EUROSAFE TRIBUNE
TOPICAL
#014
FEBRUARY 2009

SAFETY & RADIATION PROTECTION – BUILDING UP TOMORROW'S SKILLS

- Nuclear safety – radiological protection
- Power – industrial – medical applications
- Lifetime extension – new projects – phase-out
- Scientific – technical – executive skills
- Evolution of technology & operating modes
- International training initiatives

Published jointly by GRS and IRSN as a contribution to the EUROSAFE approach

CONTENTS

TO OUR READERS

Lothar Hahn and Jacques Repussard

These past two decades, nuclear safety in the Western part of the world has been focused on enhancing the safety level of existing reactors and fuel cycle facilities. In universities, the appeal of nuclear science and engineering has kept declining. Today, most of those who were involved in the construction, operation and inspection of the existing facilities are retiring. Regulators, technical safety organisations and nuclear operators are faced with highly complex issues that compound several safety challenges: reactor ageing, new fuel management, facility dismantling, waste disposal as well as the construction of new generation reactors in a context of deregulated electricity markets and globalised players. Thus, whatever option is selected within the framework of a country's nuclear policy – from phase-out to new build – the need for skills is tremendously pivotal to meet the safety requirements in the future.

Across the world, thousands and thousands of nuclear scientists and technicians must be educated, recruited and trained without delay to quench this thirst for competence. How are the needs for education and training assessed? What are the initiatives taken at national and EU levels to ensure sustainable education and training capability? How does ETSON, the European Technical Safety Organisations Network, contribute to training young scientists and engineers with a view to fostering the convergence of nuclear safety practices? We are pleased to invite you to finding some answers to these questions and many others in the present issue of the EUROSAFE Tribune and we wish you pleasant reading. 1

Lothar Hahn and Jacques Repussard

STAKES & GOALS

Hiring skilled personnel: a key issue to ensure nuclear safety in the future

Eberhard Hoffmann (Managing Director, KSG-GfS) | **Dale E. Klein** (Chairman, U.S. NRC)

To introduce the present issue devoted to education and training, the *EUROSAFE Tribune* interviewed the Managing Director of the NPP Simulator Centre located in Germany and the Chairman of the U.S. Nuclear Regulatory Commission. Their answers clearly evidence that, whatever choice is made by each country for the future of nuclear power – ranging from phase-out to new build – the need for skilled new people remains critical, even if a different mix of competences is required.

EUROSAFE Tribune. **Dr. Hoffmann, in the nuclear safety arena, how do you expect needs for skills to develop in Germany over the next 20 to 30 years?**
E. Hoffmann. The federal Republic committed itself by law to a complete phase-out of nuclear power. This situation is by no means conducive to lower needs for skills, since competent personnel has to manage post-operational issues, e.g. decommissioning and dismantling nuclear facilities, managing waste… We need young engineers to take care of this in a context of a generation shift. As a result, according to the technical publishing company VDI Nachrichten, the government as well as consulting firms and institutes like BFS, TÜV or GRS need 600 to 1000 engineers. On the industry side, a company like Areva Germany is seeking to recruit between 400 and 800 people!

EUROSAFE Tribune. **What are the initiatives to bridge the gap?**
E. Hoffmann. Adding to the current huge demand for engineers in Germany, where different sectors compete mercilessly to attract young people, the serious lack of nuclear engineers resulting from the close-down of nuclear courses in universities forces the nuclear community to recruit people who are not actually specialising in nuclear sciences and technology. And with the major German utilities going global, an increasing number of young engineers are working abroad, making available resources even scarcer in the country. To cope with this situation, 50 universities created a Circle of Excellence (Exzellenzkreis) among professors with a view to bring up a new generation of engineers in Germany, and several universities are financially supported by the utilities to achieve this aim.

EUROSAFE Tribune. **In this context, how does the Simulator Centre (KSG-GfS[1]) contribute to providing the skills needed to enhance nuclear safety in Germany?**
E. Hoffmann. Our institution located

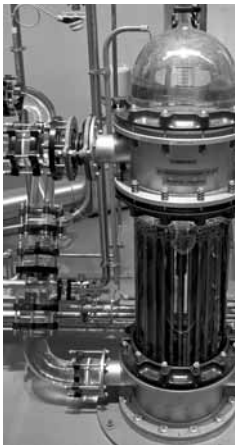
(1) KSG: Kraftwerks-Simulator-Gesellschaft mbH/ GfS: Gesellschaft für Simulatorschulung mbH.

in Essen, Germany, is becoming increasingly *the* specialist for nuclear safety training for the operational personnel. We offer a specific full-scope simulator for every power plant as well as a reactor glass model used to support teaching the thermal hydraulic processes in the primary system of a nuclear power plant with a pressurised water reactor. We welcome trainees from everywhere for both theoretical and simulator training, and we complement in this way the academic education provided by the universities. We also support institutions and companies in their effort to provide in-house training to their recruits.

EUROSAFE Tribune. **How should nuclear countries prepare for assuring safety in the future, depending on their own plans?**
E. Hoffmann. Depending on the different situations – first-time nuclear programmes, new build after years of interruption, phase-out – the bulk of competencies may differ, but skills are required in either case! In Germany for instance, we already dismantled five nuclear sites back to the greenfield: this means a lot of know-how, particularly in the storage technology where highly specialised physicists, geologists, etc. combine their skills to design acceptable storage solutions. Moreover, I think ever fewer designs will rely upon national approaches and, in this respect, it is important to introduce a more and more standardised way to 'produce' nuclear engineers, since the utilities develop internationally and the sector is consolidating. And I think organisations such as the IAEA, WANO and other players should promote international standards for nuclear safety.

EUROSAFE Tribune. **Dr. Klein, how are the activities of the U.S. Nuclear Regulatory Commission developing?**
Dale E. Klein. The NRC has been experiencing a significant increase in licensing activities at operating power plants, uranium recovery and fuel processing facilities as well as nuclear waste disposal. By late October 2008, the NRC had received 17 license applications for 26 reactor units and expects to receive perhaps as many as two dozen applications for more than 30 units by the end of 2009. These are the first requests for new power plant licenses that the Commission has received in decades.

EUROSAFE Tribune. **How can the NRC meet this challenge to fulfil its mission of protecting public health and safety and the environment?**
Dale E. Klein. The NRC established a goal of hiring an additional 200 employees in 2006, 2007, and 2008, since the Commission anticipates that its attrition rate will rise as a result of increasing competition and staff retirements. The NRC maintains a vigorous recruitment programme by participating in approximately 80 recruitment events each year at colleges, universities and professional gatherings. In addition, the NRC hosts agency recruitment events to discuss employment opportunities and benefits and conduct screening interviews. Four key factors make the most important contribution to the NRC's successful hiring programme:
- a mission that attracts a broad range of individuals to public service;
- strong, top-to-bottom involvement and support by the management;
- creative use of hiring tools and flexibilities; and
- a work-life balance that has earned the NRC its number one rating as The Best Place to Work in the federal government.



Glass model of a reactor (here the vessel) used during training sessions at KSG-GfS to display thermal-hydraulic phenomena that are not visible in an actual reactor.

EUROSAFE Tribune. **How does the NRC succeed in attracting young people?**
Dale E. Klein. The NRC finds itself positioned at the intersection of concerns about safe and reliable energy supplies as well as the environmental implications of various energy sources. Its mission resonates with the young and with the not so young. The Commission advertises the value of a career at the NRC, through ads, displays, and videos around a consistent message: "Make Our Mission Yours".

EUROSAFE Tribune. **Even the top management seems deeply involved in recruitment…**
Dale E. Klein. In my capacity as Chairman, I regard myself as the agency's Chief Recruiter. I make frequent visits to college campuses where I deliver a brief speech, and I meet with students individually to explain the agency's mission and activities. In addition, the NRC's senior executives and managers participate actively in recruitment activities: they identify the critical skill areas the NRC needs to target, give presentations at recruitment events, participate personally in interviews and follow-up contacts with prospects. Just as importantly, they sustain momentum and attention through the selection process up to the job offer. These activities make a firm impression on potential job candidates, who recognise that investing time and effort in people is a top priority at the NRC.

EUROSAFE Tribune. **What has the NRC to offer potential recruits?**
Dale E. Klein. The Commission offers recruitment bonuses to new graduates as well as competitive salaries. In addition, new employees can enjoy government benefits such as flexible work schedules, telework as well as a health benefits programme, which includes guaranteed health benefits coverage in retirement.

Like many private-sector employers, the NRC builds a pipeline of entry-level employees by engaging students during their college years. The Energy Policy Act of 2005 gave the NRC the authority to

- offer students co-operative education arrangements that cover some housing and transportation expenses during their work periods;
- hire retired employees for part-time work. The NRC uses this authority cautiously, but its value for meeting sudden critical-skill needs, or for short-term training efforts, is enormous;
- provide grants to support nuclear-related education: in 2007, the agency awarded grants to academic institutions for fellowships, scholarships, and curriculum development. In addition, the NRC has been charged by Congress to support the development of academic and trade skills essential to the safe and effective expansion of nuclear technology applications.

The Commission is very proud of its ranking as the Best Place to Work in the federal government, according to the 2006 federal Human Capital Survey. The management strives to create a workplace rich in opportunity, where employees are fully engaged in meaningful and challenging work, and value a healthy balance between professional and personal life. One result of this employee-friendly culture is that the NRC's 3,000 employees act as auxiliary recruiters.

EUROSAFE Tribune. **Do you consider the recruitment issue as solved?**
Dale E. Klein. Not yet! the NRC's hiring programme is still very much a work in progress. But for now, the agency is meeting its workforce needs, and I am confident that we have the resources we need to ensure that any potential expansion of commercial nuclear energy in the United States proceeds safely and securely. n

CONTEXT & NEEDS

Education & training: overview of the European context and needs

Gustaf Löwenhielm (SSM) | Peter Storey (HSE) | Patricia de la Morlais (IRSN)

At the end of the 1990s it became obvious that the declining nuclear investments were detrimental to the educational infrastructure in the Western countries, notably in some of them, such as Sweden and Germany, where a nuclear phase-out policy was established. Declining interest in nuclear education courses became a major concern. Furthermore, universities have less financial resources and were not willing to replace retiring professors in nuclear matters considering the lack of interest among students. In this context, an overview of the European initiatives aimed at giving education & training (E&T) new momentum is proposed below.

The status of education & training in Europe: a cause for concern?

Several initiatives highlighted the deteriorated situation of E&T in the EU, notably:

- The survey conducted in 1999 by the OECD/NEA on 16 OECD countries with 119 responding institutes. Titled "Nuclear Education and Training: Cause for Concern?" this study pointed out that broad and deep education is essential to master such a complex industry as the nuclear industry and that only universities and advanced technical schools can provide the adequate education. The report gives a picture of stagnation and beginning of a downward spiral, and suggests that governments take the responsibility to remedy this situation.
- At a conference held in Budapest in 1999, it was pointed out that countries with viable nuclear programmes do not envisage problems with nuclear education. This is true for countries in the Far East and in France. The OECD/NEA followed up the Budapest meeting with a report

Work in progress at Flamanville (France) where the first EPR-type reactor unit in France is under construction.

Some commitments associated with signing the Nuclear Safety Convention

- *"Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7 and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities."* (Article 8.1)
- *"Each Contracting Party shall take appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life."* (Article 11.2)

Education and training: definitions

■ **Education** is a way to acquire knowledge, deep comprehension and skills, up to a certain level of "theoretical and practical expertise" in the field. It allows synthesis and independent production of new knowledge. It is common practice throughout Europe that government support and funding is directed towards education and research as an investment for the future. The educational part typically takes several years to complete.

■ **Training** is the way to give "practical and operational" skills to technicians, operators and managers who have to deal with more or less complex systems involving radioactive materials. In general terms the industry or other entities support the training of their employees concerned. Training requires short or medium duration efforts (typically from a week to a year).

Sweden: an original authorities-industry partnership to support universities

In the early 1990s, it became clear that the financial situation of universities and institutes of technology did not allow them to finance PhD students on their own. The Swedish Nuclear Power Inspectorate[1] thus had discussions with the industry and it was agreed to set up the Swedish Centre for Nuclear Technology[2] in 1992. Its activity has gradually expanded, and today about 10 to 12 students are supported by SKC. This collaboration was extended in 2002 to support also professor and lecturer chairs at three universities/institutes of technology. This support has proved to be extremely important to retain nuclear education and research at the universities. This is perhaps the only example for co-operation between authorities and the nuclear industry to support universities and ensure that the education in nuclear-related subjects is retained. Besides this support, the Swedish Nuclear Fuel and Waste Management Company[3] also supports a professorship in nuclear chemistry at the Royal Institute of Technology[4].
With these agreements, the Swedish Radiation Safety Authority[5], together with the nuclear industry, has clearly demonstrated the intention to ensure that competence is maintained and developed, and it was found that the number of students has increased since these agreements came into place.

[1] Statens Kärnkraftinspektion (SKI).
[2] Svenskt Kärntekniskt Centrum (SKC).
[3] Svensk Kärnbränslehantering AB (SKB).
[4] Kungliga Tekniska Högskolan (KTH).
[5] The Swedish Radiation Safety Authority (Strålsäkerhetsmyndigheten / SSM) took over the responsibility and tasks from the Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Institute (SSI) on 1st July 2008.

where a number of recommendations were given. The first recommendation was that because of the time lag the CNRA should act immediately to restore lost competences. Other recommendations were to set up strategic plans for long-term competence and to set up national committees comprising regulators, operators and educators to ensure proper actions.

Such reports and conferences also discuss the role of training. But it was found that the situation for training was not as serious as for the education at universities. Training courses are given by the IAEA, which are an important complement to the in-house training courses in specialised subjects.

The need for closer co-operation

The Programme Committee on Nuclear Fission (CCE-Fission) launched a working group to study what the European Commission could do to alleviate the E&T situation in the European Union countries and came up with the following recommendations:

- encourage young people to join the nuclear sector,
- increase mobility of students, teachers and instructors across Europe,
- networking European study programmes,
- networking to maintain nuclear competence through E&T,
- networking to hold nuclear competence in Europe through research in support to ERA.

Emphasis here is clearly put on closer co-operation in Europe: it is suggested to implement a network for courses and programmes (in particular, a European Master of Nuclear Engineering), quality standards for study programmes and building up international recognition of the corresponding diploma. The education in nuclear universities has been revived in the US as a result of the Generation IV initiative, and in Finland where a fifth reactor unit

(EPR) has been ordered; more young students have thus shown an interest in studying nuclear engineering. But in most countries in Europe the concern still remains and the number of actions, which have been initiated and are described below, will be an important factor to uphold the competence in nuclear-related subjects.

A European strategy for education and training

The European Commission has proposed a nuclear E&T strategy based on three principles:

- common qualification,
- mutual recognition,
- mobility of teachers and students (ensure practical implementation).

If these principles are complied with, it seems that this will save resources and give all interested students access to nuclear-related courses and, in this way, alleviate the concern for insufficient education in nuclear subjects. A good side effect is that this will promote co-operation and networks in E&T in Europe.

UK: the upturn after the decline

In the UK it is recognised that a rapid growth in skills will be needed to drive UK competitiveness with the rest of the world. With the objective of addressing the UK's future energy needs, the government has set out significant plans for nuclear power. The increased demand for nuclear skills in the UK will be resourced through a range of internal strategic actions co-ordinated by government agencies, especially the Sector Skills Council Cogenet and the National Skills Academy Nuclear.

The highest priority is to fill gaps left in vocational and technical skills as a result of years of industry decline. The nuclear sector as a whole needs to quadruple the number of apprentices over the next five years. In addition the prospect of new build in both the civil and defence sectors has increased the number of students taking postgraduate programmes and as a result the number of such programmes is on the increase.

In the absence of nationally funded research programmes, the university sector is expanding to meet the demands of the industry for high-quality research and for specialist expertise that can be employed within the industry. Substantial programmes funded by the industry and the Research Councils are assisting the growth and variety of universities that have the necessary expertise to support the industry's long-term needs.

It would be fair to conclude that

- the decline in nuclear skills in the UK has been arrested and there is good evidence suggesting that the skills requirement is starting to be filled but the increasing demands of the industry as it expands means there is still a long way to go;
- having an adequate level of nuclear skills will pose a risk for most countries with nuclear aspirations.

France: 'the career paths are opened'

These past years, even France, with nearly 60 reactors and its expertise of nuclear engineering, experienced a decrease of its nuclear sector's activity, until the government decided to build a new EPR-type reactor in Flamanville, following the Finnish example in Olkiluoto. This move brought to light, just as in many other countries, the insufficient renewal of skills in research, industry and engineering.

The present developments in the nuclear power sector are fuelling a growing demand for expert assessment in many fields of competencies and, as a consequence, for adequately educated and trained human resources. Adding to this, the replacement of the retiring generation of people who worked, in France as well as in several countries, in the existing plants makes the skills issue an even more critical one.

In this respect, institutions such as IRSN, who retained their qualified researchers and experts when the nuclear sector was on the decline, are now regarded as a 'skills provider'. IRSN strives for showcasing its mission, its brand image, its values, its contribution to sustainable development as well as the wide scope of required skills and offered careers. This draws upon an attractive human resources strategy and active communication to convince talented young people that becoming a nuclear engineer is as appealing as becoming a trader! There are plenty of opportunities in many fields and the career paths are opened.

The European Nuclear Education Network (ENEN) initiative

A group of about 30 European universities was granted funds, with the objective, among others, to devise a concept for a European Master of Science in Nuclear Engineering. The ENEN Association was successful in establishing the criteria for this Master's degree and was also active in establishing international ENEN courses. The Association has been granted the NEPTUNO project and the ENEN-II follow-up project, both aiming to "better integrate European education and training in nuclear engineering and safety".

Other initiatives

One important feature in the 6th and 7th Framework Programmes is that Education and/or Training must be part of large projects, such as integrated projects, collaboration projects and networks of excellence (NoE). One example of this feature is the SARNET NoE, which allowed drafting a textbook on severe accidents. This is clearly reflected also in the efforts to set up technological platforms and in particular SNE-TP (Sustainable Nuclear Energy Technology Platform), one key initiative where E&T will be addressed through a working group on education, training and knowledge management.

Conclusion

This overview of the European context and needs evidences that each country is potentially in competition for skills as the workforce becomes more flexible – and as companies keep growing internationally – and is likely to be working in more than one country. It clearly shows that each country therefore needs to look after its own skills needs and should have a strategy that takes account of the future global expansion of nuclear. Furthermore, it demonstrates that, in spite of national responsibilities, there is great opportunity from co-ordination and co-operation in sharing training provision and sharing skills and knowledge especially in technical areas were expertise is scarce. Last but not least, the overview highlights the key role for TSOs to play in realising co-operation within Europe. n

MEETING NEEDS

Meeting the needs for education, training and knowledge management: a research institute perspective

Timo Vanttola & Seppo Vuori (VTT Technical Research Centre of Finland)

A country with a long tradition of nuclear power generation, Finland experienced a 20-year status quo of its nuclear activities, just like most 'nuclear' countries. But, unlike many of them, Finland succeeded in maintaining key skills thanks notably to the embedment of the country's nuclear research knowledge mainly in one single multi-disciplinary research organisation, VTT [1] and to the uninterrupted government support to publicly funded research programmes. Faced with the challenges prompted by the restart of nuclear power programmes, in particular the construction of the Olkiluoto-3 EPR, Finland is now finding new ways to educate and train a sufficient number of scientists and engineers by taking advantage of both national and European initiatives.

Maintaining nuclear knowledge throughout a long status quo period

In Finland, the need for nuclear power expertise goes back to the late sixties, at the inception of the national NPP programme and the planning and design of four reactor units. Erected in the seventies, those were mainly drawing upon foreign technology, hindering the development of major domestic suppliers. At that time nuclear expertise had been primarily devoted to operating plants, supervising safety and developing domestic solutions to the geological disposal of waste and spent fuel.

Basic education at university level was started at Helsinki University and at the Lappeenranta Universities of Technology. From the very beginning, it was clear that one efficient way of growing competence was research, carried out mainly with a view to supporting the safety assessment of reactors and waste disposal facilities. Since needs were of a limited extent, the research capability was mainly developed and embedded in one multi-disciplinary research organisation, VTT, and international co-operation was obviously of key importance.

During the twenty years of status quo (1980 to end of the 90s), two domestic factors may have contributed to maintaining the research capacity in many fields. Firstly, embedding the research groups inside VTT has allowed conserving nuclear skills in several key disciplines, even when the

[1] A non-profit making research organisation, VTT Technical Research Centre of Finland is the biggest multi-technological applied research organisation in Northern Europe. It produces research, development, testing and information services to public sector and companies as well as international organisations.

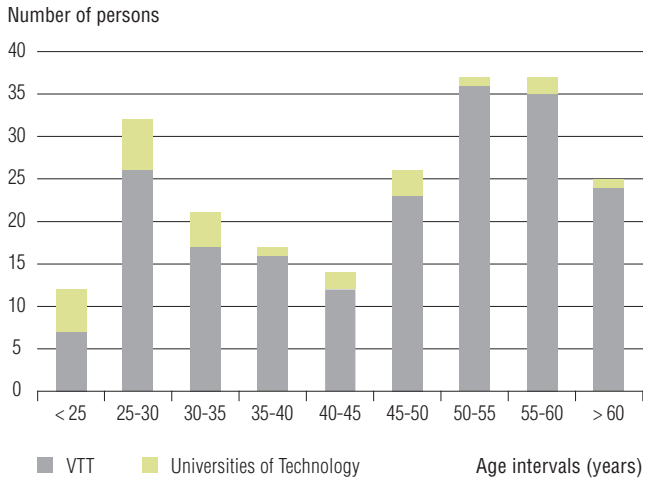


Figure 1
Age distribution of nuclear research engineers at VTT and universities of technology.

priority research targets were elsewhere. Secondly, the State's support to research remained continuous though limited. Since the beginning of 1990, the launch of co-ordinated national research programmes on reactors' operational and structural safety and nuclear waste management, with the subsequent education and training targets, has played a particular role in maintaining and developing expertise. At the turn of this century, the Finnish Parliament ratified the government's Decisions-in-Principle (DiP) on the spent fuel disposal facility to be located at Olkiluoto and subsequently on the fifth reactor as well. Thereafter it was clear that a renaissance of the domestic nuclear power programme was ahead. Students were again interested in this field, and many research topics suddenly started to gain concrete contents. At the same time, the need for educated experts both at the utility in charge of this new EPR-type reactor and at the regulator became acute. As a consequence, many experts from the research side are now moving to these organisations, adding to the shortage of educated manpower resulting from massive retirement at several institutions.

Dealing with limited domestic resources

What should be done to cope with this manpower issue, when speculation on additional units even worsens the present situation?

Firstly, from a research perspective, a tradition has been fortunately maintained and no research field needs to be restarted from scratch, thanks to the uninterrupted support to domestic research programmes and the fairly concentrated organisation of research at VTT. The research centre presently employs many young students as part-time trainee scientists already after their third academic year and offers increasing possibilities to conduct diploma theses in current research projects. Many of them continue as researchers and post-graduate students in the universities simultaneously. This hiring policy actually leads to a double-humped age distribution (see Figure 1) that naturally poses such new problems as finding enough tutors.

For a decade now, the aforementioned universities have been expanding their nuclear education programmes and student intake, despite the fact that only two professors dedicated to nuclear technology are available. This may be resolved by increasing the number of national professorships, by sending students to such foreign universities as the Royal Institute of Technology in Sweden, and by taking advantage of the ENEN [2] co-operation among the universities involved in providing academic education in the field of nuclear energy. Furthermore, especially in the post-graduate phase, it is possible to increasingly rely upon specialised training courses organised in co-operation among different nuclear organisations that pool their resources in networks such as ETSON [3].

At the moment, academic education for postgraduate students is fairly limited in Finland. Most of the higher

[2] The "European Nuclear Education Network" (ENEN) is a non-profit making association that gathers 46 members from 19 countries.

[3] The European Technical Safety Organisations Network (ETSON) was created in 2006 by the TSOs of France (IRSN), Germany (GRS) and Belgium (then AVN, now Bel V).

education and training in the research field consists of a sort of self-training, i.e. learning by doing. At this stage, international contacts obviously are of vital importance, and every year VTT sends a number of participants to international summer schools and other special courses. Co-operation with foreign research laboratories has often proved useful, e.g. by sending and receiving researchers on topics of common interest.

Annual training courses as joint national effort

However, changes in energy markets and the rapid development of technology renew the challenges associated with maintaining sufficient knowledge on a domestic scale, requiring special efforts from the Finnish stakeholders. Adding to this, a considerable share of Finnish nuclear experts both at the regulator's, the operators' as well as in research institutes and universities will have retired by mid-2010s, whereas additional human resources will be needed owing to the spent fuel disposal project, the Olkiluoto–3 project and other potentially new NPP-projects. To tackle the resulting challenges, young experts in the nuclear safety field are trained through a specific co-operation programme involving all Finnish nuclear-related organisations. Between 2003 and 2007, about 270 young experts participated in five training courses of five to six weeks focused on nuclear reactor safety, including some basic features of nuclear waste management. The sixth training course is being organised in 2008-2009. The policy consists in providing courses on an annual basis as long as enough participants will need the training. The didactic materials developed – including textbooks, overhead materials, exercises and video lectures – can be used either by the participating organisations for their own training purposes or for self-study via distance learning.

Versatile set of autoclaves developed by VTT for material performance research in simulated LWR primary circuit conditions (chemistry, temperature, pressure, loadings).

An active participation in national and European research projects

At present, VTT and the technical universities in Finland have considerably increased their efforts to participate more actively in the international co-operation pertaining to the development of the Generation IV reactors and the associated closed fuel cycle. VTT is an active partner in the SNE-TP [4]. At national level, as a joint effort by the two technical universities and VTT, a new four-year project called *New Type Nuclear Reactors* (NETNUC) was started in early 2008 within the Sustainable Energy (SusEn) research programme of the Academy of Finland. Furthermore, VTT belongs to the design consortium, lead by the French CEA, for the Jules Horowitz material testing research reactor in Cadarache (France). All these new efforts require on the one hand new manpower, but on the other hand they provide challenging new tasks that attract talented young experts into the nuclear energy field. n

[4] Launched in September 2007, the Sustainable Nuclear Energy Technology Platform (SNE-TP) is composed of over 60 organisations from 17 countries whose main interest is in research and training.

EDUCATION: THE STATUS IN THE EU

Nuclear Education and Training in the Euratom Programme

Georges Van Goethem (European Commission/DG RTD, Energy [Euratom])

Being part of the energy mix of numerous EU Member States, nuclear power should be put in the context of the EC's *Energy Policy for Europe* (EPE) and of the associated *Sustainable Development Strategy (Climate Change and Clean Energy)*. In this regard, keeping the nuclear option open means maintaining an adequate skills base to ensure in the long run sufficient personnel in research organisations and in nuclear facilities. The most important initiatives taken under Euratom[1] auspices to meet the needs in the field of Education and Training (see box on page 15) are reviewed below.

The new context of Euratom's research and training strategy

The continued safe operation of the nuclear facilities in Europe is of vital importance, and helping ensure safe nuclear power generation has always been one of the priorities of the Euratom research and training programmes. This is discussed in several places, in particular:

- **The Sustainable Nuclear Energy Technology Platform** (SNE-TP). Launched in September 2007, the SNE-TP is composed of over 60 organisations from 17 countries whose main interest is in research and training. One of the four Working Groups is devoted to *Education and Training*. The three other Working Groups are focusing on a *Strategic Research Agenda*, a *Deployment Strategy* and *Funding Mechanisms*.
- **The European Nuclear Energy Forum** (ENEF). The main interest of the ENEF is in
  - EU policy and legislation, through its two Working Groups: *Opportunities* and *Risks*, dealing also with education and training,
  - dialogue with society, through its Working Group named *Information & Transparency*.

Nuclear education: mutual recognition of academic curricula (Bologna/Erasmus process)

The goal of Euratom in the area of basic or life-long learning is to offer a number of instruments that help produce top-quality teaching modules at higher-education level. These modules are then assembled into Masters programmes or higher-level training packages that are jointly qualified and mutually recognised across the EU. This is done within the 7th Framework Programme of the Directorate-General for Research (DG RDT), using in particular the "People" programme. Collaboration is also established with the Joint Research Centre (DG JRC) and with the *Lifelong Learning Programme* of the Directorate-General for Education and Culture (DG EAC), especially regarding Erasmus. In line with the Bologna process *(European Area of Higher Education by 2010)*, the Euratom

[1] Established on 25 March 1957 along with the European Economic Community (EEC) by the Treaty of Rome, Euratom aims to create a specialist market for nuclear power and distribute it through the Community and to develop nuclear energy. One of its major projects is currently its participation in the international fusion reactor ITER financed under the nuclear part of FP7. Euratom also provides a mechanism for providing loans to finance nuclear projects in the EU.

approach for nuclear E&T is based on four objectives:

- **modular courses and common qualification approach:** offer a coherent E&T framework and ensure top quality for each module;
- **one mutual recognition system across the EU:** e.g. European Credit Transfer and Accumulation System (ECTS) of ERASMUS;
- **mobility for teachers and students across the EU:** prepare the "internal market" for free circulation of nuclear experts;
- **feedback from "stakeholders" (both scientific and financial):** involve the "future employers" in the process, thereby getting additional funding.

In order to achieve the above objectives, the *"European Nuclear Education Network"* (ENEN) non-profit making association gathers 46 members from 19 countries. Its approach will be extended to *Euratom Fission Training Schemes* (EFTS) in specific areas where a shortage of skilled professionals has been identified. The EFTS is a significant development aimed at structuring research training and career development across the EU. It is a long-term and ambitious programme, spread over many years and relying on the active participation of "future employers", i.e. representatives of system suppliers, energy providers, safety authorities and TSOs, users of ionising radiation in medicine and industry, waste management agencies, etc. Wherever appropriate, a *European passport for Continuous Professional Development* should be developed, in consistency with the national responsibilities in this domain.

Nuclear training: mutual recognition of professional qualifications (internal market)

Besides the harmonisation of academic curricula, a number of strategic studies pointed out practical problems related to mutual recognition and accreditation across the EU Member States. In the area of education (in particular universities), ERASMUS provides a series of well-tested tools, based on the Bologna process [2]. In the area of training (in particular continuous professional development), where a great variety of stakeholders are involved, the problem is more complex because there is no such process as "Bologna". The radiation protection community in particular examined the problem of mutual recognition of *Qualified Experts in Radiation Protection* in connection with the Euratom legislation on *Euratom Basic Safety Standards* (96/29/Euratom).

If the rights of EU citizens to establish themselves or to provide services anywhere in the EU are fundamental freedoms in the Single Market, national regulations that only recognise professional qualifications of a particular jurisdiction present obstacles to these fundamental freedoms. The Community Directive (2005/36/EC) applies whenever the profession at stake is regulated in the host Member States, which is the case of the *Qualified Experts in Radiation Protection*. This problem of mutual recognition of professional qualification was tackled as follows:

- **the scientific aspects** were discussed in the DG RDT-driven FP-6 co-ordination action *European Network on Education and Training in Radiolog-*

Education and training (E&T): definitions

■ **Education** is a basic or life-long learning process: education is broader than training and encompasses the need to maintain completeness and continuity of competences across generations. It is essentially a knowledge-driven process, involving academic institutions as suppliers, and students as customers.

■ **Training** is learning a particular skill required to deliver a particular outcome: training is about schooling activities other than regular academic education schemes. It is essentially an application-driven process, involving industrial training organisations as suppliers, and professionals as customers.

[2] The purpose of the Bologna process is to create the European higher education area by making academic degree standards and quality assurance standards more comparable and compatible throughout Europe, in particular under the Lisbon Recognition Convention, entered into force in 1999.

Announcement for FISA-2009, Seventh EC conference on Euratom research and training in reactor systems (Prague, Czech Republic, 22-24 June 2009). The main objectives of this conference organised by the EC Directorate-General for Research are the dissemination of Euratom Framework Programme results and the cross-fertilization of various disciplines, including through training.

ical Protection (ENETRAP, consisting principally of research and training institutions);
- **the political and legal aspects** were treated in the DG TREN-driven platform *European Training and Education in Radiation Protection* (EUTERP, consisting principally of representatives of national regulatory authorities and international organisations).

Nuclear E&T: a concern and solutions shared by all stakeholders

The Bologna process has proven to be very useful to foster convergence of academic curricula in nuclear fission (ENEN) across the EU. New mechanisms, however, should be developed to ensure the rights of EU-qualified experts at higher-education level (e.g. in radiation protection) to establish themselves or to provide services anywhere in the EU. The problem of mutual recognition and accreditation across the EU Member States might require a new type of Community actions (multi-disciplinary and multi-sectoral).

Finally, it is worth stressing that the Community actions described above are discussed by all stakeholders (in particular, through the aforementioned SNE-TP and ENEF), i.e.:
- the nuclear research organisations (public and private),
- the systems suppliers (e.g. nuclear vendors, engineering companies, etc),
- the energy providers (e.g. electricity utilities, heat and/or hydrogen vendors, etc),
- the regulatory bodies and associated technical safety organisations (TSO),
- the education and training institutions, and, in particular, the universities,
- civil society and the international institutional framework (IAEA and OECD).

Euratom education and training actions (together with research) will be further discussed at the upcoming FISA-2009 Conference, to be held in Prague on 22-24 June 2009. n

< **Internet links are proposed on page 34 (Venues & websites) to read more on the Community actions described in this article.**

EDUCATION: THE STATUS IN FRANCE

Restructuring nuclear safety training in France: a new offer to meet new challenges

Bernard Bigot (High Commissioner for Atomic Energy, French Atomic Energy Commission [CEA])

Developing and implementing nuclear energy solutions is by essence a long process that can take several decades and depends above all on the talent and know-how of researchers and engineers who must be at the same time innovative and capable of running complex facilities with a high level of safety and availability. An overview of how France is reshaping its nuclear safety training offer to take up the challenges associated with ensuring the safety and security of its present and future facilities is given below.

Today, the nuclear industry worldwide is faced with major needs for engineers and scientists. Beyond keeping a high level of safety in the existing nuclear facilities, the training programmes must adapt to the expected industrial and security challenges: development of new generations of reactors and fuels, new requirements for waste management, start of the dismantling of decommissioned facilities, development of spent fuel reprocessing. In conjunction with the ministries of education, research and industry, I promoted the involvement of the *ad hoc* stakeholders. The need for optimising training programmes to ensure that all the necessary skills are covered, that the highest standards of teaching are maintained and that training courses complement each other prompted, in the summer of 2007, the set-up of a training plan by representatives from the industry, universities and top engineering schools. This training plan is based on in-depth analyses of needs and existing training programmes. Their efforts to reinvigorate training were given a real boost by a shared vision on the best possible safety and operability conditions for the development of nuclear energy.

This collaborative effort led to a set of conclusions and recommendations concerning training in nuclear science and technology for the years ahead. Clearly, safety and radiation protection skills are pivotal for developing sustainable nuclear energy use with acceptable level of risk to human health and the environment. It therefore features prominently in this project.

Modular programmes with international aim

In France, there are three levels of training:

- **Initial training** in fundamental concepts through undergraduate courses at engineering schools or universities – such as the nuclear engineering course provided by INSTN [1] – or Master's degrees,

[1] INSTN: Institut national des sciences et techniques nucléaires/National Institute of Nuclear Sciences and Technology.

- **More specialised engineering school or university courses** focused on a specific area of expertise (safety and radiation protection) within the nuclear sector,
- **Specialist training** designed to complement professional experience or to prepare employees for company-specific training.

Here, we shall consider the first two levels. The corresponding training courses, leading to the award of a nationally recognised, government-endorsed qualification, must follow the European 3-5-8 model (Degree, Masters, Doctorate) and be modular in structure so as to facilitate the assimilation of students from other countries of the European Union and the easy equivalence with third countries who wish to develop exchange programmes with France.

Three complementary centres of excellence

Training in France is concentrated in three main geographical areas: the Paris metropolitan region, the South-East (Grenoble, Lyon and Montpellier) as well as the West (Nantes and Caen). Other sites may offer additional training in association with these major centres.

- The Paris metropolitan region has great potential, with well-established training courses, particularly at INSTN. Paris XI University and the region's elite engineering schools, particularly those belonging to the Paris Tech group, have also made a firm commitment to nuclear science and technology.
- Grenoble, home to UJF[2] and INPG[3], provides well-structured, high-level specialised training in radiation protection and safety, but some adjustments to this training must still be made in order to meet the requirements of industrial groups and public bodies. The conversion of a purely French Master pertaining to radiation protection into a European Master, the set-up of a new Master of nuclear safety covering all the aspects of safety from the design to the dismantling of a facility as well as the last updating of the training course on the most recent techniques of non-destructive testing are just a few examples of current developments.
- In the West, Nantes (university and Ecole des Mines) and Caen (university and engineering school) provide specialist training focused on nuclear safety and organisation.

High-level research requires substantial resources

INSTN's particular part in the current system is to develop and implement specialist vocational training programmes in all areas of nuclear expertise and at all levels. The INSTN's flagship nuclear engineering programme (termed "Génie atomique") has produced generations of engineers, including those who designed, built and contributed to the reliability and safety of the nuclear facilities currently in operation. One of the key attributes of INSTN, which is affiliated to CEA[4], is its easy access to the experimental facilities required to train nuclear engineers, thanks to structured co-operation with neighbouring universities and engineering schools. Quality higher education is based on a high level of research requiring substantial resources, particularly in nuclear engineering and, indeed, in the field of safety. In this respect, co-ordination between establishments allows the sharing and optimisation of human and material resources and of simulation facilities. A table showing the current and future situation of initial specialised training in safety and radiation protection is appended. The public bodies involved in nuclear research and development – CEA, IRSN[5] and ANDRA[6] – are re-

(2) UJF: Université Joseph Fourier (Grenoble).

(3) INPG: Institut national polytechnique de Grenoble.

(4) CEA: Commissariat à l'énergie atomique/ French Atomic Energy Commission.

(5) IRSN: Institut de radioprotection et de sûreté nucléaire.

(6) ANDRA: Agence nationale pour la gestion des déchets radioactifs/National agency for the management of radioactive waste.

Nuclear training in France

	Establishments	Type	Duration	Maximum intake
Existing				
Safety	UJF-UCB [8]	Master's degree	1 year	25
Radiation protection	UJF-UCB-INSTN	Master's degree	1 year	21
Decided				
Safety	ENSAM [9]-INSTN-IRSN	Specialised Master's degree	1 year	15
Planned				
Nuclear safety and organisation	Ecole des mines de Nantes	Specialised training	1 year	15

Only fully specialised training courses are listed in this table. Specific or limited courses relating to scientific fields such as nuclear physics, included in some engineering school syllabi, or dealt with as part of general safety and risk prevention master's degrees, are not included.

markably committed to getting their staff involved in teaching (nearly 80% of specialised courses in the Paris region are provided by such staff, the vast majority coming from CEA), with moreover the valuable contributions from some nuclear operators' professionals, especially EDF [7] and AREVA. However, their involvement is dispersed among different academic institutions. This situation may result in wasting the available means of expertise whereas the demand of teaching and training is on the rise. The restructuring work underway is aimed at solving this problem. In this respect, IRSN, in close collaboration with INSTN, provides most of the training delivered in the fields of safety and radiation protection today, some of which is regulatory.

Developing further the international dimension of national training programmes

Through the development of complementary programmes, the European Nuclear Education Network (ENEN) can contribute to a substantial expansion of nuclear training on a European scale, as well as to fostering common technical basis in nuclear science.
The core content of a major international Master's degree in nuclear engineering to be provided by Paris XI University and INSTN in the Paris metropolitan region is pending official approval. With the support of the industry and academia – in particular Paris Tech, Ecole centrale and Supélec –, work is well underway to create an international Master's degree as part of a high-profile and competitive training offer. Restructuring efforts are being pursued with equal vigour outside of Europe. Exchange programmes with major nuclear countries, and primarily China, are currently being developed. The enhancement of training programmes, particularly in the fields of safety and radiation protection, should also be approached with a view to setting up an international support network capable of providing expertise to countries that are new to nuclear energy.

A fortunate position to contribute to the progress of nuclear safety worldwide

In close collaboration with its European and global partners, and with the support of its nuclear industry, France appears in a position to contribute to quickly developing a high-profile international training offer. By pooling strengths in a context of nuclear "renaissance" in several European countries and across the world, great advances towards an ever-higher level of nuclear safety and radiological protection can be achieved. n

[7] EDF: Electricité de France.

[8] UCB: Université Claude Bernard (Lyon).

[9] ENSAM: Ecole nationale supérieure des arts et métiers (Paris).

BRIDGING THE GAPS

From School to PhD: the UK's initiatives to renew nuclear skills

Andrew Worrall (UK National Nuclear Laboratory) | Peter Storey (Health and Safety Executive)

The prospects for new nuclear build in the UK are likely to put continued pressure on the existing skill base of engineers and scientists. The need for new initiatives to remedy the predicted shortfall between supply and demand of the appropriate skills is now well documented, and with the adoption of programmes and activities from schools through to post-graduate qualifications, and through initiatives such as the foundation of the National Nuclear Laboratory (NNL) in July 2008, the UK is moving in the right direction to ensure that there will eventually be sufficient educated, trained and experienced staff for a safe and sustainable nuclear industry.

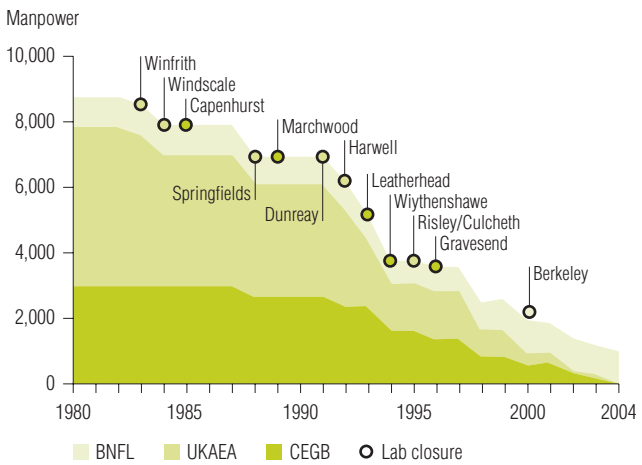
Technical skills: tremendous needs following a long decline

Over the last few years, the UK nuclear industry has been undergoing dramatic changes and restructuring such as the establishment of the Nuclear Decommissioning Authority (NDA[1]) as well as the break-up and sell-off of British Nuclear Fuels plc (BNFL). As shown in Figure 1, throughout these times of change there was a continual decline in the manpower deployed on R&D in the UK as well as a fall in public-sector funding of fission research from more than £700 million (approx. 900 million) in the mid 1970s to almost none today.

However, for the UK, the recent emphasis on clean-up and decommissioning of our nuclear legacy together with the possibility of new nuclear generating stations has underlined the need for action to replenish the skills base of scientists and engineers. Analysis by the NDA has summarised the skills challenges to be

- to fill the gap left by an ageing workforce;
- to create a consistent understanding of the long-term skills needs;
- to ensure competition and the increased use of contractors is not

Figure 1
Decline of UK R&D Manpower



hampered by lack of suitably trained people;
- to ensure that the focus of university courses, skills initiatives and standards meets the industry's needs.

These challenges apply not only to the skills needs of decommissioning and clean-up, but they are particularly appropriate to the provision of suitably skilled scientists and engineers in all aspects of the nuclear industry including new nuclear generation. The challenge of skills provision is one of the reasons why the UK government has been seeking to establish a National Nuclear Laboratory (see box I); it will have a role in running strategic R&D programmes (see box II) and in safeguarding and enhancing key skills.
Other similar national reviews in the UK have highlighted the need to also strengthen other elements of the supply chain of new graduates and trained nuclear engineers:
- A Health and Safety Executive (HSE) report on education in British universities in nuclear subjects demonstrated that there was an ageing academic workforce and no undergraduate programmes with significant nuclear content.
- Research by Cogent[2] highlighted that over the next 10 years, the UK nuclear industry will need to recruit between 5,900 and 9,000 graduates and 2,700 to 4,500 skilled trades people to meet the ongoing needs across the existing industry; additional recruitment and training would be required in the advent of new build.

Providing nuclear-specific education in the UK: a major issue at 4 levels

To address these issues and meet this demand, several key initiatives are now underway in the UK. As demonstrated in Figure 2, the demands are not simply at graduate level. There are four layers of training of increasing technical depth that have been identified, from school curricula all the way up to higher degrees. While there is a sound foundation in the national infrastructure (e.g., schools, training institutes and universities), a need has been identified to provide nuclear-specific education at key points in the pyramid.

The following examples provide an overview of some of the initiatives starting at the bottom of the pyramid (see Figure 2):

Schools

The NDA has been working on an initiative to improve science education in schools: the so called "Energy Foresight". The aim is to bring an exciting new perspective to the teaching of the

I – National Nuclear Laboratory (NNL): the cornerstone of skills development in the UK

Launched by the UK government on 23rd July 2008, the UK NNL constitutes the bulk of the UK's remaining civil nuclear fission research capability and all of the significantly active research facilities. It will therefore have an important role in skills development. It will complement a number of other initiatives and bring two essential aspects to successful training and skills development:
- Skills development in an industrial context: including formal education and training (in the NNL or through universities and other initiatives such as ETSON training courses, etc.) as well as "hands-on" training and experience.
- Facilities for study of radioactive materials.

II – The key role of R&D programmes

The traditional source of supply of scientists and engineers used to be through the grounding provided by R&D programmes. These supplied valuable experience of the context and challenges of the industry and trained young graduates to develop solutions capable of being deployed in the industrial situation. In the UK many technologists were equipped to follow a variety of career paths on the basis of the training they received in the industry's R&D programmes.
This route remains viable but there has been a significant reduction in the UK's nuclear R&D programmes over the past 15 years as outlined above. It is therefore no longer sufficient to rely on an informal 'market-led' approach; positive steps are needed to ensure that there will be the required number and quality of trained scientists and engineers.

(1) A government body responsible for managing the clean-up and decommissioning of the historic sites and legacies.

(2) Cogent is the Sector Skills Council for the chemicals, pharmaceuticals, nuclear, oil and gas, petroleum and polymer industries. They are licensed by the government to provide employers in this sector with the opportunity for coherent leadership and strategic action to meet their skills needs.

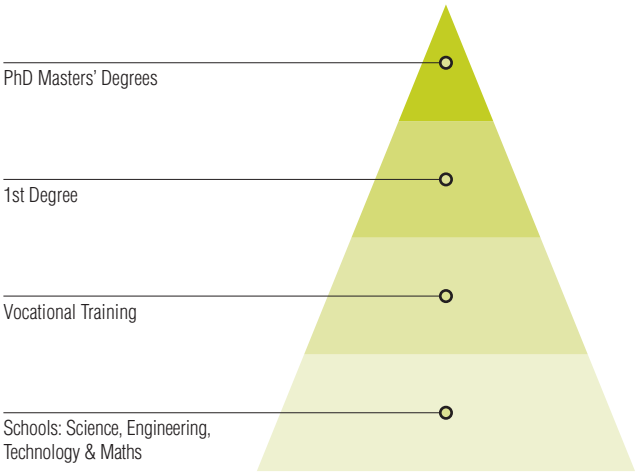


Figure 2
The Skills Pyramid

Radioactive Materials area of the Physics curriculum. During 2007/8 the programme has been rolled out to over 300 schools. As well as addressing the physics behind radioactivity, the course highlights the employment opportunities in the nuclear industry in health, power, decommissioning, and waste management.
In the last two years, Nexia Solutions (the company from which the UK NNL was based) and the NNL have contributed to a national initiative to raise awareness in engineering among 14 to 15 year olds. This comprised a three-day long team activity based on a design exercise to devise ways to retrieve sludge from a typical nuclear waste facility. The NNL recognises the value of capturing the interest of young people and will plan to continue this type of involvement along with other companies in the nuclear industry.

Vocational Training

A newly launched National Skills Academy for Nuclear will provide training across a wide range of skills needed by the nuclear industry, not only technical training, up to foundation degree level. It will be based on a hub-and-spoke model: a small centre at the hub will provide leadership and accreditation and a network of regional specialist nuclear training centres around nuclear sites will deliver the training. The largest centre, 'The Nuclear Academy', will be close to Sellafield which, because of its major decommissioning challenges, is expected to be a large skills user.

University Degrees

The essential foundation in the training of most professional scientists and engineers is the 1st degree course since it provides the academic discipline on which nuclear-specific training can be built. Imperial College in London is launching the first nuclear engineering course at degree level in the UK for many years. It will be based upon a combination of teaching in mechanical/chemical engineering and materials science, complemented by nuclear-specific modules occupying the latter half of the course. The NNL is working with Imperial College to support the course and is a member of the steering group for the course. Other UK universities are in the process of launching undergraduate courses, and there are an increasing number of postgraduate courses being launched or already underway, some leading to Masters level degrees.

In the UK, the provision of nuclear-related training is much stronger in the field of higher degrees with Masters courses in Physics & Technology of Nuclear Reactors (which has been running for more than 50 years), Medical and Radiation Physics, Nuclear Engineering, Radiometrics, Radiation and Environmental Protection, and International and Comparative Nuclear Law. The nuclear industry itself funds PhDs at a number of universities, and in recent years there has been funding from the UK government via programmes such as 'Keep-

As the UK nuclear industry will need to recruit between 5,900 and 9,000 graduates and 2,700 to 4,500 skilled trades people over the next 10 years, the National Nuclear Laboratory (NNL), founded in July 2008, contributes notably to raise awareness in nuclear engineering among 14-15 year olds.

ing the Nuclear Option Open'. Further initiatives such as the Engineering Doctorate (EngD) programmes are also proving to be successful. These degrees are intended for the UK's leading research engineers who want a managerial career in industry. It is a radical alternative to the traditional PhD, being better suited to the needs of industry, and providing a more vocationally oriented doctorate in engineering.

The NNL will continue to run a series of partnerships with UK universities – known as University Research Alliances. The present four alliances are proving to be fruitful centres of research and are responsible for postgraduate training through significant numbers of PhD projects.

Renewing nuclear skills: a long-term commitment

As can be seen, the UK nuclear industry has recognised the need to support education and training throughout the skills pyramid and is now looking to implement the effective training of the future engineers and scientists. However, it must be recognised that this is just the start of a much greater need not only to educate and train but also to provide the new staff with relevant experiences on real, live projects, including new nuclear build. n

EXISTING TRAINING

The importance of training in CSN's management strategy

Antonio Munuera-Bassols (Consejo de Seguridad Nuclear)

As the sole Spanish regulatory body competent in nuclear safety and radiation protection, Consejo de Seguridad Nuclear (CSN) is independent from any other public or private organism and reports annually to the Spanish Parliament. As a result, CSN's technical staff are required to be highly qualified and skilled to elaborate adequate reports and proposals on nuclear and radiological safety issues. Their assessments are documented and available to the public, in a transparent, efficient and effective way, making CSN a major player in contributing to build confidence within Spanish society as well as a reference among the organisations competent in nuclear safety expertise. To fulfil its Mission and comply with its Vision, CSN designed an annual training programme aimed at maintaining each category of personnel fully operational in its own area of activity.

Training: the cornerstone of CSN's Mission and Vision

In 2003, CSN's Mission statement was expressed in terms of "protecting workers, members of the public and the environment against the effects of ionising radiation". This requires implicitly that the licensees operate the facilities using radioactive materials in a safe way and that preventive as well as corrective measures against radiological emergencies be implemented. This, in turn, requires that CSN achieve and maintain a high level of expertise in nuclear safety and radiation protection, based on permanent training of its technical staff, in order to provide assessments on safety and protection issues with the required rigorousness, effectiveness, efficiency and transparency.

To accomplish its Mission, CSN elaborated a 2005-2010 Strategic Plan taking the present and expected future conditions into consideration. Acknowledging that the activities carried out at CSN are based on skills, this plan emphasises the importance of training, the development of technical capabilities and knowledge management with a view to

- ensuring the availability of professional – i.e. skilled, qualified and experienced – technical staff in knowledge areas critical for CSN's activities;
- maintaining a high level of knowledge in nuclear safety and radiation protection through permanent updating;
- setting up a knowledge management system;
- performing activities drawing upon sufficient human and technical resources;
- creating a unit responsible for the scientific and technical aspects of training [1].

Additionally, CSN's Vision describes the regulatory body as "an organisation technically qualified for its proposals, making rigorous decisions

[1] The incorporation of this organisational unit in the Research and Knowledge Management Unit is envisaged, with the aim of reinforcing the connection between training and research.

and carrying out its activities efficiently, effectively and transparently". This implies

- ensuring the availability of professionals with appropriate skills, knowledge and attitude in the areas that constitute the basis of CSN's essential responsibilities,
- constant updating of the aforementioned knowledge,
- guaranteeing a situation in which knowledge and experience are part of the body's collective equity,
- providing the professionals with the technical expertise required for the performance or their activities at all times,
- building CSN's activities upon clearly established technical and scientific criteria developed from the best available knowledge.

Enhancing the staff's technical capability: a strategic priority

A training programme is prepared annually, drawing upon the input from each organisational unit in terms of identification of weaknesses and necessary skills. It includes six training areas:

- nuclear safety,
- radiological protection,
- planning and communication skills,
- information systems and quality,
- standards and resources management,
- foreign languages.

All kinds of educational and training activities are included in this programme, e.g. courses, conferences, congresses, workshops as well as specific activities related to previously identified weaknesses. Depending on their scope and the required knowledge background, these training activities are classified as 'generic' or 'specialist' (low and high degree). The training programme is configured taking the following into consideration:

- To account for the harmonisation of reactor safety promoted by the Western European Nuclear Regulators Association (WENRA), CSN is elaborating specific regulations aimed to complete the Spanish regulatory pyramid.
- CSN is expecting to have a state-of-the-art regulatory system and regulatory practices.

- CSN collaborates with other national and local institutions on the national emergency response capacity.
- CSN contributes to the implementation of a high security system regarding the facilities, materials and activities concerned with nuclear and radiological hazards. CSN notably pursues international collaboration to prevent the smuggling of radioactive materials.
- The promotion of an R&D culture among licensees and institutions will foster the development of the adequate infrastructure and competencies.
- The consolidation of a management system based on quality and efficiency will enhance the contribution of staff to the fulfilment of CSN's Mission.

In addition, CSN's Strategic Plan comprises the development of a competency management system aimed at enhancing the staff's technical capability. Drawing upon a knowledge management system based on the IAEA framework for competency development, the main objective is to design an adequate system to establish and ascertain the regulatory competence of the technical staff. This ongoing process includes several milestones:

- Inventory and definition of prototype positions. If personnel with different technical background are necessary to assess nuclear safety and radiation protection issues, some positions are based on the same level of knowledge.
- Identification and sorting of positions with similar profile of competencies: seven distinct families in the technical field and six in the support area were identified.
- Definition of adequate profiles and competencies, and development of a 'knowledge map' for technical and support units, in accordance with skills catalogues. Besides knowledge and technical skills, this map includes management and leadership ability [2].
- Design and definition of a model for professional development. For instance, a tool aimed at assessing individually the level of professional development is being prepared.
- Design of a training plan for each family of positions with the implementation of the adequate training activities for each of them.

The annual training plan will reflect all the training activities – including schedule and budget – related to each position. It is expected to specify the minimum training for each family of positions as well as the corresponding contents, depending on the orientation – management, technical and support – of the personnel. It will also include mechanisms to assess and control the development of each training course. Activities included will cover generic, specific and high-qualification courses.

A living process to allow permanent adaptation

A meaningful tool to meet the strategic objectives and to help CSN fulfil its Mission, the annual training programme is considered as a reference and a living document to be updated whenever it is convenient, notably as unexpected needs are identified. n

[2] This map is based on the IAEA TECDOC-1254.

EUROPEAN INITIATIVES

A new European initiative for technical nuclear safety training

Benoît De Boeck (Bel V) | Ulrich Erven (GRS)

Faced with the need to train simultaneously existing personnel in new fields of the safety of nuclear facilities and new personnel entering the field of nuclear safety, several European TSOs decided to pool their teaching capabilities in order to further qualify their personnel and to respond to the strong pressure of other stakeholders in search of competent staff in this field. In this respect, the European Technical Safety Organisations Network (ETSON), created in 2006, and the EUROSAFE Junior Staff Programme (JSP) organised jointly the first Summer School in August 2008, on the campus of Technische Universität München (Munich's technical university), in the vicinity of research reactors. A pilot initiative was launched, focused on safety assessments and aimed at junior scientists from TSOs and authorities.

If some technical safety organisations (TSOs) prove to be self-sufficient when it comes to training their personnel, the majority of stakeholders admit difficulties with providing their own staff with further qualification. Many of them, such as plant developers and vendors, NPP operators and nuclear safety authorities, also feel this need. Initiatives have therefore been taken in Europe to help meet demand, and some of them will be described in this paper, mainly those taken by the European Technical Safety Organisations Network (ETSON) and its members.

With about 40 attendees actively participating in the lectures and group work, the first ETSON-JSP Summer School held in August 2008 in Garching, near Munich (Germany), proved a great success. The second edition will be held in Cadarache (France) in July 2009.

Nuclear safety training 'Made in Germany'

The training activities of TSOs are illustrated hereafter using the example of the efforts undertaken by Germany's Gesellschaft für Anlagen- und Reaktorsicherheit (GRS). To maintain its competence at the current high level, GRS is planning to recruit, in the next couple of years, new scientific and technical employees who will, for a large part, presumably lack a deep knowledge of nuclear engineering and technology. Since such knowledge is a prerequisite to work as an authorised expert in a TSO, specific training of new scientific and technical employees is necessary. Dealing with topics detailed in a mandatory Training Plan, this training – usually lasting for three

years – becomes part of GRS' Basic Training and Further Qualification Concept. The programme's modular design provides the opportunity to set individual priorities.
The Training Plan is divided into basic and specialised instruction drawing upon guidelines set up by the technical inspectorates (TÜV) and GRS. They are supplemented by the procedural instructions on further qualification laid down in GRS' Quality Management Manual.

For 2009, GRS is setting up a comprehensive Trainee Programme for a total of about 10 participants. It will be divided into four Basic Instruction courses covering technical fundamentals, the company's profile, its quality and project management, as well as the work on committees and use of instruments of international co-operation. Key element of the Basic Instruction courses is a nine-week programme providing basic knowledge on reactor safety, radiation protection and the fuel cycle, including waste management. The specialist knowledge gained is then intensified in 11 specialised courses that will also include work at an education reactor facility, simulator training and work in a radiation protection laboratory. Completed by four additional courses covering language training, rhetoric, conflict resolution as well as presentation and coaching, this training will be rounded off by visits to a PWR and a BWR plant.

The JSP and ETSON: strengthening technical co-operation at an early stage

In 2003, the TSOs of France (IRSN) and Germany (GRS) set up a group of young engineers (<40 years old) called the Junior Staff Programme (JSP). In 2005, AVN (now Bel V) joined this group that aims at

- improving co-operation between the TSOs in the long run by favouring exchanges between young engineers from the member organisations;
- enhancing the long-term partnership and preparing for mutual personnel assignments;
- reinforcing the joint impact of the member organisations in Europe through
  - a human network based on working relations but also on personal relations,
  - sharing technical knowledge inside each member organisation,
  - proposals for junior staff co-operation to study themes of common interest.

Then, in 2006, the TSOs of France (IRSN), Germany (GRS) and Belgium (then AVN, now Bel V) created the European Technical Safety Organisations Network (ETSON) with the following objectives:

- To form a suitable forum for exchanges on analyses and R&D in the field of nuclear safety, to share experiences and exchange technical as well as scientific opinions;
- To contribute to fostering the convergence of technical nuclear safety practices in Europe;
- To further the definition and the implementation of nuclear safety research programmes;
- To promote the formation of a European scientific and technical network in the nuclear safety field.

The ETSON-JSP Summer School: one step further towards cultural interoperability

Recognising the advantage to create early convergence among the various safety cultures and the growing need to train young engineers in nuclear safety and in how to perform safety assessments, the JSP took the initiative to organise a Summer School. The first ETSON-JSP Summer School was held in August 2008, on the premises of GRS in Garching, which

are located on the campus of Munich Technical University in the vicinity of the research reactors.
This Summer School was a combination of lectures and interactive elements such as group work. Apart from imparting knowledge, the objective of the Summer School was to give participants the opportunity to get to know each other and the respective organisations. In order to enable participants to work effectively, their number was limited to about 40 and they were required to have a basic knowledge of reactor physics and technology.
This first edition proved a great success, with attendees actively participating in the different activities. Their feedback will be used to further improve the concept in the future, as the Summer School is aimed at becoming a regular event that will be open to the ETSON members and to organisations invited by them. The programme will continue to be devised by the JSP members.

Ambitious initiatives to meet multilateral needs

Building on the recognised need to hire and train an increasing number of engineers in nuclear safety, and taking stock of individual TSO initiatives and training programmes, ETSON is developing training courses that are open to authorities, TSOs and the industry. This training aims to

- maintain a high level of competence in nuclear safety for all European and co-operating countries' organisations involved;
- be delivered in a modular form with a common trunk training, trainees' adaptation prior to the course, and a specialist development course after the main training;
- develop a main common syllabus that will be suited for a standard safety engineer; the main module should be suited for all potential clients in the field, i.e. the industry, TSOs, operators and safety authorities;
- define and develop also specialist modules, adapted to the industry's and the TSOs' needs, in order to enter a specialist field. This training should include useful theoretical complements, but also the presentation of safety cases that are related to practice and the familiarisation with the main tools to empower the trainee for his new orientation.

The general strategy to develop this course follows three steps:

- **initially**, to use the already existing national safety courses by TSOs, their existing documentation and an already performed preliminary short course devoted to new TSO employees and some future trainees;
- **in a second step,** to improve the basic training with feedback from the trainees and develop new modules; the second step ends with the first full training course;
- **in the third step,** to improve all elements of the courses with the same updated input as for step two; in this phase, the legal status of the institute has to be defined and settled; the third step ends with the feedback from the second full course.

The launch of this initiative is planned for 2009 and will be complementary to the JSP Summer School.
These initiatives and others will help respond to the needs of the future in the area of nuclear safety training and will at the same time be instrumental in strengthening the collaboration between the stakeholders, thereby enhancing the nuclear safety culture in Europe. n

OTHER INITIATIVES

Challenges and strategies from across the globe

Itimad Soufi (CENSTN, Morocco) | Nguyen Nam Giang (VARANS, Vietnam) | Euginijus Uspuras (LEI, Lithuania)

From Rabat to Kaunas via Dalat, nuclear energy is envisaged as a significant component of the energy mix aimed at meeting long-term electricity needs in countries with a sustained economic growth. As members of specialised institutions in Morocco, Vietnam and Lithuania, the authors give their assessments of the challenges associated with making skilled personnel available and describe the education and training (E&T) programmes set up to support the development of safe nuclear power and of radiation protection of professionals and the environment.

Maâmora, a new centre to serve Morocco's nuclear E&T aims

To prepare for the development of nuclear power, Morocco's National Centre of Nuclear Energy, Sciences and Techniques (CNESTEN) established the Kingdom's first nuclear centre near Rabat. Equipped with a 2-MW research reactor, the Maâmora nuclear centre is part of a national E&T programme aimed at addressing the regulatory, technological, financial as well as human resource aspects of nuclear power. This programme draws upon five major pillars:

- *academic courses* delivered by Moroccan universities since the sixties;
- *training and expert missions* conducted through bilateral or multilateral international co-operation;
- *field training and research* performed at the Maâmora nuclear centre;
- *specialised training and experience* provided by suppliers of nuclear technology as part of their contracts;
- *scientists' and engineers' participation in national and international networks*, as an additional means to share knowledge and experience.

Strengthening technical skills at operator, regulator and TSO levels

This major challenge is addressed through training personnel to regulate, operate and support nuclear facilities and activities in the following way:

- **Establish a national approach for the development of skilled human resources.** A national academic programme and new university programmes for the education need to be developed to support activities dedicated to the operation, regulatory supervision and technical research related to nuclear activities.
- **Support the set-up of specialised training centres** and enhance professional training in the relevant fields.
- **Secure government support** for nuclear E&T.
- **Increase the participation in existing networks** to share knowledge and operating experience, especially with regard to safety and security.
- **Encourage and support the development of local expertise.**
- **Maximise the benefit from technology transfer** through co-operation agreements or supplier contracts.

Morocco will keep focusing on providing personnel with appropriate skills and experience to conduct nuclear research and, ultimately, rolling out a nuclear power programme.

Vietnam's energy challenge: meet the electricity greed of a booming economy

Vietnam's rapid economic growth and industrial development prompted the risk of power shortage, pushing the government to diversify the country's energy sources and to set up, in January 2006, its *Strategy for Peaceful Use of Atomic Energy*. In December 2007, the Prime Minister approved the *VIth Electricity Development Plan* that sets the ratio of electricity to be generated using nuclear energy to 15-20% of Vietnam's total power output by 2050.

The status of nuclear E&T

In the field of *regulatory activities on radiation protection*, about 2,000 workers as well as 120 regulatory staff were trained or retrained in 2007. Retraining for workers potentially exposed to ionising radiations is carried out every three years.

In the field of *regulatory activities on nuclear safety*, the Vietnam Agency for Radiation and Nuclear Safety (VARANS) has just started setting up a training plan intended for specialised staff that includes self-training and guest lectures given by university professors involved in research on nuclear reactor physics and thermal hydraulics. In addition, studies and research conducted at the Dalat research reactor as well as the participation in an IAEA workshop on periodic safety reviews held in Hanoi in July 2008 are aimed at improving the regulatory staff's competency and skills in nuclear safety assessment and verification.

Concerning the nuclear *Research & Development activities*, the country's largest institution is the Vietnam Atomic Energy Commission (VAEC) with a staff of about 700. However, the small number of nuclear engineering experts at VAEC is not commensurate with the needs if the retiring generation is to be replaced and the nuclear power programme to be rolled out successfully. To cope with the lack of standard training materials and of competent lecturers in universities and research institutes, VAEC organises annually a series of training courses on radiation protection, nuclear technology and nuclear safety with the assistance from the IAEA and Japan. Participants are operators, technicians, radiation protection officers, researchers and regulators concerned by research reactors and other nuclear facilities. On its side, Vietnam Electricity (EVN) has organised two training courses on nuclear engineering for 60 engineers based on its cooperation programme with VAEC and JAIF/JETRO of Japan.

E&T needs far beyond the present capacity

The required human resource for Vietnam's nuclear power programme up to 2020 is about 800 persons: 200 for R&D, 100 for the regulatory authority, and 500 for the first NPP. Based on this estimation, 55 persons are needed annually in addition to those presently trained.

In the *Strategy for Peaceful Use of Atomic Energy*, E&T needs are determined for various purposes. First comes the need for skilled staff to operate, maintain and, ultimately, decommission the Dalat nuclear research reactor. Adding to this, trained staff needs to be available for a new, multi-purpose research reactor with thermal power in the range of 10-20 MW to be built in 2015.

For VARANS, the urgent need is to provide training for regulatory staff to be tasked with verifying site selection for future nuclear power plants and research reactors, assessing the design of imported technologies, and inspecting the facilities under construction.

A comprehensive training programme supported by the Vietnamese government

In accordance with the *Master Plan*, the three complementary sub-programmes below were submitted to the government at the end of 2008, with a view to providing the staff involved in nuclear-related activities with comprehensive training:

- **The sub-programme for the first NPP** (including project management, bidding, construction, operation, maintenance…) is implemented by the Ministry of Industry and Trade (MOIT).
- **The sub-programme for R&D activities,** technical safety organisations, regulatory authority and management of nuclear energy utilisation activities is implemented by the Ministry of Science and Technology (MOST).
- **The sub-programme for nuclear training at universities and institutions** is implemented by the Ministry of Education and Training (MOET).

The Vietnamese Atomic Energy Commission also plans to establish a centre for advanced training in nuclear technology, organising on-the-job training courses and delivering Master's and Ph.D. degrees in nuclear engineering.
In addition, Vietnam will invite foreign experts to assist in training young scientists in the fields of nuclear engineering and nuclear safety. Last but not least, major co-operation areas between Vietnamese agencies and foreign counterparts are envisaged in the near future.

Nuclear E&T in Lithuania: reinvigorating a long-standing experience

The preparation of highly qualified specialists for the nuclear industry in Lithuania goes back to 1978. Today, the E&T of nuclear energy engineers is split among institutions with a long-standing experience in complementary fields.

Academic education is provided by

- the Lithuanian Energy Institute (LEI) and the Kaunas University of Technology (KTU), specialised in experimental and analytical research related with investigation of thermal hydraulic phenomena in nuclear facilities and evaluation of NPP safety. The students have the possibility to use the LEI experimental facilities, hardware and software.
- the Faculty of Physics of Vilnius University (VU), specialised in physics. A new specialist course titled "Physics of nuclear energy" has been on offer since 2008.
- the Institute of Physics (FI), where nuclear fuel physics and radiation protection are taught.

Training is implemented at the Ignalina NPP Training centre, where more than 100 employees are prepared each year. The effectiveness of operating personnel training was strongly enhanced by the installation of a full-scale simulator.

However, the nuclear education system in Lithuania needs sharp improvement in order to meet the need for nuclear specialists for future NPP projects. Therefore, the Lithuanian Parliament and government launched the *National Programme for preparation of highly skilled specialists in the nuclear energy field in 2008-2015,* aimed to

- set up two programmes specialised in nuclear energy studies (to be implemented by KTU and LEI in Kau-

nas) as well as two programmes specialised in nuclear physics (to be implemented by VU and FI in Vilnius).
- develop an infrastructure devoted to preparing specialists and integrating educational and research activities, including the renovation of two laboratories at LEI, the creation of a Centre of Nuclear Energy Studies, Education and Research in Kaunas and of a Centre of Nuclear Energy Physics Studies and Research in Vilnius (consolidating respectively several laboratories at LEI, KTU, VU and FI), the extension and modernisation of experimental facilities and equipment in these centres and laboratories.

This National Programme is expected to allow the preparation of 30 to 50 highly skilled nuclear specialists and the re-training and certification of about 100 specialists each year.

Making Lithuania a training hub for the entire Baltic region

At the end of 2007, the Lithuanian State Nuclear Power Safety Inspectorate (VATESI) decided to establish a *Regional Nuclear Safety Training Centre* aimed at providing the new people involved in nuclear safety business with specific knowledge. This idea, discussed during an IAEA Regional Project Co-ordination meeting, raised big interest among potential counterparts (Ignalina NPP, Lithuania power company, representatives of universities and institutes), taking into account the emerging needs of new NPPs in the Baltic region. Moreover, the Vienna Agency proposed to explore the possibility of Lithuania hosting a *Basic Professional Training Course* for the entire region. As a pilot project, it was proposed to organise a two-week course on nuclear safety based on the syllabus developed by the IAEA. The proposed course will include 17 modules from the design of nuclear reactors through to radiation protection and environment control, in-plant accident management, regulatory control, decommissioning, building up organisation for new NPPs, etc.

In the field of nuclear safety, it was decided during a meeting of Lithuanian organisations held in April 2008 that the IAEA would organise the *Regional Basic Professional Training Course on Nuclear Safety* in Lithuania. Hosted by the Lithuanian Energy Institute, the course took place in Vilnius from 20th to 31st October 2008 at Lietuvos energija, the Lithuanian utility. The audience was composed of 17 participants from several IAEA Member States, 3 from the Baltic region and 20 from VATESI, Lietuvos energija and LEI. The IAEA and the Lithuanian organisations (KTU, LEI and Ignalina NPP) provided 5 and 9 of the 14 lecturers respectively.

Different contexts but common statements

In spite of dissimilar backgrounds, Morocco, Vietnam and Lithuania show common features regarding the nuclear E&T issue:
- E&T is a priority in the development of any nuclear programme.
- The scientific, technical, regulatory and managerial issues must be tackled in parallel.
- The present E&T capability in each country must be expanded to meet the anticipated needs.
- The set-up of E&T programmes and facilities commensurate with the needs requires strong government backing.
- The sharing of knowledge and experience through international exchanges is a powerful booster to train staff. n

VENUES & WEBSITES

Upcoming events

22-24 June 2009, Prague, Czech Republic

FISA-2009 Conference: Euratom Research and Training in Reactor Systems
Organised by the EC Directorate-General for Research
http://cordis.europa.eu/fp7/euratm-fission/events_en.html.

Administrative secretariat:
Marianne.Antoine@ec.europa.eu

Experience feedback on the web

- Finnish Solution to Increased Basic Professional Training Needs in Nuclear Safety, by Kyrki-Rajamäki, Riitta & Koskinen, Kaisa. ENS Conference on Nuclear Engineering Science and Technology – Education and Training (NESTet), Budapest, Hungary 4-8 May 2008. http://www.euronuclear.org/events/nestet/transactions/nestet08-transactions.pdf

- I D HUDSON, "Skills Strategy Update – Skills Strategy Present-ation given to the 2nd National Stakeholder Group Meeting", www.nda.gov.uk/documents

- "Energy Foresight and the Nuclear Decommissioning Authority join forces to deliver better science education to 14-16 year olds", Press Release 21 November 2006. www.energyforesight.org

- http://www.nuclear.nsacademy.co.uk

A few links to read more on…

- The Sustainable Nuclear Energy Technology Platform (SNE-TP): www.snetp.eu
- The European Nuclear Energy Forum: http://ec.europa.eu/energy/nuclear/forum/index_en.htm
- The PEOPLE programme: http://cordis.europa.eu/fp7/people/home_en.html
- The Lifelong Learning Programme of DG EAC: http://ec.europa.eu/education/programmes/llp/index_en.html
- The "European Nuclear Education Network" (ENEN): www.enen-assoc.org
- The European passport for Continuous Professional Development: http://cordis.europa.eu/fp7/euratom-fission/home_en.html
- The right of EU citizens to provide services anywhere in the EU: http://ec.europa.eu/internal_ market/qualifications/index_en.htm
- The European Network on Education and Training in Radiological Protection (ENETRAP): http://www.sckcen.be/enetrap
- The European Training and Education in Radiation Protection (EUTERP): http://www.euterp.eu
- The FISA-2009 Conference: http://cordis.europa.eu/fp7/euratom-fission/home_en.html

EUROSAFE Tribune
is a periodical from
the EUROSAFE Forum

Editorial Committee
Pieter De Gelder (Bel V)
Ulrich Erven (GRS)
Zdenek Križ (UJV)
Gustav Löwenhielm (SSM)
Antonio Munuera Bassols (CSN)
Edouard Scott de Martinville (IRSN)
Peter Storey (HSE)
Seppo Vuori (VTT)

Coordination
Horst May (GRS)
Emmanuelle Mur (IRSN)

Writer
Jean-Christophe Hédouin (HIME)

Design
Martin Brunner Associés

Credits
front-cover (right):
© Digitalvision/PNC
front-cover (left), back-cover,
p. 9, 10, 25: © Olivier Seignette/
Mickaël Lafontan/IRSN
p. 3: Antoine Devouard/IRSN
p. 5: © KSG-GfS
p. 7: © EDF médiathèque/A. Morin
p. 13: © VTT
p. 16: © EC
p. 23: © NNL
p. 27: © Stefan Weber/GRS
p. 28: © Dietmar Zingler/GRS
DR

ISSN: 1634-7676
Legal deposit: February 2009

The EUROSAFE Tribune
is available on the website:
www.eurosafe-forum.org

Printed using vegetable inks
and totally chlorine free,
100% recyclable and biodegrad-
able, semi-matte coated paper.

The EUROSAFE Tribune #015

will report from the EUROSAFE Forum 2008 (Paris, 3 & 4 November) devoted to

"The role of TSOs in the context of an increasing demand for safety expertise".

INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE (IRSN)
B.P.17, 92262 FONTENAY-AUX-ROSES CEDEX, FRANCE

GESELLSCHAFT FÜR ANLAGEN- UND REAKTORSICHERHEIT (GRS) mbH
SCHWERTNERGASSE 1, 50667 KÖLN, GERMANY

FOR FURTHER INFORMATION: www.eurosafe-forum.org

EUROSAFE

Towards Convergence of
Technical Nuclear Safety Practices in Europe