 EURO for 2-year on the EU side

### Partners on the Russian side

- ROSATOM
- National Research Nuclear University
  - MEPhI
  - Obninsk Technical University
  - etc.
- Research Institute for Nuclear Reactor, Dimitrovgrad
- Centre Institute for Continuing Education and Training, Obninsk etc.

# ENEN-RU Project

## Project partners for the EU side

- ENEN (Project Coordinator)
- SCKCEN, Belgium
- Czech Technical University in Prague, Czech
- Nuclear Research Institute Rez plc., Czech
- Stuttgart University, Germany
- University Politehnica Bucharest, Romania
- Slovak University of Technology in Bratislava, Slovakia
- TECNATOM, Spain
- ***All ENEN Members will have an opportunity to contribute under the ENEN umbrella***

# ENEN-RU Project

## Working structure -1/2

- **WP1:** Bologna process and ECTS in Russia (to analyse the implementation and the compatibility of the Bologna process and ECTS in Russia as a basis to enhance future exchanges of lectures and students, to promote the implementation of the Bologna process within a new National Research Nuclear University in Russia)
- **WP2:** Needs of cooperation in the long term (to define the needs and modality of cooperation between EU and Russia in the long term, to define the pilot items for E&T to be implemented by WP3 and WP4)
- **WP3:** Pilot items for Education (to conduct pilot educational courses and PhD projects, to define further actions to be taken for the long term cooperation in the nuclear Education)
- **WP4:** Pilot items for Training (to conduct pilot training courses, to cooperate with the European Training Scheme projects, to define further actions to be taken for the long term cooperation in the nuclear Training)

# ENEN-RU project

## Working structure -2/2



- **WP5:** E&T facilities, laboratories and equipments (to map the E&T facilities, laboratories and equipments for exchange purposes in EU and in Russia, to clarify the access rules and procedures, ideally to be used with WP3 and WP4)
- **WP6:** Knowledge dissemination (to secure experience and disseminate the project results, to ensure proper knowledge dissemination of the project results, such as website and database)
- **WP7:** Project management (to coordinate and manage the project according to the time schedule and budget, to produce and support the dissemination of the project results)

# ENEN-RU Project

## Expected working schedule



- Beginning of 2010 – Negotiation on the EU side (between the European Commission (EURATOM) and the ENEN)
- **Coordination Agreement has to be agreed among ALL European + Russian project partners**
- Before summer – A contract signed on the EU side (between the European Commission (EURATOM) and all European project partners)
- Launch the project early summer of 2010 for the period of 2-years

# THANK YOU FOR YOUR ATTENTION

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