July 2011

EUROSAFE TRIBUNE

Towards Convergence of Technical Nuclear Safety Practices in Europe

19

Innovation in Nuclear Safety and Security

› Innovation and safety: necessity or contradiction?

› TSOs' approach to innovation

› Innovation and cooperation in nuclear education

forum

The EUROSAFE Forum took place on November 08 and 09, 2010 in the Gürzenich in the city centre of Cologne.

To our readers

As a report from the EUROSAFE Forum held in Cologne last November, the present issue of the EUROSAFE Tribune deals with the complex links between nuclear safety/security and innovation. The views expressed by most speakers at the Forum converge on two main ideas. The first one pertains to the simultaneous challenges TSOs are faced with worldwide and the subsequent necessity for them to innovate in their ways of working together with a view to achieving more with limited resources through increased cooperation in training, jointly performed scientific research programmes, shared information and experience feedback, etc. The second one regards science. Today, the industry implements new tools such as high-power computers and sophisticated codes to reduce uncertainties with a view to adjusting safety margins to residual uncertainties. This technological step gives TSOs the obligation to gain additional knowledge of physical and chemical phenomena to perform sensitivity and uncertainty analyses, assess the industry's calculations on this basis and find out whether or not these safety margins are actually sufficient to cover uncertainties.
Since March 11th, 2011, the TSOs have been faced with an additional and unprecedented challenge: imagine the unimaginable to reassess the safety of nuclear facilities beyond the design-basis threats, beyond the operating experience feedback, beyond the protection against new forms of malevolence such as cyber attacks, beyond the just 'highly unlikely'... Here again, TSOs have to be innovative in reconsidering external hazards, science-based phenomena, etc. to support safety authorities, within a limited time span, with accurate diagnostics and advice as regards the potential upgrade or closedown of nuclear facilities. Here again, cooperation between TSOs is an essential key.

We are pleased to invite you to making your own judgement on these issues and we wish you pleasant reading.

Jacques Repussard and Frank-Peter Weiss

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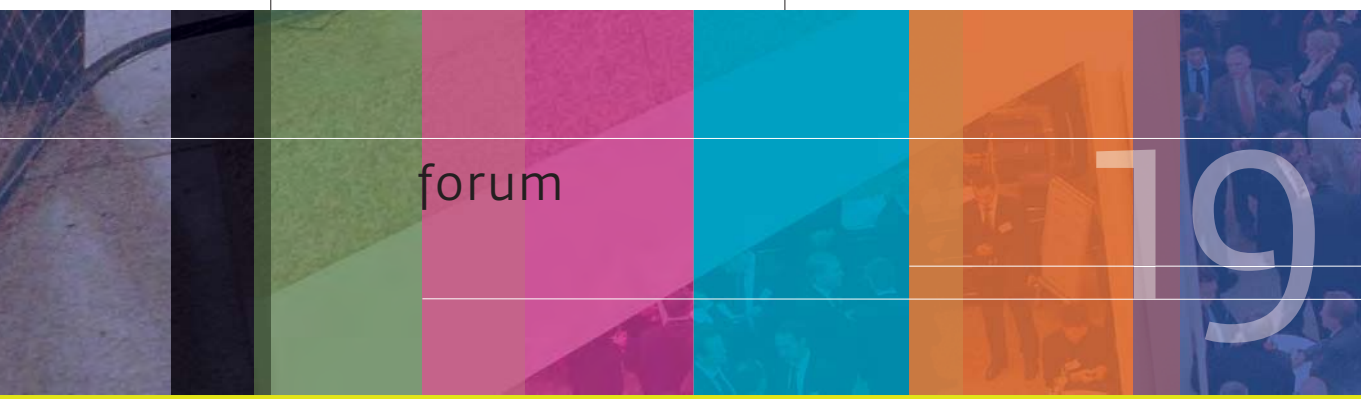

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Uichiro Yoshimura, OECD-NEA

The EUROSAFE Forum 2011 will take place on November 07 and 08 in Paris on the following topic : **Nuclear safety: New challenges, gained experience and public expectations.**

In the wake of the distress caused by the March 11th earthquake and tsunami that hit Japan's Tohoku region, the safety organisations' thoughts will focus on the safety methodologies to be adapted drawing upon the experience feedback from this tragedy in order to improve the nuclear facilities' safety and to meet public expectations. The different speakers and participants in the panel discussion will address the methodological aspects of this issue and the stakeholders' capability to maintain a high level of safety over the long run. A special workshop will deal with the common understanding of the technical aspects of the Fukushima accident.

July 2011

Cover picture:
Mrs. Ute Blohm-Hieber,
Head of unit D2,
DG Energy,
European Commission

Innovation: driving safety and security?

From left to right : Hans J. Steinhauer, Commercial and Legal Director, GRS; Jacques Repussard, Director General, IRSN; Benoît De Boeck, General Manager, Bel V.

Welcoming the 437 guests from 30 different countries to the Gürzenich Hall in Cologne (Germany), GRS Commercial and Legal Director Hans J. Steinhauer introduced the audience to the 12th EUROSAFE Forum's topic: *Innovation in nuclear safety and security*, stressing the facts that technological progress raises new safety questions that have to be answered and that innovation goes far beyond technology.

In his address, Hans J. Steinhauer pointed out the importance for TSOs to sustain their support capability in a context of global political and economic change, and reminded the audience of the focus of the successive EUROSAFE Forums in this respect: "As early as 2003, the Forum was focussing on nuclear expertise and the special challenge of EU enlargement. In 2008 and 2009, we focused on the increasing global demand for nuclear energy and safety expertise. Even today, the need for highly qualified staff and the ways to address this demand have to remain in our focus," Mr. Steinhauer claimed, stressing that the 2nd international conference on challenges faced by Technical Safety Organisations (TSO), held in Tokyo in October 2010, also emphasised the importance and difficulties of maintaining an adequate level of expertise. In his conclusion, the Commercial and Legal Director of GRS mentioned some recent initiatives carried out by the German TSO to manage knowledge and innovation, such as a trainee programme in 2008 or the creation of Future Lab, an entity dedicated to innovation. "The first concrete outcome of the new Future Lab is a new tool called Virtual Underground Laboratory. It will allow GRS to simulate and to visualise possible scenarios which may occur in an underground repository."

On the particular role of TSOs regarding innovation in nuclear safety and security

Frank-Peter Weiss, as the newly appointed Scientific-Technical Director of GRS, highlighted this specific role with these words: "*TSOs are the first to see the gaps in the assessment methods and to see the gaps in the simulation tools that are needed to address the safety issues of the current reactors. Regarding the next generation reactors, we are pretty much involved in setting up the safety requirements and the safety criteria for these reactors. By doing this for the current and the future reactors, we put the key research topics on the agenda*."

This particular role of TSOs was also put forward by the Director General of IRSN in his address largely focused on the TSOs' initiatives aimed at optimising the use of the resources dedicated to technical support functions, a key point in the successful future handling of nuclear safety matters worldwide. "*This year, we made ETSON a legal association, so we now have a new legal instrument that is able to support the community of TSOs in Europe and maybe beyond. This is in its interactions with other organised bodies, including governments and particularly the European Commission,*" Jacques Repussard said. Recalling the creation of the European Nuclear Safety Training and Tutoring Institute (ENSTTI), where the professional training of future experts is performed by experts, he pointed out the fact that ENSTTI contributes not only to saving the education & training

Welcome & addresses

force or obstacle to nuclear

Frank-Peter Weiss, Scientific-Technical Director, GRS.

resources of its founding members but also to giving countries with smaller TSOs the same access to reference knowledge as the larger organisations. "*We are in a worldwide environment, a worldwide industry, with worldwide needs for technical support and worldwide safety expectations from society throughout the world*," Mr. Repussard concluded.

ETSON, from the definition of research needs and programmes to safety assessment

In his comment on the contribution of ETSON to innovation in nuclear safety and security, Benoît De Boeck, the General Manager of Bel V,

presented the broad scope of ETSON's technical activities, managed by 12 technical groups covering fields such as operational experience feedback, electrical, mechanical and fluid safety systems, PSA, severe accidents, human and organisational factors, lifetime management, etc. "*These groups should contribute to the definition of nuclear safety research programmes and define research needs in their fields of expertise. They should also exchange information on their technical nuclear safety practises and make proposals to harmonise them as far as is practicable,*" explained Mr. De Boeck, who suggested that ETSON participate in the safety assessment of the Myrrha facility, a flexible fast spectrum research reactor in the range of 50 to 100 thermal megawatts designed for the SCK-CEN nuclear research centre in Mol (Belgium). "*This multi purpose facility is conceived as an Accelerator Driven System (ADS). For such an innovative research reactor, various technical challenges have to be answered with ETSON members' help,*" he concluded. ■

ETSON enlarges further

The EUROSAFE Forum 2010 welcomed two new members of the ETSON network. The first one is the Slovak technical safety organisation VUJE, which has become a permanent member of ETSON. The second one is its Ukrainian counterpart, the State Scientific and Technical Centre (SSTC), now an associate member of ETSON (as Ukraine does not belong to the EU).

The ETSON members.

Innovation and safety: best friends or best enemies?

What does the concept of 'innovation' encompass? Do innovation and safety move in convergent or opposite directions? What are the primary conditions to their mutual support? What role should international nuclear safety agencies, regulators, utilities, TSOs, etc. play in this issue? The presentations below provide complementary perspectives.

The scarcest resource is man

Performed by Lars Thomsen, chief futurist of Future Matters AG in Zurich and moderator of the panel discussion at the present EUROSAFE Forum, the first presentation was focused on the concept of innovation in the different senses of the word: *incremental innovation*, which consists in improving existing things, *radical innovation*, which consists in taking a blank sheet of paper to rethink technology, methods, etc., and *non-technical innovation*, which relates more to the development of organisational values and communication. "*Innovation always has to do with trial and error; it is actually an evolutionary process. I know this is very hard to understand and to implement in your industry,*" Mr. Thomsen claimed.

Mentioning several trends that will transform the industry, such as smart grids, where information and energy are combined, or e-mobility i.e. electric cars, especially in urban areas, he warned: "*The industry doesn't have enough people to drive these changes, to do the innovation necessary to transform the environment they will be in ten years from now.*" Making skilled people the scarcest resource, not only in Europe but worldwide, he concluded: "*In Germany for instance, 22% of the employees working today will go into retirement over the next 500 weeks, the next 10 years!*"

Harmonising safety standards to promote innovation

"*Technologies, which do not answer safety standards have a short life. This is not because of standards, but because these technologies do not answer the expectations of society, or fail the operational test,*" claims Denis Flory, Deputy Director General of the IAEA, reminding: "*for technologies to be further developed, there is a need for broad societal acceptance and confidence in their safety. Harmonised safety regulations, when implemented, can assure the public that industries are safe and ethical in the pursuit of profit. Indeed, harmonised standards promote innovation. Accidents, unfortunately, hinder it, as evidenced by the standstill in innovation in the nuclear power industry in the decade following the Chernobyl disaster.*"

In his presentation, Mr. Flory gave the floor a sense of the IAEA Safety Standards' spirit: an integrated approach to safety and security, the explicit consideration of severe accidents in the design of new reactors, the aim to harmonise design solutions, not to standardise them. "*The strength of harmonised standards is in a rigorous process and data drive, with a graded approach to safety. In this fashion, innovation and harmonised safety standards can leverage each other's strengths, rather than acting as competing initiatives,*" he advocated.

Estimate benefits and costs with clarity

Reflecting a utility's view, EDF's Director of research programmes Jean-Pierre Hutin considered firstly, in his presentation, the general obstacles to innovation, e.g. inadequate cost-benefit balance, people's resistance to change, the shift from paper to on-field experience when assessing the benefits from a new technology, the differing interests of vendors

Presentations

and operators, etc. Drawing upon the lessons learned from these traditional obstacles, Mr. Hutin remarked: "*When an innovation comes to the table, everybody should be involved, in the development and implementation, from the innovators to the real end users in plants. All impacts should be carefully and honestly analysed, since the innovator tends to overestimate the benefits and underestimate the costs or the drawbacks. Conversely, the utility company has a tendency to underrate the benefit and overrate the cost*." In his conclusion, Mr. Hutin highlighted the fact that impact of innovation on work practices is generally taken too lightly: "*As I said, the issue is not how to integrate new technology in existing practices, but how technology is going to change practices. If you do not admit that, you are in trouble when deploying solutions*."

Safety-oriented research: a necessity to keep up with technological innovation

In his presentation, the Director General of IRSN emphasised the need for safety-oriented research, a field which is not really included in many of the regulatory doctrines pertaining to research: "*If the knowledge about safety does not progress at the same pace as the technology,*" he claimed, "*then the licensing system falls behind. This is a recurrent danger for the regulatory systems, regarding, for example, long-term operations and new build, where licensing is occurring drawing upon standards that were produced mainly in the United States half a century ago*." Mr. Repussard also pointed out the need for expert knowledge, both at regulatory body level and at TSO level, giving his views on the key mission of technical support: "*It is not to provide expertise in real time at the given moment. It is to make sure that a safety infrastructure strategy is actually implemented. This does generate and maintain the knowledge required by the safety or the regulatory system.*" Commenting about the three elements of progress for TSOs – i. e. capacity building, the analysis of operating experience and scientific knowledge management – Jacques Repussard declared: "*What is proposed is to add networking as a way of working together, as we do in ETSON and through conferences like EUROSAFE, in order to actually do these things together. It is not new to do research together; what is an innovation is our influence on the strategic goals of the European Commission, for example. TSOs are there to provide support to public authorities, sometimes in a wider sense than the regulatory systems for nuclear operations themselves. They are there to disseminate knowledge*." The Director General of IRSN concluded his address with reminding the audience that nuclear safety excellence is a central goal and that cooperation among TSOs also facilitates the world's access to reference expertise. ■

Lars Thomsen
Chief Futurist
Future Matters AG
Switzerland

"First of all, it must be made clear innovation is a multifaceted concept that compounds increments as well as disruptions and encompasses technology as well as processes. Secondly, any innovation impacts safety in some way. Therefore, the pace of innovation in business sectors with very stringent safety requirements, such as the nuclear and the aircraft industries, is usually slower than in other sectors. Moreover, with an increasing number of stakeholders having their say in the construction and operation of new facilities, I think the pace of innovation is slower today than it used to be thirty years ago. As a futurist, I am working with some ten different industries, and it clearly appears to me that the nuclear sector needs a vision to show people that it is not becoming an 'old' industry but moving forward. As evidenced through the debates at the 2010 EUROSAFE Forum, it is actively considering new ways of communicating to attract young people and in particular young engineers. This is pivotal to enrol the men and women who will give innovation new momentum."

The slides of the presentations are available online at: www.eurosafe-forum.org > EUROSAFE Forum 2010

Innovation and safety:

"I think we should invent new methods and spread them across the fleet of operators. In the future, we will have to do it across national boundaries." Christian Raetzke, E.ON Kernkraft GmbH

"The OECD NEA is contributing to harmony based on scientific and technical understanding through its relevant committees, like working groups and joint projects." Uichiro Yoshimura,OECD-NEA

"If it is harnessed properly, the growth in technology can actually engineer out a lot of risks, even those we see today. So we ought to be looking at technology and growths in innovation to manage out risks that relate to security as much as safety." Les Philpott,HSE

The panellists

Andreas Pautz Head Reactor Safety Research Division, GRS / Les Philpott Deputy Director and Head of Policy and International, HSE / Christian Raetzke Vice President International Regulatory Affairs, New Nuclear Development/Projects, E.ON Kernkraft GmbH / Uichiro Yoshimura Deputy Director, Nuclear Safety Division, Nuclear Energy Agency (OECD-NEA).

Panel discussion

necessity or contradiction?

Moderated by Chief Futurist Lars Thomsen, the panel discussion at the 2010 EUROSAFE Forum brought together executives involved in the progress of nuclear safety and security on a daily basis for a debate on the relationship between innovation, safety and security. The major outcome of this exchange of views is that innovation can help enhance safety and security, just as the harmonisation of safety and security assessment approaches.

To initiate the debate, Mr. Yoshimura presented some considerations about how harmonisation of safety approaches helps regulators prepare for the licensing of new reactors. "*New reactors have, in general, characteristics such as systematic consideration of serious accidents at the early stages of the design process; the simplification of systems and the use of passive systems; the use of risk informed decision making that would contribute to optimising the reactor by achieving a high level of safety and reducing the cost, etc.*" Mr. Yoshimura said, pointing out how challenging such innovations are when they have to be assessed by the national regulators, according to the available national and international guides and standards. "*Harmonisation of the safety approaches requires the achievement of convergence of regulatory requirements and practices, where they exist, in relation to the considered topic. This is usually performed through comparison work and identification of the main differences between causes and standards. There is also the identification and proposal of convergence, resulting in harmonised requirements and harmony based on scientific and technical understanding. The OECD NEA is contributing to this through its relevant committees, like working groups and joint projects,*" claimed the Deputy Director of the Agency's Nuclear Safety Division, before concluding with the benefits of harmonisation, e.g. reduction of lead time in the licensing processes; concentration of the licensing process on issues of real safety concern; optimisation of the solutions proposed by vendors; reduction of market distortion and the creation of better bases of explanation of adopted solutions to the public.

Innovation and safety: a 'hand-in-glove' relationship

When he was asked whether innovation and safety were a necessity or a contradiction, Les Philpott answered very clearly that both items go together: "*The more we use innovation to design out risk, the better that is for society and the public that we as regulators seek to protect. If it is harnessed properly, the growth in technology can actually engineer out a lot of risks, even those we see today. So we ought to be looking at technology and growths in innovation to manage out risks that relate to security as much as safety,*" he said, pointing out the necessity to consider also the human factors in order to ensure that the present and future research programmes keep pace with developments in human behaviour.

"We have to be very careful about relying too much on high performance computing models."

Who should be driving innovation?

"*This is a very difficult question*," admitted Christian Raetzke. "*However, when it comes to innovation and completely new reactor designs, this is more part of the vendors' role; they offer designs, which we then take. But when it comes to operational innovation, utilities can do a lot to innovate, as they are aware of the operating team's constraints,*" stressed E.ON's VP for International Regulatory Affairs, drawing the audience's attention to regulatory innovation, a field of

Guest lecture

Jörn Pachl "Innovation in rail traffic control in Germany"

Jörn Pachl is Professor at the Technical University of Braunschweig, Lower Saxony. Invited as a guest lecturer to the 2010 EUROSAFE Forum in Cologne, this expert of rail traffic safety provided insights into the safety philosophy of rail, the evolution of safety concepts and the need for harmonisation in the railway sector. An interesting benchmark for a floor composed of nuclear safety and security experts.

After introducing the audience to the general characteristics of any rail system – i.e. the fact that it is a guided transportation system with removable track elements at turnouts and crossings where trains have an intersection at grade –, Professor Pachl presented the different safety systems used to provide safe train separation: interlocking systems such as manual block and automatic block technology, signalling, radio-communications, etc. "*There are lots of innovations in rail traffic control. It is also typical of the safety philosophy of railways. Basically, we are also based on fail-safe technology. That means if a technical failure occurs, the system will bring everything down to a stop, but the difference with the nuclear industry is that during downtime, we do not stop rail operations. We continue operations under staff responsibility, with specific degraded modes, while the maintainer is repairing the system. These are the situations where accidents happen. In more than 25 years of rail traffic control, I am not aware of a single accident caused by the failure of a vital system. However, I am aware of many accidents caused in degraded mode operations under staff responsibility, during the downtime of the vital control system,*" Professor Pachl commented.

Is rail traffic control innovative?

It definitely is, although railways never managed to get rid of their old technologies. "*Today, our control technologies in the field cover a railway history of 100 years. We can still find old mechanical lever frames beside the latest electronic computer based control consoles. All of these different generations of control technologies must be able to communicate safely through interfaces with each other,*" stresses Jörn Pachl. Another peculiarity in rail traffic control is the way innovation is performed: "*Control systems are completely different in the various European countries, as they have totally different operation rules,*" Mr. Pachl complains, "*Harmonisation of operating rules has not even started and we have not even harmonised yet very basic operation definitions. For cross border systems, we either exchange locomotives, or we have to use expensive multiple equipped locomotives. This is a very unfortunate situation and a solution has not yet been found. Even the latest computer based systems are completely different from country to country and suppliers have to develop nationalised versions of their products*". Nevertheless, European railways started a project called European Train Control System (ECTS), about 10 years ago, with the objective of providing interoperable automatic train protection systems. This was part of a project called European Rail Traffic Management System (ERTMS) under deployment on some very high-speed lines in the EU. Though slowly, harmonisation is on tracks!

innovation, which he thinks is vital, but where utilities cannot do much, except providing some impetus. "*I think regulatory innovation is something that we as operators can only ask for, but governments and regulators need to do something about it,*" Christian Raetzke claimed.

A globalised management of regulatory issues: innovation booster or retardant?

Taking the question, Uichiro Yoshimura pointed out globalisation, or harmonisation, has both effects: "*In a way, harmonisation – including standardisation –, guides technologies and ways of using practical ideas. On the other hand, standardisation can be changed after technology is developed or after some experience,*" remarked the Deputy Director of the NEA's Nuclear Safety Division. "*In this regard, regulators could perhaps be a bit more forward thinking in their relationships with the organisations that in the end make the standards or make the law,*" interjected Les Philpott "*We need to communicate rather more closely with our colleagues who push the standards, to get them into a position of not driving forward the need for a standard in the first place as the great goal. We need to work out what the problem is first and then work out what the international solutions are to those problems. And if a national standard or directive is the solution to that, then by all means go forward with it!*" Recalling the emergence, in Europe, of power companies that operate nuclear power plants in different countries, Christian Raetzke added: "*This was not the case a few years ago. I think we should invent new methods and spread them across the fleet of operators. In the future, we will have to do it across national boundaries*".

Can the nuclear sector afford disruptive innovation?

Observing that safety and innovation are actually very incremental in utility companies, Andreas Pautz commented: "*On the one hand, we believe that we have understood phenomena. Then all of a sudden it turns out that these phenomena come from a totally different source that we have not even thought about. This is why we have to be very careful, for example, about relying too much on high performance computing models.*"

Denis Flory
Deputy Director General
International Atomic
Energy Agency

"I think innovation in nuclear technology cannot translate into sustainable developments without broad society acceptance and confidence in their safety. Therefore, internationally agreed and harmonised safety criteria must be paid full consideration upon developing innovation, if we want society to fully benefit from innovation. Now, concerning the relationship between safety and security, our belief at the IAEA is that both aspects must move forward simultaneously, as their final objective is the same, namely the protection of the public and the environment. With a view to finding common paths of progress, the Agency set up a joint task force bringing safety and security experts from all over the world together to pave the way towards making full use of synergies and interfaces between these two sides of a unique coin."

Is there a gap in innovation between technological and regulatory approaches?

Mentioning the numerous issues associated with keeping existing reactors in operation, extending their service lives, building new plants, or decommissioning plants that were closed down, Les Philpott observed all these activities generate innovation and that, on the other hand, the basis upon which the regulators regulate the nuclear industry is a system which dates back to the 1960s. "*However,*" remarked the head of HSE's Nuclear Directorate in an impish tone, "*I am just wondering if a 21st century*

approach actually needs to be taken, in looking at the way in which regulators actually regulate the industry. This is just a provocative point!"

Assessing nuclear plants' generic design: a good idea... with some obstacles

Whereas supporting the basic assessment of a plant's concept, as it is currently performed in the UK, instead of the licensing of sites from the very beginning, Andreas Pautz mentioned two major obstacles: "*One of them is the competition among vendors. These days it is no big deal to validate a concept that involves a reactor pressure vessel, a couple of pipes, steam generators and so on. We know that this is proven technology; we know that it has to be constructed from corrosion-resistant material. The real innovation might not actually be accessible during the generic design assessment. This is where competition takes place, but it is also where innovation comes in and regulators have to look at very, very carefully.*" To overcome this difficulty, the head of GRS' Core Behaviour Department called for more information about the real safety cases that apply to new plants. "*The second barrier,*" he added, "*is the regulatory approach, which is inconsistent between countries. Moreover, the construction of plants always relies on the national supply chains as well. When you are building a plant, even if you start with the same concept, the plant will definitely look different in country A, country B or country C, because you are using different suppliers, or different materials... This is very difficult to assess in a generic design assessment.*" Notwithstanding these difficulties, Mr. Pautz considered the assessment of a nuclear plant's generic design a promising approach, provided the thorough demonstration of the concept's viability. "*Then this might be the basis to go ahead internationally, notably on the regulatory level,*" he concluded. ■

> *"New reactors have systematic consideration of serious accidents at the early stages of design."*

Jean-Pierre Hutin
Director of Research Programmes
Electricité de France
Chairman of NULIFE Governing Board
France

"If nuclear operators are eager to take advantage of innovation, they are sometimes sceptical regarding the developers, as they tend to overestimate the benefits from innovation and underestimate the associated constraints. In the field of IS&T for instance, if deployment is not well prepared, innovation could complicate the operator's daily life rather than making it easier. The introduction of new information technology requires a reengineering of routine work to incorporate a number of new processes accordingly, and this translates into a considerable HR work aimed at conducting change in nuclear power plants. Similarly, the development of increasingly powerful computational tools resulted in engineers relying more on modelling and simulation and less on experiments to assess the safety of new designs. The associated risks are to see experimental facilities close one after another and to see the cost of experiments rise. I think this should be also considered when assessing the benefit from innovation."

3 questions to...

Andreas Pautz

Head of Reactor Safety Research Division, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS).

What do you consider as noteworthy statements or ideas at this year's EUROSAFE Forum?

Firstly, I noticed a broad consensus among participants on the fact that nuclear safety is already innovative. On the other hand, it was recognised that safety imperatives might delay innovation, making the nuclear industry less flexible than other, far less regulated sectors such as the software industry for instance. The nuclear sector can afford incremental innovation, but hardly disruptive technology. Secondly, It appears clearly from what I heard at this Forum that it is not possible to safely design innovative technology without taking into account human factors and organisational aspects. In this respect, I think the IAEA's recommendations and safety guidelines should be used as a very sound basis for harmonising the safety prerequisites to innovation. The third statement that came up at the Forum is that we are still far away from being able to license a nuclear plant on an international scale as easily as cars or home cinemas for example. Reactor designers and utilities may have this in mind, but I am not sure TSOs and regulators share this view, as there will always be site-specific features such as the climate or local seismicity that will require significant alterations of the standard design. Therefore, the "site licensing" is not about to disappear, in my understanding.

Is there any 'ETSON view' on the relationship between safety and innovation?

Well, we see ETSON TSOs supporting each other more and more in their respective licensing work. They have established working groups on safety guidelines, they have launched regular discussions on safety issues, they are learning from their peers... Let me point out the fact that many years of GRS-IRSN cooperation on the EPR safety case paved the way to what turned out to be common practice within ETSON. From the reactor safety research side, we have several joint projects and create further synergies, which do influence to some extent our respective licensing strategies. So, there is no 'ETSON view' on the relationship between safety and innovation in the sense of a common written doctrine, but there is a large convergence of approaches.

What kind of opportunity does the SNETP platform represent to combine safety with innovation?

Upon designing the next generation of plants, designers should beware not to reproduce what they did for Generation II plants when major safety issues such as transient fuel behaviour were addressed only after the plants had been commissioned. I do not mean Generation II plants are not safe! They actually are because of their initially conservative design. What I mean is we must go on with research in sophisticated tools that enable plant designers to adequately quantify existing safety margins. SNETP shows that innovation based on enhanced cooperation of utilities rather than mere competition is possible and desirable. I think TSOs must have a strong position in SNETP to make sure safety is appropriately addressed, and plant designers as well as utilities must understand that this is by no means in contradiction, but rather a necessary prerequisite to innovative plant design.

The JSP team members

Mansour Aalam (GRS, Germany); Sebastian Band (GRS); Karim Ben Ouaghrem (IRSN, France); Frank Dierschow (GRS); Jens Eckel (GRS); Egidijus Urbonavicius (LEI, Lithuania); Sarah Vandekendelaere (Bel V, Belgium).

Created a decade ago to involve a couple of young engineers from Bel V, GRS and IRSN in pilot projects, the JSP grew up to bring together staff from each ETSON member TSO, supporting significant projects such as the JSP/ETSON Summer School. The EUROSAFE Tribune met four JSP members to address the lessons learnt from the past Summer School in Garching [Germany], the setting-up of a web platform to allow swift communication among JSP participants, the reasons to provide the JSP with a 'constitutional' status within ETSON and to identify topics of common interest among the TSOs.

What is the experience feedback from the 2010 Summer School in Garching?

Sebastian Band (GRS). *We had an average of 36 participants over the three days of this session focused on the challenges resulting from regulatory evolutions, lifetime extension, new reactor concepts, etc. Based on the survey performed at the end of the 2009 Summer School in Cadarache [France], the time devoted to work in breakdown sessions, technical visits and events was increased to allow participants to get to know each other better. I think the Summer School is growing as an important leverage in the cooperation among TSOs, as it provides staff members from different organisations with the possibility to socialise, exchange contact data, co-produce presentation material, etc. It is a kind of laboratory of innovation, and we do not want to restrict ourselves to current approaches, but to create new ways of dealing with issues. In this regard, the interactive approach is what makes the Summer School so original.*

Does the JSP Summer School have an impact on the way you are working once back in your office?

Sarah Vandekendelaere (Bel V). *Yes it does! We have heard from many participants from the past Summer Schools that they remained in contact with people who work in the same domain. Of course, once we have our web platform running, we hope to increase the number and intensity of these collaborations, not only among Summer School participants, but also among all young staff from the ETSON member TSOs. During the last Summer School we shared methodologies on ageing management with colleagues from the Japanese TSO JNES. Just consider what we achieve within one single week every year, and figure out what we could do if we had such collaboration throughout the year!*

What is the status of the construction of the JSP web platform?

Egidijus Urbonavicius (LEI). *ETSON, the European network of TSOs, is presently working on its website, and it appeared logical to encapsulate the JSP online platform in this website. This decision delayed a bit the commissioning of our platform, but the work we have done to specify the functions and services to be provided in relation to the JSP – in particular the possibility to get easily in touch, on a daily basis, with people working on the same subject as oneself – will benefit the ETSON website. From our perspective, a JSP member can be anyone who will have a password to access the JSP platform to bring ideas, contribute to exchange and joint projects, etc. And if we see a sufficient number of people working on the same subject, we can decide to set up a joint project.*

Junior Staff Programme

New Terms of Reference for the JSP

Why did the JSP members propose to draft Terms of Reference?

Karim Ben Ouaghrem (IRSN). *The JSP members took the opportunity of the launch of the new ETSON legal entity to review the Terms of Reference of the ETSON Junior Staff Programme. The main goals of the new Terms of Reference are to strengthen the link of the JSP activities to the common objectives of ETSON, in particular as regards its contribution to the networking among ETSON organisations and to the harmonisation efforts performed through the ETSON working groups, in accordance with the different ETSON activities such as EUROSAFE and initiatives such as ENSTTI. In particular, it was suggested to rename the JSP Summer School in order to avoid any confusion with the ENSTTI training. By doing so, we wish to increase the visibility of the JSP work and to provide the JSP with a real status. Experience shows that it is not possible to work on projects that are not supported by the hierarchy, particularly when current activities generate a high workload. The new Terms of Reference will help justify the involvement of young staff in JSP projects. A separate document will specify how to join the JSP, what the commitments of a JSP member are, what our working procedures are, etc. We will present the Terms of Reference at the ETSON assembly for signature by the representatives from the participating TSOs.*

> *"The Summer School is a laboratory of innovation to create new ways of dealing with issues."*

What is the aim of the survey launched by the JSP among the ETSON TSOs?

Egidijus Urbonavicius (LEI). *It is to identify topics of interest for our respective hierarchy. The underlying idea here is to involve JSP members further in ETSON expert groups, to launch pilot projects for them.*

How do you envision the future of the JSP?

Sarah Vandekendelaere (Bel V). *The collaborations during the preparations of the Summer School, the web platform and the Terms of Reference taught me a lot on the difficulties associated with the different JSP projects, one of which being the different ways of working of the ETSON members. Those make it difficult to make and implement decisions. With the awareness of these problems, we will eventually get there by applying our communication skills and continuing the search for solutions that work for everyone. It will not be easy, but the contemplation of the amazing things we will be able to accomplish together and couldn't each on our own helps a lot!* ■

Seminar 1
Nuclear Installation Safety

Facing increased complexity

Seminar co-chairmen Claus Verstegen (GRS) and Martial Jorel (IRSN).

What are the drivers of innovation in nuclear installation safety? What do they imply in terms of research and assessment activities? The audience at the EUROSAFE Forum 2010 seminar dedicated to this topic debated such questions, pointing out two simultaneous drivers: firstly the construction of new-generation reactors in different parts of the world and secondly the utilities' wish to extend the life time of their operating facilities. The common denominator of both issues is the need for new assessment methods and tools adapted to the safety monitoring of plants with an increasing number of passive safety and digital control systems on the one hand, to the safety monitoring of ageing structures, systems & components (SSCs) on the other hand.

The challenge of harmonisation in a multifaceted landscape

The first question that comes to one's mind when asking what safety research should consist in is: "*what new safety concerns is research supposed to answer in the coming years?*" This issue is becoming all the more complex as new reactors designed by a deeply reshuffled array of vendors are ordered – or under construction – in a growing number of countries including so-called 'newcomers' e.g. in the Middle East or Asia. Fostering convergence among the nuclear safety goals, approaches and practices in the restricted club of "nuclear countries" requires continuous effort from regulators and TSOs for decades. Now, how should some harmonisation of safety requirements at a high level be achieved worldwide, on markets open to commercial competition, with well different geographic, demographic, political and cultural features? The question is open, but participants in the seminar highlighted the need for vigilance to maintain and further enhance the level of safety presently achieved, irrespective of the local specific features.

A wider array of issues to be managed

What do the present and foreseeable contexts entail in terms of research and assessment activities? According to the participants in the seminar, they translate into an increasing work-

load for the TSOs, tasked with monitoring at the same time the safety of several generations of reactors. This broader spectrum of questions and issues than in the past was exemplified by the situation of France, where 58 generation-II units are operating, 1 EPR-type generation-III unit is under construction and different generation-IV projects are considered.

Another source of complexity comes from the nuclear plant design and construction groups, which are engaged in fierce competition to make their reactor concepts as attractive – i.e. as cost-effective – as possible. Such context is making safety demonstrations increasingly complex, as vendors are inclined to cut costs through reduced safety margins, drawing upon more and more sophisticated computational models to establish their safety cases. For TSOs, pushing vendors and operators to enhance safety will translate into a larger quantity of assessment work and, concurrently, of research work aimed to gain additional knowledge of the fundamental physical phenomena involved in the behaviour of reactors.

Modelling vs. experiments

Today, computer simulation is increasingly used by TSOs for safety assessment purposes, due to the significant increase in the computational power of calculators. Detailed physical models allow more and more realistic simulation of the physical phenomena involved in a wide array of incidental scenarios, saving time and money. But models still include some degree of inaccuracy and incompleteness and the temptation to bypass physical experiments and entirely rely upon 3D models in safety assessment work is a risk TSOs must be aware of. By quantifying the level of uncertainty associated with each model, the TSOs should aim at a more target-oriented use of experiments, i.e. combining smaller-scale single-effect experiments with insights from large-scale integral tests in order to validate the results obtained through modelling. By getting closer to fundamental physics, such experiments could be carried out in a cross-disciplinary approach to produce results usable for the development of generic methods applicable to safety beyond the nuclear sector.

The priorities of innovation in nuclear safety by reactor generations

Concerning the generation-II plants, commonly in operation for 30 years or more, ageing appears as the main challenge to be taken up. Built in the 70s and 80s based on conservative designs, these plants incorporate some equipment, such as the reactor vessel, that are subject to ageing but cannot be replaced. Many of those were upgraded using e.g. digital instrumentation & control, and are now operated with 'aggressive' core loading patterns (including MOX or high burn-ups) to achieve power increase or more economic and flexible operation. It is those reactors utilities are seeking to operate beyond their original service life – from the 40-year period provided by design to 60 years –, calling for innovative supervision by TSOs and regulators, since the current regulation will have to be revised to account for new requirements: What SSCs will require particularly close monitoring? Where are ageing phenomena predominantly expected? How can they be detected on time? How should maintenance (especially preventive maintenance) activities be subsequently adapted? Some insights are given by the development of new

"What new safety concerns is research supposed to answer in the coming years?"

monitoring devices that deliver precise diagnosis of the actual state of SSCs, allowing their timely replacement for instance. The perspective of an extended operation will need substantial effort not only on the ageing management programme but also on the enhancement of the safety level with the aim to reach safety objectives similar to those expected for a Generation-III reactor like the EPR.

Generation-III reactors such as the EPR presently under construction e.g. in Finland or France are evolutionary reactor concepts based on generation-II plants with the addition of improved, largely passive safety systems (such as core catchers). Being focused on specific features such as these passive safety systems or on the implementation of new materials, the safety assessment of Generation-III reactors requires the revision of some approaches and procedures, drawing upon the operating experience feedback (OEF) of generation-II plants and on the development of methods incorporating e.g. uncertainty analysis. In the case of the high-temperature reactors developed in the US and China, some R&D on materials appears necessary as well.

More disruptive in terms of innovation, generation-IV reactors aim at making nuclear power sustainable owing notably to superior fuel effectiveness, high resistance to proliferation and easy waste storage resulting from the transmutation of long-lived fission products into shorter-lived isotopes. Safety-oriented research pertaining to this generation of (predominantly) fast breeder reactors, which implement coolant materials such as sodium or lead-bismuth, will be largely focused on the safety of structure mechanics and materials.

Piet Müskens
Director, Department for Nuclear Safety, Security, Safeguards and Radiation Protection
Ministry of Housing, Spatial Planning and the Environment, Netherlands

"As new generations of nuclear facilities are under development or construction in an increasing number of countries, nuclear regulators and supervisors have to find new ways to fulfil their job. In this respect, I think there are two ways to innovate in the field of nuclear safety and security: the first is to foster a continuous improvement, in the sense of the IAEA's Nuclear Safety Standards, and the second is to create synergy in regulation and supervision on nuclear safety and nuclear security. To achieve the first objective, what I would call "innovation by internationalisation" is necessary, i.e. seeking active cooperation with fellow organisations and TSOs worldwide who also have the information, knowledge and experience needed. Partnerships have to be sought with capacity transfers based on formal agreements. Now, regarding the supervision on nuclear safety and security, what I would call "innovation by integration" is needed. In this regard, the work launched by both the Commission on Safety Standards and the Advisory Group on Nuclear Security for developing safety and security synergies and interfaces and examining the feasibility of the establishment of a nuclear safety and security standards series is both necessary and timely."

Some lessons learned

Three major lessons can be derived from this EUROSAFE Forum 2010 seminar devoted to nuclear installation safety: Firstly, TSOs must acquire a very in-depth knowledge of the design features of Generation-III reactors to be able to produce safety assessments of a quality level comparable to the assessment of Generation-II reactors. Secondly, safety must be regarded as an integral part of the design of future plants and not as a kind of "add-on" to the design. And finally, the R&D related to Generation-II reactors must go on with two driving forces: the use of more and more complex safety demonstration methods on the one hand and, on the other hand, the need to upgrade the safety level of Generation-II reactors with the aim to meet safety objectives similar to those expected from a Generation-III reactor. ■

Seminar 2
Radiation Protection and Environment

Tackling a wider scope of issues

Seminar co-chairmen Jean-François Lecomte (IRSN) and Gunter Pretzsch (GRS).

Protecting man and protecting the environment against ionising radiation was once regarded as one single issue. According to this kind of 'in each other's pocket' approach, if man was correctly protected, so was subsequently the environment. But things have changed in this field too with the development of disciplines such as radioecology and nuclear ecotoxicology. Moreover, radiation protection studies are reaching far beyond the traditional nuclear power sector to address e.g. nuclear medicine, the transport and processing of naturally occurring radioactive materials or chronic occupational exposure to low-dose ionising radiation. An interview with Gunter Pretzsch (GRS) and Jean-François Lecomte (IRSN), co-chairmen of the EUROSAFE Forum 2010 seminar devoted to radiation protection and environment.

What can be regarded as major issues in radiation protection of man and the environment for the years to come?

A first challenge results from the new doctrine conveyed by the International Commission on Radiological Protection (ICRP) according to which the protection of the environment against ionising radiation should be distinguished from the protection of man against such radiation. That kind of evolution implies the establishment of a doctrine specifically relating to environmental protection as such, and the characterisation of the advances to be achieved to meet the goals set up in this field. The way chosen by ICRP leads to the development, for the different compartments of the environment (i.e. reference plants and animals), of new concepts similar to the voxelised phantoms for the radiation protection of man. The paper titled "*Radioprotection of the environment: recent advances in nuclear ecotoxicology research*" provides insights in this domain.

Seminar 2...

Another significant change pertaining to the protection of man against ionising radiation is the widening scope of potential health effects taken into consideration in the assessment of exposures. If surveys were focused

on cancer effects until a recent date, other pathologies such as cardiovascular diseases or ocular cataracts are now under scrutiny with a view to ensuring that such scientific issues will be duly accounted for in future revisions of regulatory texts.

What are expected to be the major drivers of innovation in this context?

As reflected in the different presentations at this seminar, two main priorities are expected to guide innovation in the field of radiation protection of man and the environment: The first one can be characterised as on-going improvements in the operation of facilities, the second one as research to be performed in domains where present knowledge is still limited. Concerning the first category, papers such as the contributions titled *Radiation safety in new build*, presented by STUK, the Finnish Radiation and Nuclear Safety Authority, and *Criticality safety in the waste management of spent fuel from NPPs*, presented by GRS, respectively provide examples of new radiation-safety-related requirements to be implemented in the design of a new Finnish NPP. These pertain to materials, logistics and procedures, and of criticality-related requirements for all stages of the reprocessing or direct final disposal of spent fuel.

What does the second category of priorities consist in?

It pertains to the consolidation of the reference texts in radiation protection as a result of research carried out in domains barely considered up to now.

This starts with the research performed in nuclear ecotoxicology, a particular discipline of radioecology, in order to gain knowledge on the combined effects of different stressors on the environment by merging risk analysis methods for radioactive contamination with those for other pollutants through species sensitivity distributions. The IRSN paper titled "*Radioprotection of the environment: recent advances in nuclear ecotoxicology research*" summarises the progress achieved in this field.

It goes on with stricter requirements for the transport of Naturally Occurring Radioactive Materials (NORM) such as rare earth elements, whose safety management will become increasingly similar to the management of other radioactive materials, as explained in GRS' presentation titled "*Exposure of Workers from the Transport of NORM in Germany*".

Among other domains progressively gaining consideration, nuclear medicine occupies a central position as a result of the rapid development of medical imaging for diagnostic and interventional purposes. With medical staff relying more and more on imaging instead of classical surgery to perform diagnoses, their ocular exposure to ionising radiations is on the rise, causing damage to their vision. As reported in IRSN's paper titled "*Occupational cataracts and lens opacities in interventional cardiology: the O'CLOC study*", a cohort of physicians was monitored to compare the evolution of their lienses with that of ordinary people.

Last but not least, chronic occupational exposure to low-dose ionising radiation is also catching increased attention, as witnessed in the GRS presentation titled "*Radiation exposure of workers in waterworks*", facilities for drinking water production, treatment and distribution being categorised by the German Radiation Protection Ordinance as working areas where significantly elevated exposure to radon (Rn 222) can occur.

What are the messages to keep in mind?

The following four key statements pertaining to the European Union synthesise the presentations and debates at this EUROSAFE Forum 2010 seminar devoted to radiation protection and environment. First of all, increasingly stringent regulation provides for very low exposure in the NPPs under construction. Secondly, the final storage of low-level (LLW) and intermediate-level (lLW) waste can be considered a technically solved issue. Further on, the progress achieved in radioactive materials packaging is conducive to no serious effect on the public even in case of a potential accidental exposure during transport. And finally, the exposure to ionising radiations in facilities such as water plants is monitored and kept to a low level. ■

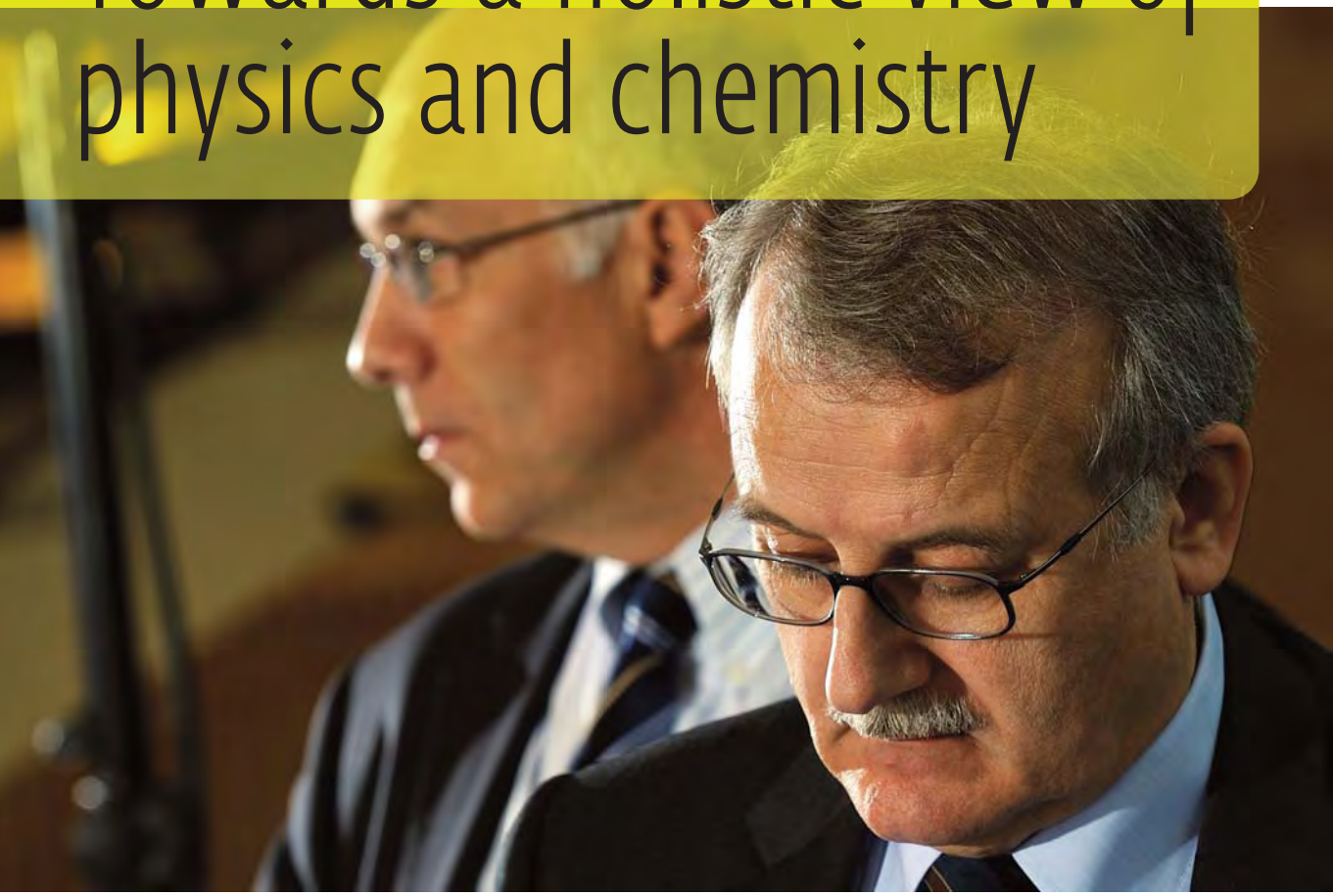
"Chronic occupational exposure to low-dose ionising radiation is catching increased attention."

Les Philpott
Deputy Director and Head of Policy and International Health & Safety Executive United Kingdom

"I see safety and innovation as a necessary partnership. Nuclear power generation technology has grown significantly since it was first introduced and this has led to major advances in reactor design and waste management that have enhanced nuclear safety for the public and wider society. Of course, people rightly question this - and as regulators, it is our job to protect the public and society from the hazards of nuclear installations. Innovation helps us in that mission because advanced technology focuses on issues of safety - and, indeed, security - at the design stage. Therefore, I see no tension between innovation and safety."

Seminar 3
Waste Management

Towards a holistic view of physics and chemistry



Seminar co-chairmen Jean-Christophe Gariel (IRSN) and Tilmann Rothfuchs (GRS).

Besides R&D related to the management of high-level waste generated by the nuclear fuel cycle, the five lectures at this EUROSAFE Forum 2010 seminar devoted to waste management tackled new topics that epitomise innovation in this field, to begin with the growing consideration given to the impact of waste generated by uranium mining and milling on the atmosphere and, thereby, on the radiological exposure of local populations. Many questions also came from the audience about innovation through experiments aimed to evaluate the behaviour of e.g. bentonite as a sealing material in intermediate depth disposal facilities or the effects of microbial activity on the containment of high-level waste. Furthermore, experiments carried out to validate computer codes used for forecasting the quantities of radon and aerosols to be released by uranium mining and milling waste and for modelling their atmospheric dispersion were commented.

Towards a German Safety Case – The ISIBEL Project Research & Development

Given by DBE Technology, the German Federal Institute for Geosciences & Natural Resources (BGR) and GRS, this lecture introduced ISIBEL, an R&D project performed in Germany to develop a new concept for a safety assessment that takes full account of the advantages associated with the final disposal of high-level waste (HLW) in salt formations. This concept draws upon the demonstration of the safe containment of the waste based on the integrity of the geological and geotechnical barriers of the final repository, and on an evaluation of the possible impairment of their integrity, opening a pathway for radionuclides. The project resulted in the development of a method for the assessment of the subsequent radionuclide releases.

Current status of gas migration and swelling experiments using engineering scale model for Intermediate Depth Disposal in Japan

Japan Nuclear Energy Safety Organization (JNES) presented a series of experiments they are performing to understand firstly the swelling behaviour of the bentonite layer, used in intermediate depth disposal facilities of radioactive waste in Japan to retard interaction of the waste and groundwater, and secondly the gas migration in the layer. These experiments carried out using an engineering scale model of the disposal facility are important to confirm the stability of the barrier system under stress generated by the swelling of the bentonite and to understand the effect of the increase in hydrogen gas pressure resulting from the corrosion of metallic waste.

Microbial activity in a deep underground high-level waste disposal cell

The French Atomic and Alternative Energies Commission (CEA), the Multidisciplinary Research Institute on Environment and Materials, University of Pau & Pays de l'Adour (UPPA/IPREM) and IRSN collaborated to perform a research programme aimed at assessing the potential impact of bacteria on the corrosion of carbon steel materials involved in the design of HLW disposal cells developed by the French National Radioactive Waste Management Agency (Andra). This programme – which does not account for the effects of high-level radiation at this stage – combines an evaluation of biodiversity of argillite and the design of a conceptual model of the development of microbial activity in a HLW disposal cell based on mass and energy balances.

Leaching of long-lived radionuclides from demolition rubble of NPPs

In cooperation with the Institute of Geoecology of the Technical University of Braunschweig, GRS conducted a study financed by the German Federal Office for Radiation Protection (BfS) with a view to evaluating the behaviour of long-lived radionuclides such as uranium, radium and thorium in the cementitious rubble generated by the dismantling of NPPs. As considerable amounts of such rubble will be produced, a new model developed on an experimental basis is needed. The study shows that an integrated approach combining soil physical and geochemical modelling is required to fully understand the complex flow and radionuclides transport resulting from leaching.

In-situ validation of the IRSN radon dispersion code CITRON in the case of uranium mining and milling waste repository

This IRSN lecture presents the experiments carried out to validate a computer code named CITRON, developed to assess the impact of mining and milling activities on the emission of radon, which can eventually increase radioactivity concentration in the atmosphere and, correlatively, the exposure of local populations. The two-step methodology set up to validate the code consists firstly in an implementation of the source-term characterisation of a uranium mill-tailing repository and then in the quantification of the atmospheric dispersion. ■

Seminar 4
Nuclear Security

Keeping awake

Seminar co-chairmen Jürgen Sternkopf (GRS) and Jérôme Joly (IRSN).

Co-chairmen of the EUROSAFE Forum 2010 seminar devoted to nuclear security, Jürgen Sternkopf (GRS) and Jérôme Joly (IRSN) provide hereunder an overview of the main aspects of the present context from a security perspective, of the priorities of international organisations and TSOs to address new threats and of some achievements in this area.

How would you characterise the present situation of nuclear security?

Since the 9/11 attack in New York City, the context remained quite tense with – just to mention the most striking attacks – the train bombing at Madrid Atocha railway station in March 2004, the London underground and bus suicide attacks in July 2005, the terrorist attacks in Bombay in November 2008 or, more recently, the Moscow Domodedovo Airport bombing on January 24th, which left 35 dead. Other plans fortunately failed, such as the 'Sauerland group' plot thwarted in Germany in 2007, a plan that could have been one of the bloodiest attacks in European postwar history, according to investigators. But tip-offs are going on, such as the warning in November 2010 of attacks planned in German railway stations and airports. It is obviously not the right time to lean back and relax! For those in charge of security in sensitive sectors such as nuclear power generation, there is absolutely no possibility to reduce prevention, surveillance and countermeasures.

In this context, what are the security priorities for the parties involved and particularly TSOs?

A lot has been done to provide NPPs with security measures. A whole system is now in place to prevent malicious acts both inside and outside plants, and it is difficult to point out a particular aspect. Nevertheless, emphasis is put for instance on the careful checking of vehicles and persons to prevent sabotage or the smuggling of explosive material into the plant. Another priority that can be mentioned is the protection of the plant's information systems – and in particular command and control systems – against viruses aimed at triggering incidents in plant operation. The Stuxnet computer worm discovered in July 2010 is a good example of sophisticated 'malware' which includes software allowing continued access to e.g. programmable logic controllers while actively hiding its presence from administrators. This shows how vigilant we must be regarding malicious strikes performed by invisible attackers.

What are the important messages delivered during the seminar?

One major message, delivered in an IAEA presentation, concerns security education. The IAEA has developed – together with academics and nuclear security experts from member states – an "Educational Programme in Nuclear Security" (IAEA Nuclear Security Series No. 12) that consists of a model Master of Science (M.Sc.) and a certificate programme in nuclear security. The IAEA supports the establishment of nuclear security at educational institutions and strives for setting up a network among educational and research institutions to enhance global nuclear security by sharing excellence in security education. Another key message is: the increase in threats is responded by the progress achieved in nuclear security measures. As explained in a lecture titled *Use of video systems in securing nuclear facilities*, new video systems are now available on the market to monitor nuclear facilities e.g. in Russia. These systems rely upon advanced image analysing techniques for the recognition of events, providing a higher level of security. The last message derived from the lectures and debates at this EUROSAFE Forum 2010 seminar could be the necessity to achieve steady but unhurried, thoroughly validated approaches and techniques in the security of nuclear plants, in order not to innovate in security at the expense of safety. ■

Christian Raetzke
Vice President International Regulatory Affairs New Nuclear Development Projects
E.ON Kernkraft GmbH
Germany

"As a lawyer, I would like to express a regulatory perspective. My perception is the nuclear industry is rather conservative regarding innovation, as it cannot obviously afford, unlike many other industrial sectors, any "trial and error" approach! Therefore, it uses to maintain existing systems and organisations that have shown their safety and efficiency until any innovation is proven to be better. In the legal and regulatory field, the high emphasis on national legislation and regulation is an additional barrier. Today, the same reactor built for example in the UK and in France will have different designs for regulatory reasons. This generates extra costs, and, at the end of the day, the limited carry-over from one country to another does not really help enhance safety. Now, would one single worldwide regulation be beneficial or detrimental to safety enhancement? Well, let's start with Europe and endeavour towards a mutual acceptance of safety reviews and a high-profile regulation common to all Member States. And, in a second step, let us promote this across the world. In this regard, I think the work performed by ETSON provides a good example of what can be done to foster a responsible growth of nuclear energy worldwide."

Europe organises to

Workshop co-chairmen Peter Storey, professor at Manchester University and Victor Teschendorff, consultant to GRS.

The availability of skilled scientists and engineers being commonly recognised as critical to ensure the safety of nuclear facilities – not depending on new power stations getting built in one country and a phase-out process being underway in another one – universities, TSOs, regulators and industrial players have seriously tackled this issue with the EC's support. The present workshop, devoted to *European Co-Operation in Education on Nuclear Safety*, provides an overview of each party's initiatives in the field of education and training (E&T) to avoid a shortage of skilled manpower in the coming years. "*The outcome for this workshop is not about organisations but is about identifying the issues and exploring the opportunities to link safety requirements with education and training and see what role universities have in realising this ambition*," Peter Storey, professor at Manchester University and co-chairman of the workshop, reminded the audience.

Workshop

Education and training: bridge the skills gap

The convergence of nuclear safety practices in Europe starts with education

In his introduction, Victor Teschendorff, consultant to GRS and co-chairman of the workshop with Peter Storey, exposed the workshop's aims and objectives, i.e. to enhance the EU's approach to nuclear safety and radiation protection; to contribute to the convergence of European technical nuclear safety practices; and to achieve mutual benefits and understanding between universities, TSOs and regulators. "*Fostering the convergence of technical and nuclear safety practices in Europe starts with education in universities. As safety is no by-product of nuclear science and technology, it has to be implemented in educational planning through TSO informed teaching programmes. This means real cases from practical work must be included in the teaching material, offering placements and projects for post graduate education and supporting the research capabilities. This will bring mutual benefits between TSOs, regulators and universities,*" Mr. Teschendorff stressed.

Performed by Ute Blohm-Hieber, head of unit D2 at the EC's DG Energy, the first presentation titled *Nuclear Energy in Europe – Benefit from the Cooperation of Universities and TSOs* deal with the role of the European institutions regarding E&T: "*Among the EU's political priorities is the guarantee of safety, security and non proliferation, including safeguards,*" declared Mrs. Blohm-Hieber "*To achieve this, we need notably harmonised education and training. This is why we set up the* Agenda for New Skills and Jobs." In accordance with this policy document aimed particularly to encourage the pooling of some resources between universities, research institutes and industry, the EC supports the creation of complementary organisations (see box. 1). These are tasked respectively with monitoring the short-, medium- and long-term needs of qualified human resources for the different stakeholders in nuclear energy; coordinating E&T initiatives at the EU Level; supplementing university courses in nuclear engineering with practical, experience-based training in nuclear safety; developing leadership among personnel; providing nuclear and radiological security related training.

Jörn Pachl
Professor, Head of the Institute of Railway Systems Engineering and Traffic Safety Technical University of Braunschweig Germany

"I have been involved in research on rail traffic systems for many years, and I think this sector is not very different from the nuclear industry as regards the relationship between safety and innovation. In both sectors, safety concerns open new paths to innovation, but they often slow the implementation of innovation down. The increasing centralisation and automation of operations, for example, certainly enhance the efficiency of operations, but conversely make it more and more complex for controllers to behave correctly in degraded operating modes. This example shows that it is very difficult to introduce disruptive technologies into safety-critical systems because of the very stringent safety requirements. Moreover, nuclear safety regulation and rail traffic safety regulation remain a national competence up to now and traffic control systems are different in each country. This is another hindrance to innovation. Therefore, I think we should focus on improving the safety vs. innovation relationship in the future, so that safety doesn't' slow innovation down anymore."

Workshop...

Michel Giot, professor em. at the university of Leuven, awarding young scientists the *Juan Antonio Rubio-Paul Govaerts ENEN-EUROTRANS Prize* for the quality of their doctoral dissertations.

Collaboration: a leverage to enhance skills and develop research

Giving the example of the UK, where the competences in nuclear engineering had to be largely restored after several decades without any new project, John Roberts, lecturer at Manchester University, explained how universities cooperate in Britain to increase research and education for nuclear students and how such cooperation could be extended at a European level. "*The way the universities in the UK tackled this problem was to form a consortium named NTEC Consortium formed by 12 universities and institutes, which bring together their own expertise to enable a Master of Science (MSc) programme to be delivered. Year on year, we have increasing numbers of students coming from industry to do continuing professional development (CPD), which is available part time, full time and in distance learning format,*" John Roberts says. "*And when it comes to research, a coordination group was formed to identify the areas where the UK requires some kind of nuclear research. The National Nuclear Laboratory, the Nuclear Decommissioning Authority, Rolls Royce, Westinghouse and so on are all included in this committee that meets and decides where they think that the Research Councils should place their funding. Over the last five years, this has given us about GBP35 million of funding from the Government towards nuclear research in the UK and this is directly attributable to a collaborative approach because all these programmes are consortia.*"

To coordinate these collaborations, a website called nuclearliaison.com lists all the nuclear interests of the university sector in the UK. "*It would be great if that could be replicated across all the nuclear countries in Europe. These could then possibly be linked by one web page that connects all the national pages together. More universities being networked would be beneficial for all aspects of nuclear research and education, including nuclear safety and regulation,*" Dr. Roberts concludes. In a similar spirit of networking, the European Nuclear Education Network (ENEN), whose activities are presented by its President, Joseph Safieh (see box. 2), contributes to the development of a European pool of competences at three levels: education, training and knowledge management.

Adding to the collaboration among universities,

Awards Ceremony

The workshop on European Co-operation in Education on Nuclear Safety was the opportunity to award the Juan Antonio Rubio – Paul Govaerts ENEN-EUROTRANS Prize to young scientists for the quality of their doctoral dissertations prepared in the framework of the European research programme for the transmutation of high-level waste in an accelerator driven system (IP-Eurotrans project) started in 2005 and ended in 2010. The five laureates are:

Carlos Guerrero, Universidad Politécnica de Madrid (Spain), for his thesis titled Measurements of the ^{237}Np and ^{240}Pu Neutron Capture Cross Sections at the CERN N_TOF Facility.

Wim Haeck, University of Ghent (Belgium), for his thesis titled An Optimum Approach to Monte Carlo Burn-up.

Laure Martinelli, University of Paris 6 (France), for her thesis titled Mécanisme de corrosion de l'acier T91 par l'eutectique Pb-Bi utilisé comme matériau de cible de spallation.

Joris Van den Bosch, University of Ghent (Belgium), for his thesis titled ADS Candidate Materials Compatibility with Liquid Metal in a Neutron Irradiation Environment.

Chuan Zhang, Goethe-Universität in Frankfurt/Main (Germany), for his thesis titled Linac Design for Intense Hadron Beams.

increased cooperation between universities and TSOs could help enhance the professional orientation of students, professor Hans-Josef Allelein, head of the Nuclear Safety and Technology Department of the Faculty of Mechanical Engineering at Aachen University emphasised in his presentation. "*A university institute does not need any guidance with respect to teaching, neither from industry nor a TSO. The university knows what it has to teach, and it also knows what it has to ask for. But it should be embedded in the community of nuclear organisations to provide the students with a sound spectrum of knowledge and I am strictly against having specialists within this space when they are at university. When they leave university, they should be able to go into industry, a TSO or work in a university,*" Prof. Allelein advocated, adding: "*I propose that TSOs involve universities when defining a project or process, and look for young people who are able to prepare the specific work.*"

The challenge of transmitting the safety culture

"*We safety people, we have a specific mindset. We think risk. We see only hazards. We do not trust. We just want to double-check, triple-check, and we sometimes get on the nerves of our interlocutors! So this is why we need specific training capability coming from our organisations, to train our safety experts, and to pass on cultural elements,*" stressed Didier Louvat, Managing Director of the European Nuclear Safety Training & Tutoring Institute (ENSTTI).

Four European TSOs members of ETSON had already identified this issue and decided to set up ENSTTI to meet the training needs of personnel working in research and in the assessment of nuclear safety and security and in radiological protection, thus catering for their own needs and proposing new entrants a model. Didier Louvat presented the approach to provide introductory courses and tutoring to young professionals. Instruction is provided by expert speakers from different fields and consists of a series of topical modules followed by practical work with exercises, workgroups and technical tours. "*One of ENSTTI's major assets is that its lecturers are the experts who do the job every day. Moreover, ENSTTI offers possible internship in its TSO organisations,*" he acknowledged.

What's next?

"*My impression of today is that we had a really interesting information exchange. We did not have that complete view before,*" concluded Victor Teschendorff at the end of this first EUROSAFE Forum's workshop dedicated to European co-operation in education on nuclear safety. Summarising a major lesson learned from the workshop, Peter Storey added: "*Universities need more professors, but it will take time to realise the long-term vision. However universities do have an important role to play in instilling the safety culture and right behaviours in our engineers and scientists of the future.*" Follow-up activities are envisaged over the coming years, picking up each time a particular aspect of E&T. The EUROSAFE Tribune will report on the progress made in this very broad area.

Co-operation in education on nuclear safety in Europe: remarks from the audience concerning...

■ ... the language barrier: "*This is an obstacle to increased cooperation and personnel mobility between*

2 questions to...

Uichiro Yoshimura

Deputy Director, Nuclear Safety Division. Nuclear Energy Agency (OECD-NEA)

What level of harmonisation is expectable in the nuclear sector?

The IAEA is promoting some harmonisation of regulations; the OECD Nuclear Energy Agency (NEA) on its side promotes harmonisation of practices through its activities related to practical, technical issues that really occur.

The industry is pushing hard towards regulatory standardisation as it is in its own interest. We often hear discussions about how to certify products internationally for example, but I think such discussions are a bit premature, though initiatives such as the MDEP are on their way. A very interesting initiative regarding the enhancement of the safety level of new reactors is the Multinational Design Evaluation Programme (MDEP) for which the NEA has been chosen to perform the technical secretariat duties. TSOs have routinely been key participants in MDEP discussions and have been invited as requested by the national regulators. The goals of MDEP are to cooperate on the safety reviews of some new reactor designs and to explore opportunities to harmonise regulatory requirements and practices – all in an effort to enhance safety of new reactors. As part of the MDEP efforts, the NEA is supporting information sharing among the MDEP members that may lead to potential harmonisation. This work includes, for example, cooperation on vendor inspections to explore how different licensing authorities can use each other's inspections and conduct jointly inspections and share information accordingly. The MDEP participants also discuss regulatory and technical issues surrounding the safety design reviews among regulators who are assessing the same reactor type such as the AP1000 and the EPR. These working groups invite various stakeholders including reactor vendors, new nuclear power plant licensees, and industry representatives to participate in discussions about new reactor safety issues. This new practice provides an international basis to discussions conducted eventually in a national context.

Are there particular obstacles to harmonisation?

This question is hard to answer in one word, as the notion of "obstacle" is highly depending on individual views... But what we try to do at the NEA is to put the different parties involved around the table. As everyone knows, vendors are now facing fierce international competition, and competition and harmonisation could be perceived as opposite notions. But based on the experience feedback from previous accidents, the industry knows that an accident anywhere in the world is an accident everywhere. So I think the cursor between harmonisation and competition should be placed with the "safety first" principle in mind and it is in the interest of the industry also. Moreover, we see now new entrants coming up and I think it is essential that TSOs and regulators from all the "advanced" nuclear countries support these new entrants with a common set of principles, even if their practical support differs according to the country. One of the responsibilities of advanced countries is to help new entrants address technical issues, and TSOs have a pivotal role to play in this field.

Box 1: E&T initiatives at the EU Level

European Human Resources Observatory on Nuclear (EHRO-N)
• Tasks
-Establish and regularly update a database on the short-, medium- and long-term needs of HR for the different stakeholders in nuclear energy
-Identify gaps and deficiencies in the European nuclear E&T infrastructure and elaborate recommendations
-Play an active role in the development of a European scheme of nuclear qualifications and mutual recognitions
-Regularly communicate relevant data to the MSs organisations involved in nuclear E&T.

European Nuclear Education Network (ENEN)
• Non-profit organisation, established in 2003
• Objective: The preservation and further development of expertise in the nuclear fields by higher education and training. This objective is realised through the cooperation between universities, research organisations, regulatory bodies, the industry and any other organisations involved in the application of nuclear science and ionising radiation.
• Membership: 60 members (universities, research centres and nuclear industry) in 18 EU countries, South Africa, Russian Federation, Ukraine and Japan
• European Council backing: In December 2008, the European Council adopted the conclusion that refers explicitly to the ENEN and otherFP6/7 initiatives originated by the ENEN.

European Nuclear Energy Leadership Academy (ENELA)
• Initiative anchored in ENEF and supported by the industry.
• Strong focus on legal and regulatory issues.
• Objectives:
-Professional high level development
-No competition with initial academic education
-Offering a global view for future middle and top managers
-Attracting "non nuclear" professionals to nuclear energy
-Filling in the "middle age" gap with high level professionals
-Developing a global awareness of aspects of nuclear energy
-Networking at a European level and beyond
• Audience:
-Graduates
– Young professionals
-High potential professionals
-Policy makers, opinion formers.

European Security Training Centre (EUSECTRA)
• A JRC project.
• Objective:
-Provide nuclear and radiological security related training
-Support and complement such activities at the national level.

European Nuclear Safety Training and Tutoring Institute (ENSTTI)
• Created by European TSOs with the EC's support.
• Objectives:
-Supplement university courses in nuclear engineering with practical, experience-based training in nuclear safety.
-Transfer the knowledge, experience and culture of the European Technical Safety Organisations.

member states. Emphasis placed on this issue in E&T should allow the technical part of expertise being carried out using documents in other languages like English, only the legal part remaining in the national language."

■ ... the preparation of the next generation of university professors in nuclear engineering: *"One should consider not only the positive aspects of pooling resources, but also the possible side effects. Sometimes, full-time university professors who are retiring are being replaced by part-time professors hired from the industry or from research centres, so the expertise is being lost in the universities."*

■ ... the quality of engineering and science courses: *"An engineer working in civil engineering for the design and construction of power plants needs to be a very good civil engineer. Once recruited, he or she might need some 'nuclearisation', which consists of radiation protection and everything needed to help him or her understand the environment of a nuclear power plant and maybe some specialised course on e.g. seismic aspects."*

■ ... internships: *"The number of possible internships in Europe is below expectations. The industry should make an effort to increase the possibilities for students to have an internship in their plants."*

■ ... the teaching of safety: *"Any nuclear teaching programme should have something on safety from a very early stage. It does not matter whether the person leaving that university will stay in nuclear altogether, go to other fields of engineering, to the industry or to the regulator. To reinforce the safety education in the framework of its educational programme, the ENEN for instance has introduced case studies at the end, and this should be done in*

Box 2: The three pillars of skill building

Education

-Supported by the 5th and 6th Euratom Framework Programmes (FP), the ENEN has developed, in particular, E&T courses in a European exchange structure (Master level), based on core curricula and optional fields of study. Of particular interest isthe list of 295 ENEN courses (modules) that were producedin 25 nuclear fission disciplines, including the full curriculum leading to the original certificate of European Master of Science in Nuclear Engineering (EMSNE). Thus ENEN is considered as an important step towards the harmonisation of E&T activities in nuclear fission and radiation protection in the EU.
-Through the FP6 ENEN II and EUROTRANS projects, the ENEN has contributed to the organisation of PhD level courses.
-In 2009, EUJEP project started an exchange of students and faculty members with Japan. A similar challenge is ongoing forexchanges with Canada.

Training

-Based on the FP5 NEPTUNO project, some ENEN members have also developed training courses for young professionals. In the framework of FP7 "Euratom Fission Training Scheme (EFTS)", a new challenge for the ENEN is to establish a common certificate for professionals at the EU level.
-The ENEN participates in four European Fission Training Schemes (EFTS) projects: 1) ENEN III for nuclear engineering, 2) ENETRAP II for radiation protection, 3) PETRUS II for geological disposal of radioactive waste and 4) TRASNUSAFE for the nuclear safety culture.
-Once established, the same concept is to be applied to all ENEN and other training courses as appropriate in order to contribute to the harmonisation across Europe.
-The ENEN also leads two FP7 projects for cooperation beyond the EU, i.e. ECNET project with China and ENEN-RU with the Russian Federation.

Knowledge management

-After the creation of the first database under the FP6 NEP-TUNO project, a new ENEN database was developed during the FP6 ENEN II project and is to be opened in 2010. It covers all E&T courses, Master programmes, PhD topics and job opportunities provided by the ENEN members and partners.

Hans-Josef Allelein
Professor, Head of Department of Nuclear Safety and Technology Faculty of Mechanical Engineering, Aachen University, Germany

"I have heard very interesting contributions and discussions at the Forum's workshop dedicated to European Co-Operation in Education on Nuclear Safety. I heard for instance that there is still a huge demand for young engineers, but looking a little bit more in details, the shortage of engineers with a nuclear-safety background is not that important. As a professor of the Aachen University and as one of the directors of the Institute for Energy and Climate Research at the Jülich Research Centre responsible for nuclear safety, I would like to remind the EUROSAFE Tribune readers that the first duty of a university is teaching and, to some extent, training with the support of external partners such as research centres or TSOs. I would also point out that, beyond sufficient financial support, universities need to tap into what other organisations are doing; they need to be truly 'embedded' in the national and European nuclear community alongside industrial operators, vendors, utilities, TSOs, research centres, etc. This is key to enhance safety through innovation."

classrooms by the collaboration of professors, teachers from universities, and experts from TSOs or regulatory bodies."

■ ... the attractiveness of careers in the nuclear sector: *"If students take a four-year engineering course, and if a major part of that course is focused on nuclear matters, they will certainly be looking to the nuclear sector for a possible career. Moreover, it would be interesting to see more and more experts from the industry participate in the first years of the engineering programmes, just to give the passion for nuclear topics to students having to decide between different options. If they see very early what can be the outcome of what they are studying, they can be motivated to go there."*

■ ... transnational mobility and on-the job learning. *"The European Credit system for Vocational Education and Training (ECVET) is a common framework that facilitates the accumulation and transfer of credits from one qualifications system to another. It aims to promote transnational mobility and access to lifelong learning. It is not intended to replace national qualification systems, but to achieve better comparability and compatibility among them."*

■ ... the commissioning of new build: *"In Europe, especially in Western Europe, commissioning has not been practised for a long time, and since it is a very intense period in the life of the power plant, ENEN could think of how to prepare experts for that particularly important activity."* ■


EUROSAFE
Towards Convergence of
Technical Nuclear Safety Practices in Europe

Coming next...

The EUROSAFE Tribune n°20 will deal with:

The TSOs' position on the safety research to be performed over the next decades

This issue will provide a TSOs' view on the technical needs in nuclear safety-oriented R&D and highlight the necessity of pooling resources among nuclear stakeholders including utilities and designers to drive future research programmes based notably on the experience feedback from the March 11 event in Japan.

More on: www.eurosafe-forum.org

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