Nuclear Education in France

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and CEA
Setting up a nuclear industry raises big challenges:

- It is a complex industrial and business system
- It requires high quality standards
- It requires high safety and security standards
- It requires to comply with international rules
- It requires to have developed an in-depth and comprehensive understanding of the technologies and complexities at all levels
- It requires a critical mass of competent human resources
A nuclear accident somewhere is an accident everywhere

- Safety and security of nuclear reactors and fuel plants
  - In depth understanding of the physical science and technology
  - Capacity to improve the technology
  - Capacity to set new efficient safeguards

- Strong ethics at workplace
  - Ability to inform and communicate
  - Ability to anticipate and prevent departure from normal operating conditions
  - Ability to react rationally and efficiently to an unexpected event

- A world shared responsibility:
  - Sharing experience and initiatives
Share best practices in education

- **Involvement of industry in the education process**
  - participation in the design of courses contents
  - Experts lecturing at universities and engineering schools
  - internships
  - Scholarships

- **Networking at national and international levels**
  - Sharing information, expertise, lecturers, experimental facilities
  - ENEN in Europe, ANENT in Asia, WNU worldwide

- **Strong support of Governments**
  - Invest in science and engineering education
  - Accreditation and external assessment of curricula
Institutional Structures:
- Ministries
- Independent Safety Authority ASN
- TSO: IRSN
- Waste management: ANDRA

Industrials: EDF, AREVA sub-contractors

R&D CEA, CNRS, Universities

Educational Institutions
A very active nuclear sector

- EDF recruits ~ 500-600 engineers/year → 2018
  - Mostly graduates (engineer/master level)

- AREVA
  - 54 000 hirings in 5 years over the world

- EDF and AREVA train intensively their new staff
International conference on access to civil nuclear energy (March 8-9, 2010, Paris)

- Initiative of the President of the French Republic

- President of the EC, DG of IAEA, SG of OECD, French PM, Ministers of many countries out of 65

- Willingness to assist any country wishing to have access to nuclear energy for peaceful purposes, which fully abides by its non-proliferation obligations.

- Training issues: creation of an International Institute for Nuclear Energy.
CFEN was created by the Minister of High Education and Research in 2008

- to assess the adequacy between the education offer, the students population and the industrial/research needs.
- to advise the Office of High Education on opening new academic curricula in the nuclear domain.
- To promote new curricula such as the new Master of Science in Nuclear Energy starting in Paris 2009.

the High Commissioner for Atomic Energy chairs CFEN

Members are representatives of:
- Governmental authorities in Education, Research, Industry, Foreign Affairs
- Academic institutions: Universities and Engineering schools
- Nuclear industry (AREVA, EDF, GDF-SUEZ, sub-contractors),
- Nuclear R&D institutions (CEA, IRSN, ANDRA)
Nuclear Energy Education: year 2010-2011

35 master level curricula with internships
Universities & Engineer schools; about 1000 students out of which 180 foreigners

- Paris area: GA, INSTN, MNE
- Grenoble INP
- Caen: ENSI
- Nantes: EMN

Dedicated programs for nuclear engineering

- Chemistry: ENSCP Paris
- ENSCM, U.-Montpellier 2...
- Nuclei materials: Grenoble INP
- Waste management: Valence

Programs focused on a very specific nuclear discipline

- Optional nuclear modules within a training with broader content
- (“Energy”, material science, chemistry, thermal-hydraulics, safety, ...)

Other curricula

- Provence: Aix- Marseille
- Rhône: Lyon
- Nord: Lille

Programs in preparation (scheduled to open year 2011-12)
Main Courses: 5 Master’s degrees & 1 Engineer degree

- **International Master’s degree of Science Nuclear Energy – MNE**
- **Génie atomique / Nuclear Engineering – GA**
- **Materials Science for Nuclear Engineering” Master’s degree – MANUEN**
- **Sustainable Nuclear Energy and Waste Management” Master’s degree – SNEWM**
- **“Separation Chemistry, Materials, Processes” Master’s degree**

Regions:
- Paris
- Grenoble, Alps Mountains
- Montpellier, Mediterranean Coast
Number of students completing a nuclear energy curriculum at the Master-Engineer level in France. Academic year : 2010-2011

<table>
<thead>
<tr>
<th>Kind of Curriculum</th>
<th>Number of students</th>
<th>Number of foreign students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedicated to Nuclear engineering</td>
<td>391</td>
<td>91</td>
</tr>
<tr>
<td>Specialized nuclear domain</td>
<td>277</td>
<td>60</td>
</tr>
<tr>
<td>Familiarisation with nuclear energy</td>
<td>346</td>
<td>32</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1014</strong></td>
<td><strong>183</strong></td>
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- **Other trainings in France :**
  - At professional level are also available from engineer schools & INSTN and from industry (EDF, AREVA, ...)
  - At PhD level « International School in Nuclear Engineering »
Master of Science in Nuclear Energy (MNE)

www.master-nuclear-energy.fr

Claude GUET  IAEA course  Saclay 05/07-2011
All courses in English. 100+ highly selected students

www.master-nuclear-energy.fr
Core courses

◦ Nuclear physics
◦ Fluid dynamics and heat transfer
◦ Material science
◦ Overview of energy technologies
◦ Instrumentation & Control
◦ Electrical engineering
◦ Chemical engineering
◦ Economics, management

Language and Culture courses

Student project and internship (10 weeks)
MNE: Program contents: 2nd year

- Core courses:
  - Nuclear safety and radioprotection
  - Project and risk management
  - Computer design and simulation
  - Environmental issues

- Choice between 5 majors:
  - Nuclear Reactor Physics and Engineering (NRPE)
  - Nuclear plant design (NPD)
  - Nuclear operations (O)
  - Fuel cycle (Engineering and Radiochemistry)
  - Decommissioning and waste management (DWM)

- Experimental sessions and training on EDF full-scope simulators

- Visits of nuclear sites (Flamanville 3)

- Master’s thesis and internship (20 weeks)
  - within an industry company or a research lab

www.master-nuclear-energy.fr

Claude GUET  IAEA course, Saclay 05/07-2011
Institut National des Sciences et Techniques Nucléaires (INSTN)

- Part of CEA, INSTN created in 1956: high level courses in nuclear energy disciplines including training of nuclear physicians, radio-pharmacists and medical physicists.

- The over 50 years old "Génie Atomique" curriculum has trained a large fraction of the French leading nuclear practitioners.
  
  - Open to students having an engineering degree. Today "Génie Atomique" curriculum welcomes 100 graduates.
  - Open to foreign French speaking students with similar pre-requisites.
  - It provides them with an extra diploma which certifies their qualification in nuclear engineering, operation of reactors, safety management, decommissioning, and waste management.
INSTN. Continuing education

- Organized International training seminars within the ENEN (European Nuclear Education Network) framework or in collaboration with IAEA, in conjunction with French nuclear industry

- Advanced training for experienced professionals. Contact with French industry

- Specific seminars for non-nuclear professionals willing to learn about a specific topic

- Courses for nuclear professionals at bachelors’ level
A programme to train the trainers has been cooperatively implemented by the major French nuclear energy stakeholders.

It is devoted to the training of university faculty and scholars.

It is implemented in a close working relationship with them, on the basis of an in-depth analysis of the local education system.

It usually consists of three phases. See next.
Cooperation between France and Poland
Partnership between all French nuclear energy stakeholders

- **Phase 1: six weeks nuclear Tour de France**
  - To get well acquainted with a broad nuclear context from mining to
  - To visit nuclear plants: NPP, fuel cycle, waste
  - To meet and exchange with French education network
  - To learn and exchange about communication and public acceptance

- **Phase 2: twelve weeks intense advanced training**
  - Fundamental nuclear science
  - Applied courses (safety, radioprotection, NPP’s, waste,...)
  - Access to experimental facilities: ISIS, irradiation and characterization
  - Access to simulators
  - Focus on pedagogical issues

- **Phase 3: setting up new curricula**
  - Assistance in education and training program design
  - Internship

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I2EN missions
I2EN: a window and a gate to French E&T system

- **Response to international education and training requests** originating from government agreements, international initiatives (IAEA, AEN ...), in particular those managed by AFNI. Also from industry

- **Information center for foreign students**: orientation to the most appropriate French curricula. Advice them during the selection, admission and installation processes

- **Gate for foreign engineers** (French and non French speaking) wishing to update, complement or enhance their qualification in domains related to nuclear energy, towards all French professional training curricula

- **Comprehensive panorama of French E&T offer** at each and every level of the nuclear energy high education system (Bachelor, Master, PhD), (web site under construction)

- **French node of an European and international network of centers of excellence** for sustainable nuclear energy
Objective: think tank on major nuclear issues and challenges:

- Role of nuclear fission in the energy mix
- Waste management issues
- Proliferation risk
- Security of nuclear plants and nuclear materials
- Environmental issues
- Economic issues
- Public debates and political decision
- Legal aspects and regulation

Method: Organization of “International Events”

Participation Target

- Academics and PhD students, R&D practitioners, Industry engineers and managers, Decisions Makers, ..
I2EN: Building a national base to support the international mission

- Analysis of all French curricula,

- Follow up on the global population of teachers in nuclear energy relevant disciplines

- Support to Ministry of Education and Research on definition of the national policy of E&T on nuclear energy

- Annual report on job need of French nuclear industry and the evaluation of the adequacy of the existing education system

- Assistance to CFEN (council for nuclear energy education and training) regarding qualification level of French curricula

- Help to coordinate French teaching activities in the nuclear energy domain

Claude GUET IAEA course Saclay 05/07-2011
The International Institute of Nuclear Energy

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Start of activities: September 1st 2010
Location: Saclay campus
Thank you for your attention