

# EUROSAFE TRIBUNE

# #007

SEPTEMBER  
2005



## EXPERIENCE FEEDBACK

## A CORNERSTONE OF NUCLEAR SAFETY

A review of the main themes discussed at the sixth EUROSAFE Forum held in Berlin in November 2004.



## CONTENTS

### LECTURES / DEBATES ..... p. 4

**“In nuclear safety, an improvement anywhere is an improvement everywhere”**

### SEMINARS ..... p. 11

#### **Nuclear installation safety assessment**

Sharing experience through international working groups ..... p. 11

#### **Nuclear installation safety research**

Cross-industry and cross-speciality subjects to enhance research attractiveness ..... p. 14

#### **Environmental and radiation protection**

New approaches, new tools, new experiments ..... p. 17

#### **Waste management**

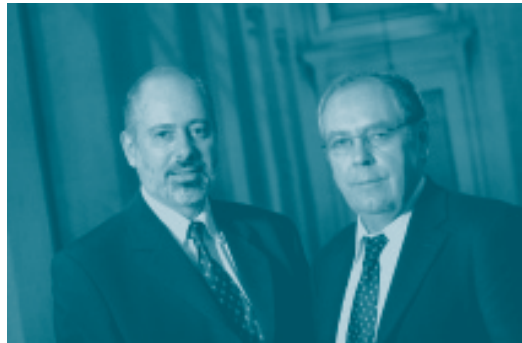
A wider coordination of research programmes under EC leadership .... p. 21

#### **Nuclear material and nuclear facilities security:**

How well are we prepared? ..... p. 24

### EVENTS & WEBSITES .... p. 26

➤ All the papers referred to in the seminar section of the present issue are available at [www.eurosafe-forum.org](http://www.eurosafe-forum.org)



Jacques Repussard and Lothar Hahn

**E***r rare humanum est, perseverare diabolicum...* If groping around is part of the human way to move forwards, blindly sticking to wrong behaviours is detrimental to progress. This assertion could summarise the “experience feedback” issue debated during the last EUROSAFE Forum held in Berlin on November 8<sup>th</sup> and 9<sup>th</sup> 2004.

What are the difficulties associated with retrieving the relevant data to learn from experience? To which extent are models trick-orientated ways of thinking? What part do complacency and the aversion to uncertainty play in repeating errors? Does a blame-free culture mean impunity or rather encourage honest and open attitudes? What can the stakeholders in the nuclear safety issue – engineering firms, equipment vendors, operators, nuclear authorities, technical safety organisations, etc. – learn from other industrial sectors, such as aircraft manufacturing or air transport, faced with stringent safety requirements? These questions and many others, discussed at the Berlin Forum, are reported in the present issue of the EUROSAFE Tribune.

Directed at a readership composed of the different parties engaged in the nuclear safety and radiological protection debate – scientists, researchers, engineers, operators, managers, regulatory bodies, NGOs, opinion- and policy-makers – the EUROSAFE Tribune is aimed at supporting the trend towards closer co-operation among European nuclear safety institutions and towards deeper mutual understanding among the aforementioned stakeholders. Nuclear safety is of concern to us all. As a reader you too can make a difference, by commenting on the contents of the EUROSAFE Tribune and suggesting topics you would like to see dealt with.

Printed in English, this periodical is also available in French and German on the EUROSAFE website ([www.eurosafe-forum.org](http://www.eurosafe-forum.org)). As the organising parties, GRS and IRSN wish you pleasant reading. ●

# LECTURES - DEBATES →

## AIMING TO DISSEMINATE THE BEST PRACTICES

Traditionally devoted to plenary presentations and debates, the first day of the Berlin 2004 Forum was opened by Lothar Hahn (Technical and Scientific Director at GRS) and Jacques Repussard (Director General at IRSN). After Heinz Liemersdorf (Head of the Operating Experience Division at GRS) and Jean-Christophe Niel (Director of the Strategy, Development and External Relations Division at IRSN) had expressed their common views on the inputs of experience feedback in the development of a safety philosophy, the audience enjoyed the valuable opportunity to hear from the retired Vice-President for Flight Safety at Airbus, Mr. Yves Benoist, how the aerospace industry strives for learning from operating experience.

**“In nuclear safety,  
an improvement anywhere  
is an improvement  
everywhere”**

■ **Introducing the topic selected for this edition of the Eurosafe Forum – Learning from experience: a cornerstone of nuclear safety – to a crowded floor composed of nuclear professionals from all over the world, Lothar Hahn reminded the audience of three major challenges shared by technical safety organisations: provide necessary expertise to support nuclear authorities, encourage knowledge management to conserve and strengthen competence over the generations, and participate in updating rules and regulations. In this respect, it should be remembered that TSOs are faced with those challenges in the context of an ever enlarging EU and a deregulated electricity market.**

### ➤ **From mere technical safety to safety management**

Adding to this introductory address, Heinz Liemersdorf and Jean-Christophe Niel prompted the reasons why learning from (operating) experience became increasingly essential. They recalled that, when evaluating the history of using nuclear energy, it has to be distinguished between a pre- and a post-TMI and Chernobyl era. Before those two major accidents occurred, nuclear safety was synonymous with technical safety, since the safety philosophy of an NPP was mainly based on the following three aspects: multiple barriers for the retention of fission products with stringent quality requirements, anticipatory analyses of possible events as well as the implementation of effective and reliable engineered safeguard systems for their control, and specific research to gain

insight into phenomena, effects, event sequences, and influences as a basis of the safety-related design. *“However,” they said, “events such as TMI and Chernobyl revealed the significance of operator actions and of the cultural and organisational environment for reactor safety, leading to the present definition of nuclear safety, which relies on technical safety + safety management. In this definition, safety management includes all influences related to human factor, organisational aspects, the interaction of man, technology and organisation (MTO), and measures to optimise the nuclear safety culture.”*

### ➤ **Developing operational safety approaches**

After TMI and Chernobyl, emphasis was put on the development of scientific models aimed to collect, select and process an ever larger scope of data related to the behaviour of equipment and systems, but also to human factor. The use of such tools as the probabilistic safety analysis (PSA) allowed, through the quantitative assessment of the safety level of nuclear facilities, advances in understanding how the interaction of man, technology and organisation impacts operational safety. The practice of daily evaluation using such tools evidenced that in principle safety-relevant events are complex processes which may affect different technical systems as well as the behaviour of the personnel. It also showed for instance that it is inappropriate to discount any findings on operational systems that have no safety significance if comparable

safety-related systems exist which might potentially be affected.

In some cases, the analysis of practical experience brought to light unexpected results: it revealed for instance that it is mostly the licensee who often sets too high standards and then breaks off any further observations, if e. g. materials, components affected or the location of installation do not correspond to the specifications.

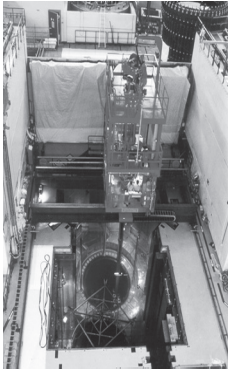
### ➤ **Relying on complementary tools**

Concluding their presentation by an outlook on future prospects, Heinz Liemersdorf and Jean-Christophe Niel indicated that probabilistic safety analyses should be used more systematically, as the most important prerequisite – namely the availability of a plant-specific PSA – has been largely fulfilled for all European plants. They pleaded for the parallel use of deterministic and probabilistic approaches in reactor safety assessment and, in this purpose, for an ever more effective feedback of safety-related operating experience.

### ➤ **Aircraft industry: an example of systematised technical event reporting**

At the very beginning of his presentation, the former Vice-President for Flight Safety at Airbus synthesised the problem posed to aircraft manufacturers in the field of operational safety by pointing out that they have no direct knowledge of encountered difficulties. Therefore, access to experience feedback is essential to modify their products with a view to improving operating efficiency, accommodating changes in technology and flight ➔





### PREREQUISITES FOR LEARNING FROM EXPERIENCE

The use of experience feedback from NPPs requires:

- A suitable method for processing each NPP's own findings, events and their causes for internal use as well as for the transfer of appropriate information to external authorities,
- Information paths (systems) for the exchange of the findings,
- An adequate method for evaluating the findings from other NPPs to clarify their applicability to other plants and to implement improvements.

For an effective use of experience feedback the following prerequisites have to be fulfilled:

- Covering all incidents worldwide is necessary, as relevant events do not occur very often,
- Performance of in-depth accident analyses and not just of remedial actions,
- Willingness to report openly and adequately about all relevant findings,
- Willingness to learn from the experience of others and to make one's own improvements.

→ operation (e.g. by updating aircraft with fault-tolerant technologies) and, ultimately, selling more aircraft on a highly competitive market.

In the air transport sector, experience feedback is systematised: since the early 1970s, carriers operating Airbus aircraft have been required by contract to provide the manufacturer with certain important information. Moreover, aircraft manufacturers and operators are both committed to report to the airworthiness authorities. During the year 2003, the Airbus fleet accumulated about 9 million flight hours and 4 million flight cycles. The manufacturer received 36,180 queries, 885 of which were considered as significant

events and submitted in a "Technical Event Report". Beyond figures, it is interesting to focus on the reporting means. An array of complementary channels was set up, to start with the resident customer support managers, whose task is to listen to customers on a daily basis. Other events are reported during operational and technical visits, during operator conventions or through pilot associations and regulatory authorities. A computerised process is under evaluation with some airlines. In turn, Airbus provides feedback to operators in different ways, depending on the significance of the event: this ranges from information provision through to mandatory main-



tenance actions or inspections. Corrective actions for all significant technical events and repetitive minor events are defined by the manufacturer and the implementation of critical actions is mandated through airworthiness directives issued by airworthiness authorities.

### ➤ Coping with barriers to the trustworthy reporting of operational issues

Present incident feedback, Yves Benoist stresses, is related to *technical issues*, leaving one question open: are the main causes to the most frequent accidents addressed? As aviation grows, it is widely recognised among aircraft operators and manufacturers that it is necessary to improve operational safety records further to maintain the confidence of passengers and the public at large. In this respect, the analysis of incidents statistics evidences that 95% of all mishaps with Airbus aircraft result from failures in human performance due to inadequate or misunderstood procedures, improper training, insufficient situation awareness, difficulty in understanding displayed information, etc. It also shows that, in numerous cases, mishaps could have been prevented if the manufacturer or the management of the airline had been made aware of similar accidents.

When searching for the reasons why similar failures happen repeatedly, it appears that some factors hinder open and sincere event reporting. Crew members for instance may fear losing face or their job or even being exposed to judicial sanctions resulting from criminal liabilities. On its side, the air-



“Experience feedback is a permanently running activity with very significant workloads; it is an endless task, but it is an essential way of improving safety.”

line management is concerned with preserving the corporate image and faced with scarce resources to analyse the events. Among the proven ways to overcome these barriers, Yves Benoist mentioned the implementation of a Flight Safety Confidential Reporting System, the provision, free of charge, of all operators with an Aircrew Incident Reporting System, an annual Flight Safety Conference aimed at sharing experience, a safety magazine introducing the lessons learnt to pilots and operators, in-depth confidential analyses of operational events performed upon operator request, and the development of a flight data analysis program.

*“Experience feedback is a permanently running activity with very significant workloads; it is an endless task, but it is an essential way of improving safety”*

Yves Benoist concluded. ■

■ Chaired by Ashok Thadani, Director for International Research and Development Projects at USNRC, the panel discussion allowed open exchanges between the floor and the stage on the key issues related with experience feedback: e.g. collecting usable data, modelling operational experience, sharing the lessons learnt, etc. Four nuclear experts from Belgium, France, the Netherlands and the United Kingdom shared their experience and views on these topics with the Eurosafe Tribune.



### ➤ Why do the same incidents occur repeatedly?

For André Vandewalle, recurring events evidence that operating feedback is not working properly: “We need therefore to improve our processes. A lot of work is done to collect and analyse events, to get the lessons learnt and to propose corrective actions. But it seems that we do not enough “close the loop”, i.e. look at the effectiveness of our corrective actions. Sometimes, we don’t even know if these actions have been implemented correctly” he regrets. Having listened to Yves Benoist’s presentation on the organising of experience feedback in the air transport business, Piet Müskens declares he was struck by the double reporting system in use in that industry (one synthesis for the safety-relevant incidents, and one for all the recurrent incidents). “This has to do with the intention of banning out all repetitive, recurrent incidents. I think that if we develop, in the nuclear industry, a system which achieves the same goal, we are very well on the way to continuous improvement” he claims. According to André Vandewalle, there are several reasons for the difficulties linked with the transmission of the information collected in operation e.g. to regulators. One of them probably is the opening of the electricity market: “Due to what we call “deregulation” in Europe, the electricity producers are now

in competition. If you share some kind of experience, it can give other operators some added value, because it will prevent problems or incidents in their own facilities.” Mr. Vandewalle underlines, mentioning the lack of resources as another reason: “To some extent, people are trying to do their job, and the writing of reports is not their first priority. So, there are fewer reports than before, although this remains the way to share experience.” Ashok Thadani concludes the debates on this particular issue by pointing out that recurrent events can be diminished only with a strong commitment from the operating management to follow through the improvement process.

### ➤ Collecting and analysing data: the necessity of an enquiring mind

A view expressed by one attendant among the floor launches the debate. According to the speaker, models were created not in order to measure things, but to explain things, to represent things. “Scientists have always been living with models, but models are tricks, they are ways of thinking, and there are often inhibitions to think outside the models. This is why different approaches have to be used in order to cope with the fact that models are trick-orientated ways of thinking. The problem is then to have people who have time to take distance from problems. In the context



E U R O S A F E  
BERLIN 2004





*Towards Convergence of  
Technical Nuclear Safety Practices in Europe*



**Participants in the panel discussion (see Photo from left to right)**

- *Gérard Gary* (France): Director of Research at the Laboratory of Solid Mechanics at Ecole Polytechnique. Member of GSIEN (Group of Scientists for Information on Nuclear Energy).
- *Piet Müskens* (Netherlands): Director of the Nuclear Safety Department at the Netherlands Inspectorate of Housing, Special Planning & Environment (KFD). Consultant for the ecological inspectorate of Ukraine.
- *Ashok Thadani* (United States): Director International for Research and Development Projects, USNRC.
- *André Vandewalle* (Belgium): Head of Nuclear Installations Inspections at the Belgian AVN (Association Vinçotte Nuclear). Chairman of the Working Group on Operating Experience at the NEA Committee on the Safety of Nuclear Installations (CSNI).
- *Richard Jones* (United Kingdom): Regulatory Inspector at British Nuclear Group. Involved in such developments as INES or IRS.

*of deregulation which puts increasing economic pressure, this is very difficult!" he claims. "Models are helpful as long as you realise that they have a limited value. The question is: can we afford the luxury not to use models?" asks Piet Müskens. Commenting on this, Richard Jones explains that the organisation he belongs to is searching for new techniques to try to avoid any prejudgment of an event when collecting information: "Just by selecting categories*

*to put events into, one has already prejudged the events to a certain extent. One of the techniques we are presently looking at is free-text data mining. But no single technique in itself is the answer and we need to look at a range of different techniques to improve the data analysis" he highlights. For Ashok Thadani, who chairs the debates, it matters to show an enquiring mind: "If you don't have it, you just accept results that are presented to you through* →



Yves Benoist

Former Vice-President Flight Safety, Airbus

### Never discourage honest reporting!

"I think an efficient prevention plan is mainly based on statistics. In the air transport business, statistics show that accidents or incidents are mostly caused by operational issues, not by product defects. For this reason, the only way to achieve progress is to get those who were faced with trouble to report their problems and their understanding of the situation. Unfortunately, in some countries, simply recognising an error that might have been conducive to endangering other people's life is enough to take one to the court of justice! Thus, whereas professionals strive for obtaining the relevant information aimed at preventing possible accidents, the judicial system tends to put this process in jeopardy, as it deters concerned people from behaving in an open and honest manner! So, in a nutshell if I may, I wonder who is ultimately endangering other people's life: is it the aircraft's pilot... or the judge? For my part, I strongly support blame-free reporting if it is compensated for by a commitment to increased vigilance in the future. In this case, it is the best way to fight against complacency."

some black box. The point is to try to understand why you get the results you are getting". This view seems largely shared by Mr. Jones who declares that the concepts developed at the reactor design stage should be applied throughout operation, i.e. the principles of diversity and redundancy, separation of control and protection, separated responsibilities and also different methods: "We should not rely entirely on a single system; we should have different routes to check that we have come to the right conclusion" Mr. Jones claims. "Another way to try to get out of the tracks you're following is to use various methods – deterministic approaches, PSA approaches, etc. – to the same problem" André Vandewalle adds, strongly backed by Ashok Thadani who concludes: "I'm afraid we hide from uncertainties by using models, and this is why I favour probabilistic approaches, because that forces one to lay down the basis for what one is saying." To Richard Jones, open-mindedness is essential very early in the process when considering relevant data. At this stage, it is vital to ask oneself "What kind of event did I discount? What did I say cannot happen, what is out of consideration? Look at those events too!"

### > Struggling against complacency

If analyses are performed abundantly and modifications carried out accordingly, why do the same events occur again and again? "Am I doing a useful job? Isn't there some kind of complacency?" one could ask oneself. In charge of nuclear installations inspections in Belgium, André Vandewalle explains how his organisation strives re-

lentlessly for diminishing recurring events: "We do have some, not that many, and we analyse those events, the corrective actions that were taken, the procedures that proved insufficient to prevent the recurrence of this kind of event. So we keep questioning why those things happen again and again and how we should improve the system." Endorsing this view, Piet Müskens reminds the audience that, regardless of the industry concerned, experience feedback is a never-ending task: "In this respect, I would like to stress that one of the basic principles of nuclear industry is continuous improvement" he concludes.

### > Looking for open-mindedness and a blame-free culture

To Piet Müskens, trying to keep away from the reflex of self-righteousness requires certain conditions: "Regardless of the industrial sector – nuclear or chemical or other –, I think that, when failures are reported, the first reaction of the management should not be punishment but appreciation, because the more you get people talk about incidents and events, the better the safety culture." This view is echoed by André Vandewalle who stresses that a lot of work still has to be performed to collect information about human failures and, more generally, about human-factor related activities. Reminding the audience of Mr. Benoist's address pertaining to the fear of airline pilots or managers to be blamed for recognising errors, Mr. Vandewalle declares: "This, again, illustrates similarities between the aircraft business and our own activity. I think different countries have

different cultures, and in some countries, I hear people talk about a “blame-free” culture, trying to get the information from the operator, even if the operator has done something wrong. This is fundamental, since you cannot analyse and take corrective actions based on information that you have not collected!”

### ➤ Enhancing public awareness of safety through experience feedback

Gérard Gary emphasises the difficulty of getting the concept of safety across to the general public: “Safety is a very relative notion, he stresses, and we do not feel it the same way when we ride our car or take a plane”. Stating that many people apply rules very confidently, just as if they were based on solid, comprehensive scientific knowledge, he points out the necessity of helping the public think beyond the rules thanks to a permanent communications effort aimed at showing the limitations of present knowledge and the subsequent precautions when applying rules. “The information that the public can receive is often not clear at all, improving the communications is therefore an important issue” he concludes. A view strongly supported by André Vandewalle: “I was impressed by what I heard about aircraft industry, since we have very similar problems in the nuclear industry. We have the same confidentiality issue. It is thus difficult to tell everything to the public, to give detailed information about events. Nevertheless, it is fundamental to get the important information to the public, just as it is important to get the information from the operators, from the manufacturers. And we see how difficult it is sometimes to get



good communications between operators and manufacturers or even among operators themselves.” Going further, Piet Müskens declares that he does not consider communication as a problem, but as a duty: “I think nuclear industry still has to do a lot to make itself acceptable to the public. As long as there is a kind of fear for the public, the public will never accept nuclear industry.” Commenting on this, Gérard Gary points out that the public at large fears economic efficiency to be detrimental to safety: “They fear deregulation will lead to less safety to make more money. I think it would make sense to explain clearly that there is no antinomy between both objectives” he stresses. But in this respect, he adds that “one difficult point about public information is that the ‘media’ between the professionals and the public, – i.e. the press – is not always interested in giving ‘good’ but rather ‘sensational’ information”. ■

# Nuclear Installation Safety Assessment: Sharing experience through international working groups

■ Ten contributions pertaining to the safety assessment of nuclear facilities were presented at this Berlin 2004 Forum. Some deal with methodological principles aimed at getting more from the lessons learnt in operation; others relate to technical advances in very specific domains; many of them, however, highlight the ever closer collaborative work among TSOs from several European countries. Let us have an insight with the EUROSAFE Tribune.

## ➤ Climate change and NPP operation

What might happen if air and water temperatures were to exceed the limit values taken as a reference for designing the cooling system of NPPs? The concern about global warming is making this question more and more relevant. In fact, air and water temperature thresholds were reached in large parts of Europe during the summer of 2003. The investigations carried out in French and German NPPs show that there are still safety margins for removing the reactors' residual thermal energy. They also evidence the need for more assessment and analysis work in order to differentiate between the facts which may have little influence on the reactors' behaviour and those that may have a strong impact.

## ➤ Operating experience and safety management system

The central issue of the second presentation is the use of the operating experience gained in German NPPs for building up the operator's safety management system. As a pathfinder in this domain, Germany set up a very co-operative process involving operators, safety assessment bodies as well as the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). In this respect, the focus is on the attention attracted by the developments in Baden-Württemberg.

## ➤ Technical improvements and effectiveness assessment

Being an RBMK-type reactor, Kursk 1 underwent thorough safety assess-

ments over several years after the Chernobyl accident. Based on the considerable assessment work performed by an international working group, major technical measures were taken to raise the reactor's safety level. Experts from six countries built up a team to review the in-depth safety analysis report prepared by the working group. Their conclusions provide interesting lessons on the approach followed by the working group to assess the effectiveness of the technical improvements carried out on the reactor, as well as on the structure and contents of the report.

### ➤ Should regulatory organisations perform experience feedback activities?

Operating experience feedback based on events is usually considered as important in the improvement process of the licensee organisations. Is it useful that regulatory organisations perform

similar kinds of activities? Is the duplication of activities performed elsewhere a waste of time and resources? Drawing upon its own experience, Association Vinçotte Nuclear, the Belgian regulatory organisation, explains how experience feedback activities completed by regulators are beneficial to the improvement of the overall safety of NPPs and how they are conducive to enhancing the effectiveness of the regulatory organisations.



### ➤ Shared expertise and plant safety alignment

As part of the Tacis initiative aimed at aligning nuclear plant safety throughout the European continent, Riskaudit, a joint-venture set up by the French and German TSOs, supports the State Nuclear Regulatory Committee of Ukraine (SNRCU) in the licensing of two new units in the country (Rovno 4 and Khmelnytsky 2). In this respect, a review of 19 measures →



**Wolfgang Renneberg**

*Federal Ministry for the Environment, Nature Conservation and Nuclear Safety  
(Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU)*

### Plea for a self-learning system

The repeated occurrence of difficulty with the handling of fuel elements in different NPPs within a period of one or two years made experience feedback from the nuclear industry a real issue in Germany, as prompt experience feedback would have helped prevent the repeat of the problem. The trouble that occurred at Philippsburg became

the starting point of a self-learning process, since the Federal Ministry for the Environment (BMU) ordered as a condition for restarting the plant that the operator build up a safety management system. It can now be considered a success in the development of nuclear safety in Germany that one incident in 2002 triggered a reaction from the authorities which lead to the set-up of a safety management system in all

German NPPs. We are presently in the process of making the structure of experience feedback between the operators, the Länder and the federal government a more responsive one. We are also trying to improve communication and gain more experience with a view to developing a self-learning system conducive to a new supervisory strategy on the part of the regulator.





→ performed prior to the completion of facilities by the operator NAEK in the framework of its Modernisation Programme 2000 is presently assessed by Riskaudit to help SNRCU decide whether or not start-up is to be authorised.

## ➤ **Compared probabilistic analyses on accident precursors**

From 2000 up to 2003, a comparison exercise focused on accident precursor programmes was performed by IRSN, GRS, and NUPEC (Japan). This was aimed at meeting three objectives: to compare in detail the different methodologies used to quantify incidents which can be considered as accident precursors, to understand the methodological approach and the

practice of precursor analysis of the other participants, and to define what could be learnt for future precursor analyses. Generally, the participants identified similar scenarios of potential degradation. However, for several dominant sequences, differences in the results can be attributed to variations in plant design, the strategy of management, and in the methodological approach. ■



# Nuclear Installation Safety Research: Cross-industry subjects to enhance research attractiveness

■ At a time where research budgets are declining, efficiency is to be enhanced through knowledge-sharing and cross-fertilisation among all stakeholders, including the industry, universities, etc. Another manner of improving safety in the nuclear sector is to draw upon results achieved by other industries. Thus, traditional research fields such as thermo-dynamics brought innovation through tools adaptable for nuclear safety. Cross-sector research feedback is also a way to create more attractiveness for engineers who do not want to devote their professional career exclusively to nuclear safety. The trend towards networked research and a wider scope of issues involving soft sciences was clearly reflected by the lectures held at this Berlin 2004 Forum.

## ➤ Experimental research feedback to validate computer codes

Research pertaining to severe accidents in nuclear power reactors is one field where Europe-wide work sharing and result dissemination are particularly advanced. This began with a joint initiative by the German and French technical safety authorities, GRS and IRSN, aimed at modelling the complete scenario of a hypothetical severe accident in a light water reactor, from the initial event through to the possible radiological release of fission products from the containment. Called *ASTEC* – for Accident Source Term Evaluation Code – this system of calculation codes was assessed by several

European TSOs within the framework of the *Vasa* (Validation Strategies for Severe Accident Codes) and *Evita* (European Validation of the Integral code Astec) projects supported by the European Commission. The application scope of the *ASTEC* source-term evaluation code is now aimed at being progressively adapted to modelling accident sequences in reactor types other than pressurised water reactors (e.g. VVER, BWR, Candu and RBMK). The creation of the *Sarnet* European network of excellence in April 2004 is a step further towards a sustainable integration of the European research capabilities on severe accidents. It allows the coordination of research prio- ➔

→ rities and the achievement of an optimised use of the resources dedicated to this major safety issue. Moreover, Sarnet will contribute through synergies with educational institutions to keeping this research field attractive for students and young researchers, preserving thereby the European scientific leadership in the domain of severe accidents in nuclear power reactors.

In a similar approach, a network was set up in Germany to address the needs for developing models adapted to the accurate simulation of the flow, heat and mass transfer phenomena in nuclear reactors. The CFD Network developed *CFD* (Computational Fluid Dynamics), a software capable of modelling three-dimensional effects in the containment and primary system of a light water reactor, which cannot be

satisfactorily predicted by one-dimensional system codes.

## ➤ Human factor, a fully-fledged discipline of nuclear safety research

Operational safety involving soft sciences is a fairly new and rapidly growing field in nuclear installation safety research. Besides purely technical subjects, such as the numerical simulation of fission product release under accidental conditions with the *MFPR* code or the structural-mechanics simulation of the *Sandia* large-scale experiment with a prestressed-concrete containment model, contributions devoted to safety issues involving human factors, such as a method for evaluating possible operator errors in diagnosing and decision-making in emergency situations, were presented by Dr. Werner Fassmann (GRS). This method, which



**Piet J.W. Müskens**

*Director, Nuclear Safety  
Department Inspectorate  
of the Ministry of Housing,  
Spatial Planning and  
the Environment in the  
Netherlands*

### Experience feedback: communication is a must

Continuous improvement of safety is although essential for nuclear industry not conceivable without efficient communication. Whenever wherever in the world an event in a nuclear facility occurs, the entire nuclear community throughout the world must know about it. Sending information from *anywhere* to *everywhere* is a basic requirement of experience feedback. In this respect, the EUROSAFE Forum plays a key role in the system of communication.

Continuous improvement relies upon openness and transparency. Those are necessary conditions to enable safety assessment agencies and regulatory bodies to attest to the public that operators are learning relentlessly by experience to reach an ever-higher level of safety. Nuclear community should also seek for improvements from advanced event reporting systems in other branches like for instance the systematic trouble reporting systems of the aerospace industry. As obvious as it may seem, there is no continuous improvement

without effective implementation of the recommendations issued by expert working groups. It is a never-ending task for regulators not to get indulgent with previous achievements and for operators not to get complacent.



is aimed at identifying, analysing and probabilistically evaluating possible operator actions which are not required by procedures and can degrade plant safety in emergency situations, was used for re-analysing the 1979 Three-Mile-Island accident. The results contribute to a better understanding of the causes and conditions of the inopportune action performed by the plant's operator team.

### ➤ A major issue: promoting and maintaining nuclear safety research

The decreasing research funding by Governments as well as the narrowing focus of utility-sponsored programmes call for closer international co-operation aimed at maintaining critical competence on nuclear safety. In this context, the Nuclear Energy Agency (NEA) of the OECD plays an impor-

tant part in promoting collaborative research programmes. One of the unique features of the NEA is that it organises safety research activities and, through its safety committees, addresses safety challenges and looks for common approaches to regulatory practices and criteria. The Agency provides in this way a significant contribution to the dissemination of the lessons learnt. ■

## Environmental and radiation protection: New approaches, new tools, new experiments

■ From occupational exposure during operation through to the radiological issues linked with the decommissioning and dismantling of nuclear facilities or with the transport of radioactive material, the contributions presented at the Berlin 2004 Forum provided valuable feedback pertaining to the major aspects of environmental and radiation protection, including the assessment and management of the radiological risk and the prevention of terrorist attacks using radioactive materials.

### ➤ Tools and surveys to monitor occupational exposure

With a view to providing the parties in charge of the radiation protection of workers employed by operators, of epidemiological studies as well as the TSO itself with one large database centralising all dosimetric data, IRSN set up an ionising radiation exposure monitoring information system called *Siseri*. In operation since the beginning of 2005, this database offers users different functions: secured archiving and retrieval of information about dosimetry monitoring of workers; control and optimisation of occupational exposure; secured access by radiation protection professionals and doctors to the individual dosimetry monitoring of each worker, and visualisation of dosimetry histories. It also provides a suitable database to support statistical or epidemiological surveys. *Siseri* col-

lects about 30,000 records/day concerning approximately 250,000 persons, including 80,000 workers in the nuclear sector.

What also became obvious at this Berlin 2004 Forum was a trend of decreasing collective occupational exposure in almost all German NPPs due to different factors such as:

- the stabilisation of the workload after long periods of backfitting and modifications performed in accordance with the findings of risk studies and PSAs;
- the improved plant design drawing upon experience feedback by avoiding sources of long-lived activation products and by providing improved working conditions and radiological conditions;
- good practices of radiation protection and working techniques have been implemented into the work

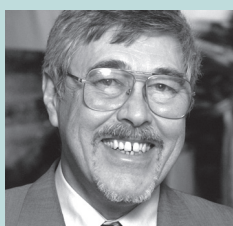
planning and implementation during outages to reduce the exposure of the personnel.

Moreover, the implementation of a career dose limit, in compliance with the German regulatory framework, and the discussion and publication of a reduced annual dose limit contributed to a reduction of personnel doses.

### ➤ Experience feedback in nuclear facility decommissioning and dismantling

As a specialist in consultancy, inspections, tests as well as certification and training, the German TÜV SÜD Group monitors LWR dismantling operations. Its experience feedback, presented during the seminar, shows that remote-controlled techniques and various decontamination procedures provide a double benefit: to reduce per-

sonnel exposure during dismantling and to allow reactor dismantling without long periods of safe containment, thus reducing the corresponding costs. The German experience gained in the decommissioning of the Greifswald and Rheinsberg NPPs was shared with the operator of the Lithuanian Ignalina NPP within the framework of a project financed by the German Federal Government. The experience transfer pertains to project management, project planning, licensing procedure and waste management as well as social aspects of the further development of the industrial site. The output of the project including the lectures could be used for the preparation of potential experts responsible for the decommissioning of other NPPs in East European countries in the future. ➔



**André Vandewalle**

*Division Head - Nuclear  
Installations Inspections -  
Association Vinçotte Nuclear*

#### Trustworthy information, the base of real experience feedback

The equipment of nuclear plants has reached a certain level of maturity and malfunctions are now increasingly linked with the human factor. Thus, dealing with the behaviour of man in facilities is a sound way to reduce the occurrence of incidents. To me, any experience feedback, especially the one related to human performance, is based only on honest, trustworthy information collected from operators, and such sincere reporting

is only possible in "blame-free" organisations. Far from any kind of irresponsibility or impunity, the possibility to recognise a mistake, to question oneself about real problems is a valuable source of progress. But this means a change in the attitude of personnel from the utility organisation from top to bottom as well as for inspectors. When we, at AVN, developed our own methodology for analysing behaviour-triggered incidents, we opted for a smooth, stepwise

implementation so as to avoid as much as possible interfering with the operator's efforts and aiming at creating a confident relationship between operators and our inspectors. Since we are engineers, we called upon the support of a specialist in human performances to deal with some aspects of human behaviour linked with operating instructions, evolution of organisations or individual conducts. We know that such processes take time but also that considerable advances are within our reach.





#### ➤ Exposure linked with the transport of radioactive material

With a total volume of approximately 750,000 radioactive material package shipments per year, Germany is – together with France and Belgium – one of the largest shipper countries of radioactive materials in the enlarged European Union. A comprehensive survey performed by GRS on the transport-related doses in Germany confirms that the exposure of transport workers and the public is well below the applicable regulatory dose limits. This general observation is - according to an EU-wide assessment study performed on behalf of the European Commission - broadly consistent with the operational experience in other Central European EU Member States. *“Nevertheless, there is no room for complacency in optimisation of protection and safety of people, property and the environment and possible develop-*

*ments, both in operational procedures and equipment being used for transport and handling should be considered. Sometimes, improvements in safety and protection can be achieved at very little costs and thus transport operators should establish regular reviews of their methods of work and equipment.”* G. Schwarz and F. Lange, the authors of the contribution, comment.

#### ➤ Radiological risk assessment and management

Improving the assessment and the management of radiological risk is a major issue in environment and radiation protection. Therefore, IRSN set up two projects, aimed at gaining better understanding of the dissemination of radioactive pollutants into the biosphere and of the response of the ecosystem to this pollution, respectively. Launched by IRSN in 2002 and sponsored by Electricité de France, the *Symbiose* project consists in designing and developing a modelling platform for assessing the fate and transport of radionuclides in environmental systems, and their impact on human health, fauna and flora. The results prove beneficial for different purposes, ranging from impact studies on nuclear accidents or performance assessments of waste disposal facilities to generic biosphere modelling studies. The objective of the second project, launched in 2004, is to represent and to compare the response of various ecosystems to a radioactive pollution through one single standardised tool. As the sensitivity of agricultural lands ensues from the pollution of the food chain via the contamination of soil,



crops and livestock, the *SENSIB* project is aimed at developing both a methodology to calculate sensitivity indexes and a radioecological sensitivity scale usable when assessing and managing risks for humans and for the environment.

As the country outside the former Soviet Union that received most radioactive fallout from the Chernobyl accident, Norway is challenged with the long-term management of its contaminated rural areas. From the measurement of activity concentration levels through to the countermeasures used, the compliance with regulations, and the financial consequences of this radioactive pollution, the Norwegian Radiation Protection Authority shared with the participants in the Berlin 2004 Forum the significant experience gained in the assessment and management of the corresponding aspects.

### ➤ Experiments aimed at coping with terrorist attacks

Today, malevolent dispersion of radioactive material is part of the risk to be taken into consideration by the authorities in charge of environment and radiation protection. With a view to comparing experimental results of the atmospheric dispersion of airborne particles with calculation codes, blast experiments were performed in Germany in the summer 2003 with the participation of several German organisations and institutions. The observed initial cloud volumes were more than an order of magnitude smaller than those calculated with other widely-used formulas, such as *Hotspot*. As a smaller volume of the initial cloud leads to higher near-ground concentration maxima, the results obtained support an appropriate adjustment of currently employed calculation methods. ■



**Jean-Pierre Roux**

Senior Executive Advisor for  
Operational Nuclear Safety -  
Electricité de France (EDF)

### Higher safety performance means higher operational performance

We are sometimes faced with the reappearance of events we thought we would never have to cope with again. After years during which technical and technological contributions made it possible to reach high levels of performance, areas of improvement are to be found chiefly in the field of safety management and human factors. At EDF, we therefore strive for developing an ever stronger safety

management as part of an enhanced corporate safety culture. This is a long-term process, since it requires in-depth work on organisation management in order to set up a durable system. In a market deregulation context, we regard this as mandatory for operating NPPs in a sustainable manner. Hence, experience feedback will result in higher safety performance, which means higher operational performance, as both rely upon the same resources: man and organisation.

Beyond improving the overall performance of the fleet currently in operation, the eventual introduction of the European Pressurised Water Reactor provides new opportunities for working about such issues as better performing organisations, leadership and staff involvement, adequate handling of drifts as well as the suitable evolution of safety management in the future.

# Waste management: A wider coordination of research programmes under EC leadership

■ The contributions presented at this seminar devoted to radioactive waste management showed how important the support of the European Commission became to programmes and initiatives aimed at integrating the knowledge gained in the different Member States and at providing, through future research programmes, a sound basis for decision-makers concerning the construction, licensing and implementation of repositories. The lectures also evidenced the need for dedicated forums to be set up by TSOs with a view to allowing scientific exchange about research results.

### ➤ HLW final repositories: EC support to the development of concepts

CROP (for Cluster Repository Project) is a European thematic network project involving nine end-user organisations from Europe and North America. This project, which is aimed at evaluating and developing concepts of final repositories for high-level radioactive waste (HLW), is a good example of experience feedback integration to the benefit of the parties involved. After having supported several underground research and development projects dealing with the disposal of radioactive waste in crystalline rock, salt and clay formations, the European Commission launched the CROP initiative with a view to synthesising construction experience and results from testing of engineered barrier systems (EBS) in underground laboratories.

The purpose is to integrate technical and economical improvements into the design and construction of the future European repositories for highly radioactive waste.

### ➤ R&D on HLW storage: EC support to the prioritisation of future joint projects

NET.EXCEL is another European Commission-funded initiative, performed as part of the 5<sup>th</sup> Euratom framework programme. Its aim is to network the R&D carried out by European end users and to add value to the achievements of each of the eight participants. The project's approach is to establish a list of priority "Research, Technical development and Demonstration" (RTD) issues that could benefit from European co-operation and to determine procedures that may en-



hance the future systematic co-operation for the disposal of highly radioactive waste in the three classical rock media: salt, clay and crystalline rock.

### ➤ Waste management strategies: EC support to the comparison of alternative strategies for long-lived waste

Performed within the 5<sup>th</sup> framework programme of the European Commission for the evaluation and comparison of the alternative long-term strategies for the management of long-lived radioactive waste, the COMPAS (for Comparison of Alternative Waste Management Strategies for Long-Lived Radioactive Wastes) project established a thematic network involving the EU Member States. Their first common objective is to share information on the major issues associated with a number of alternative waste management strategies so that the key issues in a range of countries can be readily assimilated by policy makers and the public at large. The second intent is to evaluate and compare alternative strategies for the management of long-lived radioactive waste, taking into account regional differences. The third purpose is to provide a forum for discussing issues and exchanging information, thus enabling the participants to reach a common understanding of the rationale for existing and proposed waste management strategies.

### ➤ Experience feedback on the safety of HLW's geological disposal

Besides the projects supported by the EC, the seminar devoted to the management of radioactive waste enabled

participants to share the latest developments concerning the research work performed on geological disposal. The contribution on the probabilistic approach of the long-term durability of concrete structures thus revealed that the application of the PSA method – mostly used until then for the safety assessment of reactors – paves the way to new investigations in the field of waste disposal through the acquisition of numerous experimental data. Concerning the thermal effects of radioactive waste on the geological barrier, the study performed by the French Ecole Nationale des Ponts et Chaussées on Boom clay provides interesting feedback on the opportunity to keep high-level waste in interim storage for a period of time sufficient to allow for a substantial temperature decrease prior to getting it shipped in containers for final disposal. The need for additional research projects on this issue is also pointed out. ■



# Nuclear material and nuclear facilities security:

## How well are we prepared?

■ From facility operators and shipment companies to regulatory bodies, all the parties involved in the nuclear sector share a common matter of concern: struggling against the proliferation of fissile material and against malevolent acts. What are the advances in terms of physical protection of the nuclear facilities? Is there a European approach of requirements in this field? How can nuclear plants be protected against sabotage and how can the transport of packages be secured? How well are nuclear professionals prepared to face emergency situations?

The EUROSAFE Tribune proposes below a double focus on the progress reported by expert parties from both the Western and Central parts of Europe.

### ➤ Studies for a better protection of nuclear facilities against sabotage

Usually, malevolent acts such as sabotage are not directly considered in the safety demonstration of a nuclear facility. Yet, failures specifically caused by such acts can lead to incidents or accidents with radiological consequences. For this reason, specific studies aimed at assessing the needs for protection of nuclear facilities against sabotage have to be performed. These studies are based on a two-step analysis.

First, each zone of the facility is ranked according to a *sensitivity* analysis taking into account the radioactive material inventory, possible accident situations as well as an estimate of the con-

sequences of these accidents. Three types of zones are thus differentiated depending on the gravity of the consequences of a malevolent act: risk zones, where an action can lead to radiological consequences only if two risk zones are affected at the same time; critical zones, where an action can lead to radiological consequences



deemed acceptable from a safety point of view; and vital zones where an action can lead to more serious radiological consequences than those considered in the safety demonstration of a nuclear facility.

In a second step, a *vulnerability* analysis to each type of aggression is performed for each zone in order to assess the real possibility of carrying out a malevolent act in the concerned zone. This analysis consists of two parts: the estimate of the resources required to sufficiently damage a system or a function and, on the other hand, the qualification of the paths leading to zones or systems considered as sensitive.

To support the vulnerability assessments of nuclear facilities, a "Structure Resistance Capability in a Malevolent Situation" program is necessary for the prediction of the damage caused to structures or systems. This program may include both experimental and analytical tools.



Jean-Jacques Van Binnebeek

Director General  
Association Vinçotte Nuclear

#### Beware of models!

A model is a structure of thinking, a framework which makes people feel comfortable with and often leads them to forget about the model's limits. By definition, a model is never totally accurate and, in this sense, I consider it a trick-orientated way of thinking. Many experts devote much energy to complying with predefined rules and models, creating some kind of "professional automatisms", which prove dangerous in real-world life since fundamental questions such as "what is this model worth? How far is it relevant?" are disregarded. Subsequently, the recommended solutions do not forcibly prove to be the most relevant ones. I think one has to keep relying upon one's own judgment, one's own critical reasoning to make and implement decisions rather than hiding behind established models. Thus, there should not be any doubt about the necessity to keep vigilant, open-minded, self-questioning and to refuse routine and self-righteousness. To me, keeping that collective critical reasoning is a major human resource issue for enhanced nuclear safety.

#### > Enhancing staff preparedness to emergency situations

Strengthening the protection of nuclear facilities against malevolent acts is one major facet of security, the other being the capability of plant personnel to face emergency situations. Let us share the experience gained through onsite exercises at German nuclear facilities.

In Germany, obligation is made to NPP operators to carry out once a year exercises combining emergency situations initiated by attackers from outside the plant with additional physical protection scenarios. In compliance with different guidelines, the exercises are performed based on predetermined malevolent scenarios and their implementation involves, besides nuclear plants' personnel, the police as well as external observers. Different steps are followed: the attack is identified and the police alerted; the first measures are taken by the security personnel; internal communications ensure accident awareness; cooperation is engaged with the police and the crisis management group.

The lessons learnt from previous combined exercises show that great demands are placed on the participants, since many aspects of the exercises are beyond plant's design. They also evidenced the limits induced by the compliance with law when such aspects as acting in self-defence or in assistance of an emergency are concerned. ■



# EVENTS & WEBSITES

## UPCOMING EVENTS

➤ *7-11 November 2005, Vienna, Austria*

**Compile experience feedback on the present revised safety guides and issue outlines for a next generation - Requirements and Safety Assessments**

IAEA Meetings, Conferences and Symposia - Meetings on Nuclear Installation, Radiation, Transport, and Waste Safety

➤ *13-17 November 2005, Washington D.C, USA*

**Talk About Nuclear Differently: A Good Story Untold**

ANS Winter Meeting and Nuclear Technology Expo, organised by the American Nuclear Society

➤ *22-25 November 2005, Espoo, Finland*

**Technical Meeting on Implementing and Licensing Digital Instrumentation and Control (I&C) Systems and Equipment in Nuclear Power Plants**

organised by the International Atomic Energy Agency (IAEA)

➤ *23-25 November 2005, Brussels, Belgium*

**ETRAP 2005 - 3<sup>rd</sup> International Conference on Education and Training in Radiological Protection**

➤ *30 November-2 December 2005, Vienna, Austria*

**International Conference on Operational Safety Performance in Nuclear Installations**

Organised by the International Atomic Energy Agency (IAEA)

➤ *11-14 December 2005, Versailles (near Paris), France*  
**ENC 2005**

Organised by SFEN (French Nuclear Energy Society)  
Sponsored by ENS (European Nuclear Society) and ANS (American Nuclear Society)

➤ *12-16 February 2006, Vienna, Austria*

**Defining tomorrow's vision of nuclear energy**

PIME 2006 (conference on Public Information Materials Exchange)

➤ *17-23 April 2006, Minsk, Belarus*

**International Conference on the Occasion of the 20th Anniversary of the Accident at the Chernobyl Nuclear Power Plant**

➤ *14-19 May 2006, New Orleans, USA*

**International Conference on Probabilistic Safety Assessment and Management (PSAM8):**  
**<http://www.psam8.org>**

Organised by the International Association of Probabilistic Safety Assessment and Management (IAPSAM)

➤ *11-15 December 2006, Athens, Greece*

**International Conference on Lessons Learned from Decommissioning of Nuclear Facilities and the Safe Termination of Nuclear Activities**

Organised by the International Atomic Energy Agency (IAEA)

## EXPERIENCE FEEDBACK ON THE WEB

➤ *Nuclear power plant operational experience feedback:*  
**<http://www.stuk.fi/saannosto/YVL1-11e.html>**

➤ *Managing Changes Effectively: Proactive Safety Management Strategies Related with the Operating Experience Process*

by Humberto Werdine (September 2004):  
**<http://www-ns.iaea.org/downloads/ni/meetings/top-iss-2004-oct/proactive-safety.pdf>**

➤ *Nuclear Installation Safety*  
website of the IAEA:

**<http://www-ns.iaea.org/home/nis.htm>**



The next EUROSAFE Forum  
will be held in Brussels  
on 7 and 8 November 2005

The eighth issue of  
the EUROSAFE Tribune will be  
devoted to:  
Nuclear Waste Disposal -  
Safety and Acceptance

**EUROSAFE Tribune** is a periodical from the EUROSAFE Forum. **Editorial Committee:** Jean-Bernard Chérié, IRSN – Benoît De Boeck, AVN – Ulrich Erven, GRS – Mikko Kara, VTT – Peter Storey, HSE – Christer Viktorsson, SKI – José I. Villadóniga Tallón, CSN. **Coordination:** Horst May, GRS – Emmanuelle Mur, IRSN. **Credits:** Georg J. Lopata, Berlin – Thomas Gogny, IRSN. **Writer:** Jean-Christophe Hédouin. **Production:** Regina Knoll, GRS.

**ISSN:** 1634-7676. **Legal deposit:** September 2005.

The EUROSAFE Tribune will be available on the **Website:** [www.eurosafe-forum.org](http://www.eurosafe-forum.org)

**INSTITUT DE RADIOPROTECTION  
ET DE SÛRETÉ NUCLÉAIRE (IRSN)  
B.P.17**

**F-92262 FONTENAY-AUX-ROSES  
CEDEX**

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

**FOR FURTHER INFORMATION:  
[www.eurosafe-forum.org](http://www.eurosafe-forum.org)**

**E U R O S A F E**



*Towards Convergence of  
Technical Nuclear Safety Practices in Europe*