Preparing Human Resource to support the Nuclear Power Value-Chain - Best Practices of the United Kingdom and France

@ Nuclear Power Asia 2013
15-16 January 2013
Shangri-La Hotel, Kuala Lumpur

By:
Sheriffah Noor Khamseah Al-Idid bt Dato’ Syed Ahmad Idid
Malaysia
Nuclear Power Reactors Worldwide (A Snapshot)

Decisions On Nuclear Power in the United Kingdom (May 2010) & Overview OF NPP in the UK

Decisions before and after Presidential Elections in France (May 2012) & Overview of NPP in France

UK & France Signed a Landmark Agreement on Civil Nuclear Cooperation – 17 February 2012

British & French Nuclear Education & Training Agency Signed Cooperation in Nuclear E&T

Nuclear Fuel Cycle & Nuclear New Build Supply Chain - Implications for Nuclear Human Resource Development

Human Resource to support a Nuclear Power Programme (NPP)

Nuclear HCD Needs – Professionals, Technicians & Craftsmen & Sources of Human Capital for Nuclear Power

Nuclear Education & Training – The United Kingdom’s Perspective

Nuclear Education offered by Consortia of Institutions in the United Kingdom

Nuclear Education & Training – The French Perspective

Nuclear Education & Training for Decision Makers and Project Managers

Recommendations
Nuclear Power Plants Worldwide
Nuclear Power Reactors Worldwide

World Nuclear Power Reactors
439 operational reactors in the world providing 13.8% of the world’s power
As of April 1, 2011

Britain and France, two countries with a long nuclear experience

28 NPP Decommissioned in United States, as of Jan 2012
12 NPP Decommissioned in United Kingdom I, as of Jan 2012
12 NPP Decommissioned in France I, as of Jan 2012

NPP’s are being Decommissioned after Fukushima Accident

Top 5 producers of uranium:
1. Kazakhstan (27%)
2. Canada (20%)
3. Australia (16%)
4. Namibia (9%)
5. Russia (7%)

% electricity generated:
- 0 to 25%
- 25% to 50%
- 50% to 75%
- 75% and above

There are 62 reactors currently being built. With 484 additional reactors being planned or proposed to be operational by 2030.
Decision on Nuclear Power in the United Kingdom
On 10 January 2008, the British government published a *Nuclear White Paper*, which announces that a new generation of nuclear power plants will be built in the UK to contribute to the promotion of a—secure, diverse and low-carbon energy mix.

On 9 November 2009, the *draft Nuclear National Policy Statement (NPS)* presented by the government indicated that ten sites had been listed as potential locations for new nuclear power plants (NPP) as part of an over whole energy strategy.

Public consultations have been carried out and the regulatory justification (assessment of social, economic or other benefits versus potential health impact) and a National Policy statement were meant to be adopted by the Parliament later in 2010.

The new coalition *government formed after the elections of May 2010 had adopted revised draft National Nuclear Policy Statement (NPS) on energy* and launched on 18 October 2010 a consultation on them, which was open until 24 January 2011.

The statements recognize the essential role that nuclear has to play in ensuring energy supply along with other low-carbon energy sources by 2025 and confirm eight sites as suitable locations for nuclear new build.

Secretary of State for Energy and Climate Change, Chris Huhne, announced the regulatory justification of two new nuclear reactor designs: i) Westinghouse’s AP1000 & ii) Areva’s EPR. which have undergone Generic Design Assessment (GDA) in the UK.
There are currently nine (9) nuclear power stations (with 16 Units of Nuclear Reactors - Magnox, AGR and PWR) across England, Scotland and Wales, providing around 16% of the electricity consumed in the UK in 2010.

7 twin Units of AGR
1 Magnox at Wylfa 1
1 PWR at Sizewell

Ten (10) of the UK's nuclear power stations have ceased operation and are at various stages of decommissioning.

Ten (10) of the UK's nuclear power stations have ceased operation and are at various stages of decommissioning.

Magnox Limited is the management and operations contractor responsible for the day-to-day operation of the site under contract to the Nuclear Decommissioning Authority.

EDF Energy is the UK's largest generator of low carbon electricity. It owns and operates eight (8) nuclear power stations in the UK.

Life extensions averaging seven years for the AGR units are being considered, and EDF Energy is looking in particular at Hinkley Point and Hunterston in this regard. It is likely that a 20-year life extension for Sizewell B will be sought in due course. The Office for Nuclear Regulation undertakes 10-year reviews of all reactors.

Wylfa power station on Anglesey in North Wales, the last remaining Magnox site, originally to shut down in 2010 will now close in September 2014.
There are currently nine (9) nuclear power stations (with 16 Units of Nuclear Reactors—Magnox, AGR and PWR) across England, Scotland and Wales, providing around 16% of the electricity consumed in the UK in 2010.

a) 1 Magnox at Wylfa 1
b) 7 twin Units of AGR
c) 1 PWR at Sizewell

Ten (10) of the UK's nuclear power stations have ceased operation and are at various stages of decommissioning.

In 2012 EDF announced it expects 7 year life extensions on average across all AGRs, including the recently life-extended Heysham 1 and Hartlepool. A 20 year life extension is the strategic target for the Sizewell B PWR. These life extensions are subject to detailed review and approval.
PROPOSED NEW NUCLEAR BUILD IN THE UNITED KINGDOM

The UK had announced that Nuclear power is a cornerstone of the government's low-carbon agenda. In October 2010, the British Government gave the go-ahead to permit private suppliers to construct up to eight (8) new nuclear power plants (in existing nuclear power plant sites).

Three companies planning new nuclear power plants in the UK: 1) EDF 2) Horizon and 3) NuGen – were preparing to generate 16GW of electricity capacity by 2025 from their new sites, enough to replace Britain's current nuclear output.

Without new sites there will be only one operational nuclear plant left in the UK by 2023: Sizewell B in Suffolk.

German’s E.ON and RWE npower, had formed the joint venture Horizon to build NPPs in the United Kingdom (for 6 GWe).

After Government of Germany announced plans to phase out Nuclear power, Horizon On 29 March 2012 scarped its plans to build NPP in UK and open bid to buyers

Hitachi has purchase of Horizon, for a reported £696 million & plans to build two or three of its own 1300MWe Advanced Boiling Water Reactor (ABWR) plants at each site

EDF, the French state-controlled company, in partnership with British gas owner Centrica, is proposing to build two Areva EPRs at Hinkley Point, Somerset, and two at Sizewell, Suffolk (6.4GWe). They are continuing ahead with their plans for UK’s new build.

NuGeneration, a joint venture between Iberdrola and GDF Suez, is intending to build up to 3.6GW new capacity at Sellafield, Cumbria -will make a decision by 2015.
3 Decision on Nuclear Power after Presidential Elections in France (May 2012)
President Sarkozy is a strong proponent of nuclear energy, considers it to represent the strength of France, the pride of France, the independence of France. He has pledged to continue supporting nuclear power in France if he continues as President of France.

He holds the view that nuclear energy is critical in supplying jobs and low-cost power.

During his premiership France has 58 nuclear power reactors generating 75% electricity at low cost. French electricity tariffs are the cheapest in Europe. France is also exporting electricity to other countries.

During his election campaign, President Francois Hollande has pledged to close 24 of France's 58 reactors and to reduce reliance on atomic power but not end it altogether.

Partial nuclear phase out in France, closing the oldest 24 reactors by 2025.

Lower the share of nuclear power in France's energy mix from the current 75% in 2012 to 50% by 2025.

He would shut Fessenheim in Alsace, near the German border, by the end of 2016, sticking to his election pledge to halt its operations by the end of his mandate in 2017.
Nuclear Power Plants in France

a) 8 GCRS (UNGG) decommissioned &
b) 58 PWRs from Westinghouse design in operations as of 2012
   900 MWe (20) + 1300 MWe (34) + 1450 MWe (4) being the N4 design

c) EPR (1600 Mwe) in Flamanville and Penly

As of 2002, Électricité de France (EDF) — the country's main electricity generation and distribution company — manages the country's 59 nuclear power plants
4 UK & France signed Landmark Agreement on Civil Nuclear Power Cooperation
U.K. Prime Minister David Cameron signed a landmark agreement in Paris on civilian nuclear power cooperation with French President Nicolas Sarkozy, paving the way for the construction of a new generation of power stations in Britain. “Partnership as the closest between the two countries after WW2“

This serves as an important political signal that Britain and France, two countries with a long nuclear experience, will not follow Germany down the path of phasing out nuclear power but are pursuing a shared commitment to civil nuclear power, establishing a framework for co-operation on security, research and development, education and training.

The governments and industries of both countries has set out a shared long term vision of safe, secure, sustainable and affordable energy, that supports growth and helps to deliver the nations emission reductions targets.
British & French Nuclear Education & Training Agency Signed Cooperation in Nuclear E&T
Organisations dedicated to education & training in nuclear energy from both sides of the Channel are getting closer.
The organisations confirmed their commitment to partnership working by signing a Collaboration Agreement at the British French summit held in Paris, 17th February 2012.

The National Skills Academy for Nuclear (UK) and the International Institute of Nuclear Energy i2NE (France) have identified common areas of interest and potential cooperation that will really drive forward performance improvement and safety across the nuclear industry. through the establishment of high standards and expectations for training, education and qualifications.

Working together, the Skills Academy and I2EN will build on their expertise to enhance skills development and establish an effective collaborative approach between the UK and France in addressing the skills and educational challenges.
6 Nuclear Fuel Cycle & Nuclear New Build Supply Chain
Nuclear industry value chain, includes the:

1) **Front-end fuel markets** (i.e. uranium mining through fuel fabrication),
2) The overall **nuclear reactor sector** (nuclear reactor planning, construction, operations and maintenance and decommissioning), as well as the
3) **Back-end of the fuel cycle** (fuel treatment /reprocessing, storage and disposal)
The main elements of the nuclear new build supply chain are shown in the diagram below:

Source: The Supply Chain for a UK Nuclear New Build Programme by Dr. Stephen A Court
National Metals Technology Centre (NAMTEC), February 2009
Human Resource to support a Nuclear Power Programme (NPP) – An Overview of skills & competency needed
All these organizations require competent people, should plan and ensure adequate human resources!
Nuclear HCD Needs
– Professionals, Technicians and Craftsmen
& Sources of Human Capital for Nuclear Power
NUCLEAR HUMAN RESOURCES
PROFESSIONALS, TECHNICIANS & CRAFTSMEN

Professionals (Engineers/Scientists/etc.)

Colleges  Universities  Industries

Pre-University  Graduate Training  Career Development

Technicians

Craftsmen

Vocational School  Apprenticeship

Welders  Pipefitters  Concrete workers

Nuclear Leadership for
- Politicians/
- Decision Makers
- Management of
  i) NPP
  ii) Nuclear R&D Inst.
  iii) Other related
      Agencies
9 Nuclear Education & Training
- The United Kingdom’s Perspective
Nuclear New Build Supply-Chain

The main elements of the nuclear new build supply chain are shown in the diagram below:

Source: The Supply Chain for a UK Nuclear New Build Programme by Dr. Stephen A Court
National Metals Technology Centre (NAMTEC), February 2009
Undergraduate Nuclear Engineering

MEng with Nuclear Power Engineering & Sustainable Energy

MEng in “Mechanical and Nuclear Engineering”
MEng in “Chemical and Nuclear Engineering”
MEng in “Materials and Nuclear Engineering”

University of Central Lancashire

MSc Nuclear Safety, Security and Safeguards
MA Degree in Nuclear Regulation

MPhil Nuclear Energy which combines nuclear technology with nuclear policy and business

Masters of Law (LLM) International and Comparative Nuclear Law and Policy

Planning, Policy, Legal & Regulatory (Nuclear Law), Safety & Security

Note: A group of universities in Austria, Germany, the Netherlands, Norway and the United Kingdom will launch the first comprehensive Master’s Degree Programme in Nuclear Security in the first quarter of 2013, using the material produced by International Nuclear Security Education Network (INSEN)
Nuclear Engineering Doctorate Scheme

EPSRC: £4M award for 50 Research Engineers (4 cohorts)

Launched: September 2006

Research areas: Reactor Technology; Waste Management; Decommissioning; Materials; Socio-Economics; Safety systems
MPhil  Nuclear Energy which combines nuclear technology with nuclear policy and business

Certificate of Nuclear Professionalism (CoNP)  Certificate, introduced in 2011 Covers 7 Modules
Safety, Environmental and Security Management
Technical Leadership
Communications
Commercial Awareness
Project Management
Nuclear Principles, Protections & Frameworks
Safety Case Production and Evaluation.

Certificate of Nuclear Professionalism is developed in partnership with employers and the Open University and was introduced in 2011 focus on nuclear principles, safety, behavioural, commercial and project management skills.

FdSc in “Nuclear Project Leadership” (From 2009)
FdSc Nuclear Project Management & Control

Consortium of Universities in Nuclear Science

- Aston University
- 20/20 Business Insight
- UCLAN University
- Open University
Programme launched in 15 June 2011 for engineering students to have hands-on experience in designing and constructing a scaled down nuclear power plant in Constructionarium facility at Bircham Newton in Norfolk. Students will be assessed on radiation protection, site licensing, budgetary control and project management.

The Engineering Construction Industry Training Board (ECITB) is the statutory organisation, national training provider and awarding body with responsibility for the training and development of the UK’s engineering construction.
Programme launched in 15 June 2011 for engineering students to have hands-on experience in designing and constructing a scaled down nuclear power plant. Students will be assessed on radiation protection, site licensing, budgetary control and project management.

The Nuclear Island has been developed by a partnership of:
- Imperial College London,
- Constructionarium,
- Cogent Sector Skills Council,
- Engineering Construction Industry Training Board (ECITB) and
- Construction Skills.

The partnership received funding to develop the project from the National Higher Education Science, Technology, Engineering and Mathematics (HE STEM) Programme and the Royal Academy of Engineers.
The Dalton CPD Centre design short courses for specific business needs covering the nuclear landscape, governance, policy, supply chain and material.

22-24 Mac 2012 Nuclear leadership and governance for senior managers facing nuclear industry change.

1 day Introduction to Nuclear Energy is particularly suited to employees of companies thinking about entering the nuclear supply chain.

University of Central Lancashire
PGCert Governance of the UK Civil Nuclear Industry (e-Learning)
New Nuclear Build and Manufacturing (NNUMAN) programme has been awarded £4m funding by the Engineering and Physical Sciences Research Council (EPSRC) to research for new, innovative and efficient manufacturing technologies to enable UK manufacturing companies to learn the benefits of the new methods and apply them to new nuclear power plants.

The most improved manufacturing processes developed in NNUMAN will be taken forward to prototype by Nuclear AMRC to enable UK manufacturing companies to learn the benefits of the new methods and use them to enable consortium members to become the suppliers of choice to the global nuclear industry.

A one stop shop for skills for nuclear manufacturing & further development of key training courses and qualifications to support the up-skilling of manufacturers.
The National Skills Academy Nuclear - Manufacturing is a collaboration between the National Skills Academy for Nuclear, Semta (Sector Skills Council for the Advanced Manufacturing and Engineering sectors) and the NAMRC.

The collaboration will work together to provide:

A one stop shop for skills for nuclear manufacturing.
High Quality Provider Network
Innovative support tools
Further development of key training courses and qualifications to support the up-skilling of manufacturers.

In addition, the dedicated manufacturing team will also look at ways of addressing the most critical technical skills shortages identified in the manufacturing segment of the nuclear supply chain, such as:

- Project Management
- High Integrity Welding
- Control and Instrumentation
- Planning and Estimating
- Non-Destructive Engineering
- Manufacturing and Design Engineering
Gen II established in June 2000 by five partner companies – Sellafield Ltd, Tata Steel Europe (formerly Corus), Amec, Iggesund Paperboard and Innovia Films. offers:

**Advanced manufacturing short courses**
- i) Instrumentation system, control & testing
- ii) Process Plant pumping & piping system
- iii) Technology of Fluid Flow in Pipelines

**Nuclear Worker Apprenticeship**
- i) Electrical Apprenticeship-12 month course
- ii) Pipefitting Apprenticeship- 12-18 months
- iii) Welding, Fabrication and Pipefitting Apprenticeship – 12-18 months
- iv) Fabrication (Fabrication is the term use to cover a wide range of occupations including: Welders, Platers, Sheet Metal Workers, Pipe Fitters) Apprenticeship – 15 months
- v) Mechanical Apprenticeship – 15 months
- vi) Nuclear Worker Apprenticeship – 24 months
- vii) Process Apprenticeship – 12 months
OPERATION - Part I

Operations & Maintenance

- Operation & Site Management
- Nuclear Fuel Supply
- Engineering / Technical Services
- Waste Management & Disposal

University of Central Lancashire

FdSc in “Nuclear Related Technology - Commissioning & Maintenance”

BEng (Hons) Nuclear Plant

MEng in “Mechanical and Nuclear Engineering”
MEng in “Chemical and Nuclear Engineering”
MEng in “Materials and Nuclear Engineering”

Imperial College London

MEng Mechanical and Nuclear Engineering
MEng Chemical and Nuclear Engineering

University of Leeds

MEng Mechanical and Nuclear Engineering

MANCHESTER 1824

MSc “Nuclear and Radiation Physics”

MEng Mechanical and Nuclear Engineering
MEng Material Science and Nuclear Engineering
MEng Chemical and Nuclear Engineering

University of Strathclyde

MPhil Nuclear Engineering

Certificate of Professional Development in Radiation Protection
OPERATION - Part 2
Operations & Maintenance

- Operation & Site Management
- Nuclear Fuel Supply
- Engineering / Technical Services
- Waste Management & Disposal

MSc “Physics & Technology of Nuclear Reactors”
BSc Nuclear Science and Materials

MSc in “Safety Engineering”
MEng Nuclear Engineering

MSc in “Radiation and Environmental Protection”
MSc in “Radiation Detection & Instrumentation”

Certificate of Professional Development in Radiation Protection

MSc Physics and Advanced Materials

Nuclear Engineering Doctorate

Universities of Bristol, Leeds, Sheffield, and Strathclyde.
Decommissioning

Planning & Licensing → Decommissioning

University of Central Lancashire
FdSc in “Nuclear Decommissioning”
PGCert in “English for Nuclear Decommissioning”

University of Birmingham
Postgraduate Diploma(PGDip)/Certificate (PGCert) in “Radioactive Waste Management and Decommissioning”

Lancaster University
MSc in “Decommissioning and Environmental Clean-up”

The Supply Chain for a UK Nuclear New Build Programme

Updated February 2009
10 Nuclear Education offered by Consortium of Institutions in the United Kingdom
   i) NUTEC
   ii) National Skills Academy for Nuclear (NSAN)
A consortium of UK universities and other institutions providing postgraduate education in Nuclear Science & Technology

(a consortium of 11 institutions: Universities of Birmingham, Lancaster, Leeds, Liverpool, Manchester and Sheffield, City University, London, HMS Sultan, Imperial College London, UHI Millennium Institute & Westlakes Research Institute)
Continuing Professional Development (CPD)

Individual subjects are presented in 'short course' modules for engineers and managers in full-time employment who wish to advance their skill and knowledge base.

The core of each module is one week of direct teaching at the relevant institution, minimising the time away from the workplace for an employee whilst maximising its effectiveness.

Master's degree in *Nuclear Science and Technology* provided by a consortium of UK universities

i) part-time basis over a period of 3 years as well as
ii) full-time in 1 year

**Course Structure**

The qualifications offered are available on a full-time or part-time basis.

I) **Full-time MSc taken over 1 year:**

4 core and 4 elective modules are taken over a period of approximately 9 months. The project and dissertation then follows.

II) **Part-time MSc taken over 3 years:**

Year 1: 4 Core modules (Successful completion attains Postgraduate Certificate = PG Cert)

Year 2: 4 Elective modules (Successful completion attains Postgraduate Diploma = PG Dip)

Year 3: Project & Dissertation

**MSc in “Nuclear Science & Technology”**

**PG Dip. in “Nuclear Science & Technology”**

**PG Cert. in “Nuclear Science & Technology”**

(Modules of which are also made available to Industry for CPD Training)

http://www.ntec.ac.uk/

NTEC MSc is accredited by

i) Institution of Engineering and Technology

ii) Institution of Mechanical Engineers

iii) the Energy Institute

iv) Institute of Materials, Minerals and Mining
<table>
<thead>
<tr>
<th>Module Number</th>
<th>Module Title</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>N03*</td>
<td>Radiation &amp; Radiological Protection</td>
<td>Manchester</td>
</tr>
<tr>
<td>N04*</td>
<td>Decommissioning, Waste, Environmental Management</td>
<td>UCLan</td>
</tr>
<tr>
<td>N23</td>
<td>Radiological Environmental Impact Assessment</td>
<td>Manchester</td>
</tr>
<tr>
<td>N12</td>
<td>Reactor Thermal Hydraulics</td>
<td>Manchester</td>
</tr>
<tr>
<td>N06</td>
<td>Reactor Materials &amp; Lifetime Behaviour</td>
<td>Manchester</td>
</tr>
<tr>
<td>N09</td>
<td>Policy, Regulation &amp; Licensing</td>
<td>Manchester</td>
</tr>
<tr>
<td>N21</td>
<td>Geological Disposal of Radioactive Waste</td>
<td>UCLan</td>
</tr>
<tr>
<td>N01*</td>
<td>Reactor Physics, Criticality &amp; Design</td>
<td>Birmingham</td>
</tr>
<tr>
<td>N32</td>
<td>Experimental Reactor Physics - 2nd year Part Timers</td>
<td>Prague</td>
</tr>
<tr>
<td>N10*</td>
<td>Processing, Storage &amp; Disposal of Nuclear Waste</td>
<td>Sheffield</td>
</tr>
<tr>
<td>N08</td>
<td>Particle &amp; Colloid Engineering in the Nuclear Industry</td>
<td>Leeds</td>
</tr>
<tr>
<td>N02*</td>
<td>Nuclear Fuel Cycle</td>
<td>UCLan</td>
</tr>
<tr>
<td>N05</td>
<td>Water Reactor Performance &amp; Safety</td>
<td>Imperial</td>
</tr>
<tr>
<td>N11</td>
<td>Radiation Shielding</td>
<td>Liverpool</td>
</tr>
<tr>
<td>N31*</td>
<td>Management of the Decommissioning Process</td>
<td>Birmingham</td>
</tr>
<tr>
<td>N13*</td>
<td>Criticality Safety Management</td>
<td>Manchester</td>
</tr>
<tr>
<td>N29*</td>
<td>Decommissioning Technology &amp; Robotics</td>
<td>Lancaster</td>
</tr>
<tr>
<td>N07</td>
<td>Nuclear Safety Case Development</td>
<td>Manchester</td>
</tr>
<tr>
<td>N14</td>
<td>Risk Management</td>
<td>City</td>
</tr>
<tr>
<td>N32</td>
<td>Experimental Reactor Physics - Full Timers</td>
<td>Vienna</td>
</tr>
</tbody>
</table>
The **Certificate of Nuclear Professionalism** is a higher educational programme designed to equip individuals with the necessary skills required for today’s professional working within the nuclear industry.

It has been developed by the National Skills Academy for Nuclear, The Open University with involvement from industry and Higher Education, ensuring that it meets the needs of the nuclear sector.

Students studying the Certificate of Nuclear Professionalism are required to register onto the Open University’s Virtual Learning Environment where learners will upload evidence of their learning, access tutor support and complete their final integrative assessment.

The first step of registration is via the Skills Academy website.
The modules which make up the Certificate of Nuclear Professionalism are:

<table>
<thead>
<tr>
<th>Modules</th>
<th>Module Titles</th>
<th>Institutions offering the courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>Safety, Environmental and Security Management</td>
<td>UCLan</td>
</tr>
<tr>
<td>Module 2</td>
<td>Technical Leadership</td>
<td>Aston Business School</td>
</tr>
<tr>
<td>Module 3</td>
<td>Communications</td>
<td>Business Insight 20</td>
</tr>
<tr>
<td>Module 4</td>
<td>Commercial Awareness</td>
<td>Aston Business School</td>
</tr>
<tr>
<td>Module 5</td>
<td>Project Management</td>
<td>Aston Business School</td>
</tr>
</tbody>
</table>
| Module 6 | Nuclear Principles Protections & Frameworks       | UCLan
  Note: Open University offer module 6 as e-learning. |
| Module 7 | Safety Case Production and Evaluation             | UCLan                                                  |

The modules are available through a number of providers of the Skills Academy.
Nuclear Education & Training - The French Experience
In order to ensure the availability of necessary human resources, the government established in 2008 the French Council for Education and Training in Nuclear Energy (CFEN) chaired by the High Commissioner for Atomic Energy.

It includes representatives from governmental authorities in education, research and industry such as
i) academic institutions (universities and engineering schools),
ii) chief industrial actors (AREVA, EDF, GDF-SUEZ, ANDRA, and subcontractors),
and
iii) the main nuclear R&D public institutions: CEA and IRSN.

Its mission is to improve the balance between the education options being offered, the number of students and the needs of industry. = Convergence of Supply & Demand

(CFEN), advises the Office of Higher Education on opening new academic curricula. It also co-ordinates the international recruitment of students and provides a point of contact with AFNI for education and training.
Nuclear Energy Courses offered in France

Masters Degree

Master International Nuclear Energy

PhD in Nuclear Energy

PhD

Institut National des Sciences et Techniques Nucléaires
The first year (M1) of the course (Master in Nuclear Energy) consists of scientific foundation courses (both fundamental and applied):

- Nuclear physics
- Material sciences
- **Energy production technologies**
- **Project management**
- Electrical power engineering
- Option 1: continuum mechanics
- Neutron physics 1
- Languages and culture
- Fluid mechanics
- Process engineering
- Solution chemistry
- **Economics of energy**
- Option 2: automatic control systems
- Thermodynamics

Second year (M2) students choose one of the five majors:

- Nuclear Engineering
- Nuclear Plant Design
- Operations
- Fuel Cycle (Engineering or Radiochemistry)
- Decommissioning and Waste Management

This master's is also supported by major, internationally renowned French nuclear industrial companies: EDF, AREVA and GDF Partners

This master's degree is supported by four institutes at the Saclay Campus:
- **The Paris-Sud 11 University** (basic and applied physics, nuclear physics and energy physics)
- ParisTech schools (nuclear power, energy, energy efficiency, storage, economics, etc.)
- Ecole Centrale Paris and Ecole Supérieure d'Electricité
- INSTN
Nuclear Engineering Courses offered in France

Bachelor Degree

Mines Paris Graduate School/École des Mines Paris (ENSMP)

Masters Degree

Master in Nuclear engineering

Master in Nuclear engineering

Master in Nuclear engineering
Other Engineering Courses offered in France

University Montpellier

Bachelor Degree
Diploma of Electronics Engineering with Specialization Nuclear Matters

Masters Degree
Master in Nuclear Engineering and Nuclear Chemistry

PhD
University Bordeaux in Laboratory of Analytical and Bioenvironmental nuclear chemistry

PhD in Nuclear Chemistry
<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution/Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s Degree in Nuclear Installations Engineering</td>
<td>École Nationale Supérieure des Mines Saint-Etienne</td>
</tr>
<tr>
<td>Bachelor’s courses of Technology of Decomposition of Nuclear Installations</td>
<td>National Chemistry High School of Montpellier</td>
</tr>
<tr>
<td>Master of Civil Engineering of nuclear energy installations</td>
<td>École des Ponts Paris Tech</td>
</tr>
</tbody>
</table>
Université Aix Marseille II: a public research university in France created by the merger of the University of Provence, the University of the Mediterranean and the Paul Cézanne University.

- Master in Nuclear Risk
- Master in Law and Energy Governance (introduced in Sept 2010, in collaboration with CEA)
- International School of Nuclear Law - short course

Joseph Fourier University

- Master of Nuclear Industry and Industrial Engineering of Environment
Other Nuclear courses – Part Two

Mines School of Nantes/École des Mines de Nantes

MSc in Advanced Nuclear Waste Management

Grenoble Institute of Technology, in collaboration with EDF and INSTN

Master International Materials for Nuclear Energy (MaNuEn)

Institut National des Sciences et Techniques du Nucléaire (INSTN)

Modelling and Simulation Master Degree
Nuclear Education & Training
- For Decision Makers & Project Managers
Since 2005, the French nuclear supply chain is pooled around a competitive cluster called the Burgundy Nuclear Partnership (PNB). PNB gathers about 150 businesses from Parent Body Organisations (PBOs) such as EDF or AREVA to Small and Medium Enterprises (SMEs), public laboratories and postgraduate education centres.

Mid-2007, PNB identified a lack of high level training programs dedicated to decision-makers and project managers and initiated International Nuclear Academy.

Arising from this, an International Nuclear Academy dedicated to offering courses for decision makers and project managers was launched in 2009 by Mr. Nobuo Tanaka, International Energy Agency Executive Director,
Institute of Continuing Professional Development programs for the nuclear supply chain.
NOS SOLUTIONS / YOUR SOLUTIONS

Programmes de formations courts
INTER ENTREPRISES
Développez votre réseau

INTRA ENTREPRISES
Répondez aux besoins spécifiques de votre entreprise

Programmes de formations longues
Partenaire académique du Mastère Spécialisé en Technologies, Management et Sûreté Nucléaire co-délivré par SUPELEC et le CNAM

Short-term CPD programs
Networking with your peers
Bespoke programs designed for your specific needs

Long-term CPD programs
Academic partner of the Advanced Master in Nuclear Technologies, Management and Nuclear Safety delivered by SUPELEC and CNAM

www.inuclear-academy.com
The nuclear industry also set up new education and training programmes. For example, AREVA is involved in the creation of the European Nuclear Energy Leadership Academy for nuclear leaders - But this has been stopped recently
13 Recommendations
1. Set up a Task Force on Nuclear Education & Training, could be chaired by Minister of Education with membership of all Nuclear HRD stakeholders
   Invite Universities, Industry, Government Agencies & Others to sit & talk TOGETHER on the way forward for Nuclear Education & Training

   Partnership or Consortium may be established for offering
   Degree courses, Continuing Professional Development
   May refer to UK & French Best Practices
   - Avoid Duplication & Competition (resources wasted-people, time & money!!!)

2. Identify Nuclear Education & Training Needs for stakeholders:
   eg a) Government – Planning/Policy/Governance/Risk/Export Control
      b) Industry – Business opportunities: manufacturing, construction, engineering etc
      c) Regulatory body – Law & Regulations
      d) Academia & R&D Agencies – Nuclear S&T, R&D
3. Critical to remember – Manpower trained is NOT JUST to work in a nuclear power plant or station but in other organizations in the nuclear power sector value-chain eg Government, Industry and Businesses, Media, Finance etc

4. Prepare Nuclear HRD Roadmap to outlining areas/fields/number of personnel/timeframe/funds required

5. It may not be strategic for a number of universities to be offering same or similar courses on nuclear engineering. It may be more relevant for each university to identify its strengths and then offer the selected courses to support nuclear power. eg University A offers Nuclear Engineering, University B offers Nuclear Safety and Security, University C offers Nuclear Law and Policy, University D offers Nuclear Energy incorporating Business
6. For institutions currently offering only Nuclear Engineering courses it may be relevant to introduce other related courses-independent or as part of an existing module covering Nuclear Energy, Law, Governance, Risk, Business, Finance, Economics etc.

7. Apart from the offer of Nuclear Engineering courses for undergraduates/graduates, institutions of Higher Education as well as private E&T Centres could consider also offering courses to:
   a) Working professionals
   b) Technicians
   c) Craftsmen
8. In view of the great importance of public opinion and the significant role of the media must be given due recognition
- Open/ Introduce & offer Nuclear Education & Training to Media representatives
  i) Develop specialized topics/curriculum to encourage media participation and
  ii) consider inviting foreign media to share their views and experiences on nuclear power with local media and the general public

9. As Financing is amongst the critical factors for Nuclear Power Projects to be realistically implemented,
- Open/ Introduce & offer Nuclear Education & Training to representatives from the Banking & Financial Sector
  i) Develop specialized topics/curriculum for financiers and
  ii) consider foreign investors in NPP to share their views & experiences
10. As Nuclear Leadership is fundamental to ensure the safe, secure and profitable operations of nuclear power plants (to the NP plant owners as well as national economy) WNA & Other relevant Nuclear E&T Agencies could consider introducing

Nuclear Training Programmes (short courses) for Nuclear Leaders covering:
  i) Politicians  
  ii) Policy and Decision Makers  
  iii) Senior Management of Nuclear Power Plants  
  iv) CEOs of Nuclear Businesses

in place of ENEL which had just closed down.

[Note: As the World Nuclear University (WNU) ‘s 6 weeks summer course targets young professionals up to the age of 40 years the Nuclear Leadership course could cover Politicians, Policy & decision makers as well as Professionals above 40 years who are given leadership roles in Nuclear related initiatives]
Thank you

email: sheriffahnai@hotmail.com