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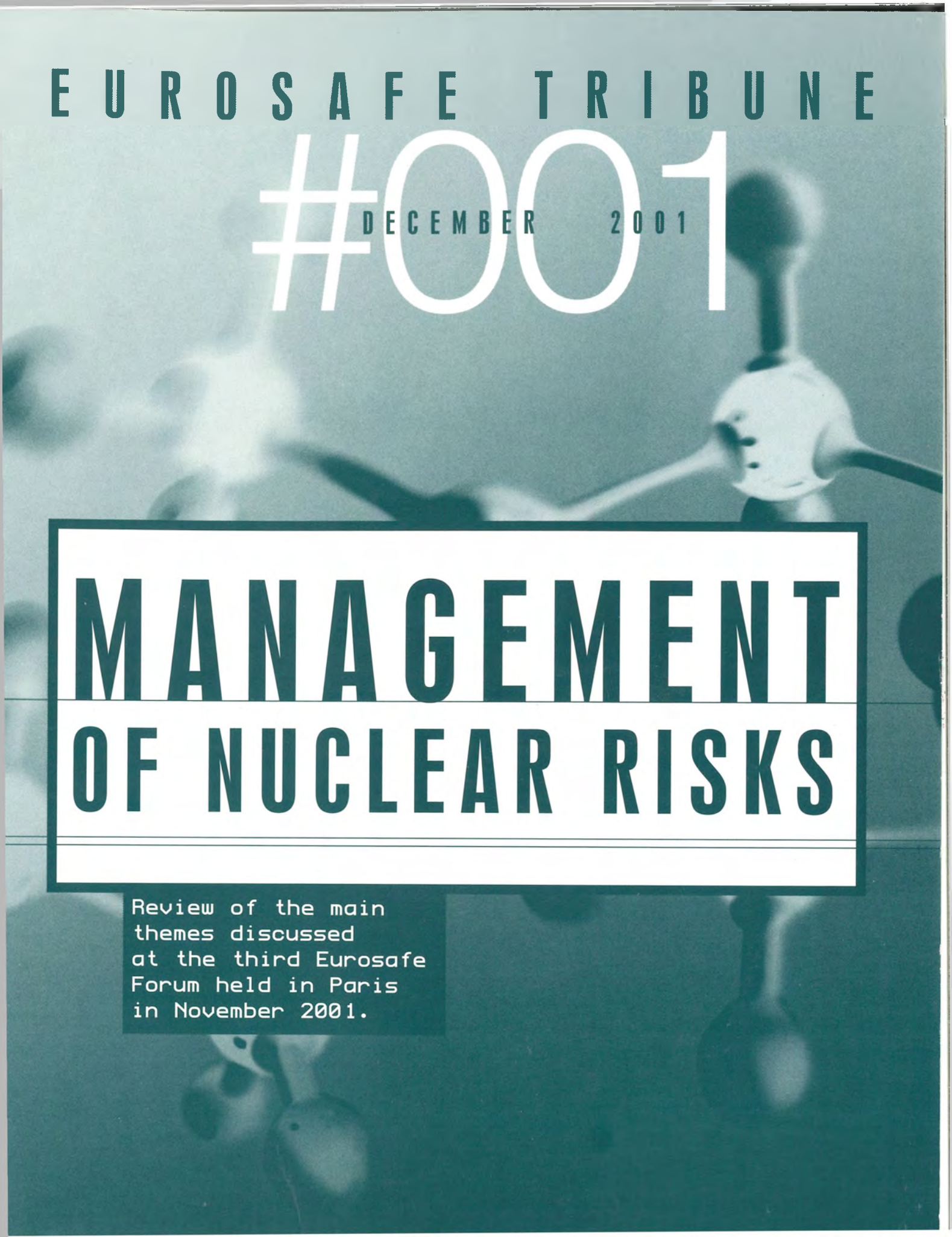

MANAGEMENT OF NUCLEAR RISKS

Review of the main themes discussed at the third Eurosafe Forum held in Paris in November 2001.

TO OUR READERS

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➤ All the papers referred to in the seminar review are available on www.eurosafe-forum.org

Adolf BIRKHOFER and Michel LIVOLANT

We are pleased to introduce this first issue of the Eurosafe Tribune, a new publication released as a complement to the expert contributions delivered during the Eurosafe Forum held in Paris on November 5th and 6th, 2001.
Printed in English, this periodical is also available in French and German on the Eurosafe Web site. Aimed at providing continuity between Eurosafe Forums, the Eurosafe Tribune is 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. Issue after issue, our goal is to support the trend towards closer co-operation among European nuclear safety institutions and towards deeper mutual understanding among the aforementioned stakeholders. We are convinced that accurate information as well as open dialogue make an important contribution to enhancing nuclear safety, since what is at stake is far from being only the experts' business.
We are glad to see that the research programmes carried out across the European continent in a bilateral or multilateral framework are resulting in increasingly convergent safety approaches and practices. This is an encouraging trend in a context of energy sector deregulation which puts budgets under pressure while the public clamour for ever greater safety intensifies.
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. Last but not least, keep in touch with us with a view to the next Eurosafe Forum, due to be held in Berlin in Autumn 2002. ●

ROUND TABLES → MANAGEMENT OF NUCLEAR RISKS










Speakers at the first round table

Leonid A. Bolshov, *IBRAE nuclear safety institute (Moscow, Russia)*
Leif Johansson, *Ringhals AB (Väröbacka, Sweden)*
Klaus Köberlein, *GRS department of probabilistic studies (Munich, Germany)*
Jean-Paul Samain, *FANC, Federal agency of nuclear control (Brussels, Belgium)*
Raymond Sené, *NGO providing information on nuclear energy (France)*

Speakers at the second round table

Roger Coates, *BNFL, British Nuclear Fuels plc (Risley, UK)*
Dana Drabova, *SÚJB, State Agency for Nuclear Safety (Czech Republic)*
Jean-François Lacronique, *OPRI, Ionizing radiation protection organisation (Le Vésinet, France)*
André Oudiz, *IPSN (Fontenay-aux-Roses, France)*
Mycle Schneider, *WISE, NGO providing information on energy (Paris, France)*
Vincente Serradell, *University of Valencia (Spain)*

Held during the first day of the Eurosafe Forum and moderated by a journalist, two round tables bringing together speakers from different countries and different areas – safety institutions, universities and research centres, nuclear operators, NGOs, etc. – gave participants an opportunity to debate on two major themes: the management of accident risks and the management of radiological risks relating to human health and the environment. The round tables also gave everybody in the audience an opportunity to benchmark their own situation in the broader picture. The major issues addressed during the first round table (devoted to the prevention of accidents) were a review of social and technical aspects, the decision-making process, the new challenges and trust and public opinion. The second round table (focused on radiological protection) addressed such issues as: what research work is needed for a better understanding of radiation effects? What about precautionary principles? Are they worth comparing with other industrial risks? And what is the link between the stakeholders, the other groups or authorities who may be involved in the decision-making process in the nuclear field? Throughout the debates, the Eurosafe Tribune picked up seven underlying notions which give a good flavour of the current concerns and show the trend towards convergent safety approaches and practices. We would like to share some thoughts and comments on these notions with the reader.

NEW RISKS

what are peacetime safety approaches worth in a war context?

The September 11th attacks against such American symbols as the World Trade Centre in New-York City and the Pentagon in Washington DC brought new areas of concern to light: how to prevent a wide-bodied aircraft filled to bursting with kerosene from hitting a nuclear plant? Can nuclear facilities withstand such strikes? What might be the damage for workers, the public and the environment? Views voiced by the speakers showed that risks resulting from unlucky circumstances in peacetime totally differ from suicide attacks carried out in a spirit of war. The former have been widely modelled and taken as a basis for plant design, the latter are not. The former mainly involve operators' responsibility, the latter mainly involve States' responsibility.

Raymond Sené depicted the new context and what is at stake "*One must not confuse the likelihood of an aircraft without any pilot at all and one with a terrorist on board. In the former case the estimate is 10-7 that the aircraft hits the target, in the second, the estimate is 10-7 that the aircraft misses the target. In the past we used to assume that a terrorist would try to intervene or attack a facility whilst still intending to save his own life. This is no longer the case. All of a sudden we have strong motivation, because we are no longer in a situation where peace prevails and this is why, if we do not alter our behaviour and our way of thinking and if we continue to be satisfied with our protection measures, something might well happen in the end.*"
According to the speakers, there is no such thing as zero risk and the real question is to determine the level of risk acceptable to enable human activities:

"*We are questioning the essence of civilisation,* Jean-Paul Samain declared, *and measures to be taken against terrorism will lead to restrictions and limit individual freedoms. This is the major challenge we are all faced with. And we cannot say that it is all up to the politicians. We also have our share of the burden. There is also an underlying question in my view: what degree of risk we can live with?*" Adding to this, Klaus Köberlein explained why new forms of terrorism, unlike "classic" malevolence, cannot be approached using probabilistic methods: "*The possible impact from sabotage or people who try to destroy NPPs has been considered and prevention measures have been taken. Of course they have not been published because it would not be a good idea to publish such things. Suicide attacks are new. We never considered that somebody would be prepared to offer his life to harm other people. That's a new experience.* ➜

→ *To sum up, the probability of a criminal accident makes no sense. If you want to quantify the risk, you have to compare with similar risks. So to calculate the risk of a nuclear catastrophe from terrorist attack, you have to compare it with the risk for other kinds of terrorist attack."*
In conclusion, Leonid Bolshov pointed out the psychological impact associated with nuclear facilities as potential targets, though other speakers stressed that many places are more vulnerable than NPPs: *"Physical protection, special preparation against terrorist attack is a major question for the nuclear industry and work has already been accomplished. However, it is difficult to find details of this work in the media or in the literature, for very obvious reasons: not to give terrorists clues as to where to go and how to proceed. When terrorists try to do something, the point is to have as much impact on public opinion as possible. For this reason, any nuclear target is a wonderful target since in the public's mind, nuclear is something very dangerous."* ■

INFORMATION

who to tell what?

■ If the question can be asked very simply, the answer is far more complex. Obviously, providing information and communications on nuclear issues is a real challenge to the professionals in charge. It deals with such diverse aspects as the gap between the perception of risk and the reality of risk, the heterogeneous composition of what we use to call "the public", the scientific accuracy of data and their credibility... In changing political and social contexts, simple questions do not imply simple answers.

For Raymond Sené, truth is the basic principle of credibility, the basic condition of trust: *"Trust is something that vanishes rapidly and is very difficult to rebuild. If you try to postpone communications then the media will become interested and will think something has been covered up. But you don't want to lie to people. They have various sources of information and whenever there is a incident in France, we receive dozens of faxes and phone calls. So people do have other sources of information and if they realise that they've been treated like children, they will think there is something mysterious going on. I think this situation has improved in France."*
Taking the September 11th terrorist attacks into account, Jean-Paul Samain pointed out that if the utmost must be done in the field of physical protection of nuclear facilities, very little should be said about it so as to keep preventive measures efficient. *"The public's reaction is to say they are not properly informed and I think this is an example of the communication issues we all have to deal with. I don't think we should say or tell all,*

although everything should and must to be done. We should not indicate the different precautions and safety measures that are taken, and this is the big challenge for safety authorities. We need to take measures and prevent intrusion and I don't want to explain what we are going to do, since this would mean weakening our protection system." He nevertheless believes that open, frank, and quick communications are conducive to a peaceful relationship with society: *"We need to have a proactive offensive attitude and if we want to win the trust of the public and be listened to, we have to be the first to talk about the issue. In Belgium there is an obligation for operators to issue press releases. If they do not, we [FANC] will do it for them. Apart from a few terrorism-related exceptions, we see that media attention to accidents occurring in power plants is inversely proportional to the state and quality of the information."*

With reference to the same events, Leonid Bolshov pointed out the problem of information control and its use as a weapon: *"The problem of terrorism is the release of false information. Just imagine for a moment that in the New York Times, Washington Post, Figaro or whatever, information were released that a bomb was located somewhere, or that one exploded, and ten thousand people had already died and a hundred thousand more would die in half an hour. The impact of this false information on human beings would be really severe. So we need to be very cautious and very responsible about every statement that we make."*

Building on Sweden's long tradition of dialogue between the people involved in the nuclear industry and the public, Leif Johansson called attention to the benefits to be derived from an open communication policy: *"We have learned a in the 25 years since the debate started in Sweden and I think we started our dialogue by trying to convince people that we were on the right track. I think the public started to listen and we have also learned that we must produce communication and build confidence with openness, honesty and by being quick to respond. I've seen from the figures in favour of nuclear in Sweden - it's around 80% of the population, despite the fact that we have closed down one plant. This figure has obviously changed since these accidents [the September 11th terrorist attacks]. But during normal circumstances it is very stable and I believe this is thanks to good open communications."*

For Klaus Köberlein, who specialises in probabilistic issues, open and honest communications with non-specialists is a difficult task, since the absolute safety required by society just does not exist and only a certain degree of safety is achievable: *"My experience is that it is not easy to explain to most people what probability means. People tell me they want to have safety not probability and if I tell them there's no such thing as absolute safety, it's always a matter of probability, many people do not want to accept it. Of course you can discuss whether the probability is low enough or, for certain damage, whether it is acceptable. But in the first instance, people have to accept that there no absolute safety. You can evaluate safety only by applying probability. In fact this is what people do in everyday life when making decisions. But many people are not aware of this and do not like to be told that there is a probability that something could go wrong. They want to be reassured that everything is safe."* ■

"An important condition for managing risks efficiently is the acquisition of the best possible knowledge and experience feed-back pertaining to those risks. Some types of risks - traffic accidents for example - regrettably provide knowledge based on daily experience feed-back. In other areas, like the nuclear one, accidents are fortunately far less frequent, and the risks therefore not as well known. This makes probabilistic approaches and simulation valuable tools both for finding out how to prevent nuclear risks and how to mitigate their consequences. Since safety requires substantial investment, it is important to be in a position to decide where to put the money. Such tools also help identify in which areas knowledge has to be improved and, subsequently, how to allocate research budgets properly. "

Klaus KÖBERLEIN
Head of Probabilistics Department, Operating Experience Division - GRS.

KNOWLEDGE VS. CERTAINTY

what room for scientific doubt?

By quoting Bertrand Russell's famous sentence – "What man desires is not knowledge but certainty" – as the conclusion to his introductory speech to the first round table, Professor Ortwin Renn from the University of Stuttgart posed the problem of the acceptability of scientific doubt.
The public demands certainties whereas professionals can only answer in terms of probability, randomness, degree of belief, quantification of uncertainty, prevention of events and mitigation of their effects... Do safety performance indicators show the progress achieved or the long way still to go?
A few experts offer their opinions below.

During one of the question & answer sessions after the round tables, a CNRS [the French National Scientific Research Centre] researcher in the audience raised the issue that knowledge and uncertainty should be placed in the perspective of scientific progress: "*We are living through a fantastic cultural revolution regarding genomics, she said. The fact that the mapping of the human genome has progressed so well in the course of the previous years means that we can have another look at some of the impacts of radiation on genetics in the light of genomics and other new sciences. All the data that were based on Hiroshima and Nagasaki should be re-examined and reviewed so we can see what will happen in the next generations. Alongside the impact on genes, what needs to be understood is impact of radiation and also the response to all types of stress like oxidants, or pH and temperature changes. Concerning interaction with chemical compounds, there can be affinities, there can be enhancing effects. And these respond to other forms of stress and they still need to be explored. Epidemiology is also an important research area and we know our populations are at risk, because some genes are more vulnerable to radiation. I think this should be taken into account and made the subject of further studies.*"

As a physician in charge or radiation protection, Jean-François Lacronique has particular experience of the acceptable limits of scientific doubt in the everyday relationship with the public: "*If you ask a very simple question such as, what is the impact of a given dose of radiation on snails or fish? The answer is of course such that it creates uncertainties. We do not know what is going to be produced, we do not know when it's going to take place, after how long, or the*

> "Since each country has its own nuclear safety rules, a peer review of the work performed in a country by colleagues from other countries is very important for comparing practices, getting opinions on one's own research and ensuring that the basis for decisions is the same. Today. Recently an evaluation of nuclear safety (in a broad sense) in the applicant countries has been performed. Work performed jointly with colleagues from central and eastern European countries also contributes to safety in western Europe, as it makes each party consider its own approach. In other words: when you judge somebody else, you judge yourself. It is the mirror you need."
>
> *Hans FORSSTRÖM*
> *Head of unit Energy research / Nuclear fission and radiation protection Research Directorate-General European Commission.*

nature of the lesion produced. And so people will say that scientists do not know a lot about the impact of radiation on the human being. There's a huge difference between the expression of scientific honesty - and we admit we cannot know everything - and the interpretation put on that by the public at large. The public considers that it hasn't got a clear-cut yes or no answer, yet a physician sometimes has to say yes or no. Shall I take iodine? A physician who cannot establish a diagnosis right away because he needs complementary examinations would be honest. But if a physician were constantly to doubt and continuously to express those doubts to the patient, then he would not be a good physician either. It is sometimes difficult to provide clear answers, but we have to help our patients."

Klaus Köberlein summarised what is at stake from the probabilistic expert's point of view: "*An important aspect in risk management is understanding the risks you are faced with. An appropriate tool is to perform risk analysis and to evaluate the risks that remain in spite of safety measures. We will never get absolute certainty; we will always have uncertainty in risk assessment but there are also tools to quantify even that remaining uncertainty. The point is that it is not so important to get an exact number from this kind of risk analysis as to get insight into the key effects on health and the environment.*" ■

RISK MANAGEMENT

technical vs. social drivers

■ In a time when deregulation puts pressure on costs yet public research is allocated tight budgets, research prioritisation becomes a crucial issue. Should short-term goals prevail at the expense of long-term goals? Should research programmes be selected based on the priorities as perceived by scientists and the nuclear community, or as a result of the expression of public concerns? Quite different views were voiced...

"*What are the research requirements to support the decision-making process and normal operating mode?* André Oudiz asked. *To answer the question, we first have to see what the social requirement is, what people want to know about these types of risks. Today we see that the level of sensitivity is quite high and there is great awareness. As far as environmental risk is concerned, people do concentrate more and more on health. In France, we are going to set up environmental health institutions. Today the population is very concerned about problems such as those affecting meat or dioxins in other materials. You can see that people are concerned. There is a kind of social tension surrounding all these problems, particularly in the radiology field and these concerns require answers in the field of research.*" So, social demand drives research? Not certain, replied Raymond Sené: "*A lot of work has been done on safety. However, is it for the sake of the population or for the sake of the industrial tools? To a certain extent the operators and utilities want to produce and generate electricity. Whenever there is an accident in a coal mine, it is over within a few days and operations start up again. At TMI there were no consequences whatever, but the plant was shut down. Decontaminating and dismantling are very expensive,* ➜

→ *which is why safety is crucial to protect the industrial tools. There is a positive input and that is the protection of the population, but I think it is just a positive impact that does not fall short of operators' concerns in first place."*

Mycle Schneider suggested that comparisons with other industrial sectors such as the chemical industry would help in making long-term decisions: *"For risk management theory, it is interesting to look at how our chemical colleagues consider long-term problems. There's a lack of long-term strategy or calculation. There are more pragmatic approaches that enable the risk to be managed in minimal conditions. We have to see what other sectors do about carcinogenic and genotoxic fears, because we can draw some lessons."* ■

COMPETENCE AND EXPERIENCE

who will maintain the level?

■ What about tomorrow? The knowledge and experience gained by the nuclear community – researchers, engineers, operators, etc. – is considerable and the problem of maintaining and enriching this precious capital arises as more and more professionals retire. In most European countries, a nuclear career no longer seems as attractive as it once was. Even if we are not on the cliff's edge, the question of what can to be done to convince bright students to join the nuclear community must be paid the utmost attention.

Vincente Serradell thought that the low attractiveness of nuclear research is due, in Spain, to public belief that nuclear energy has no future: *"Probably because the perception of nuclear energy is not good, there has been over the past years a decline in enrolment of students. This is very worrying because it affects the possibility of nuclear energy revival in the future. Even research programmes cannot be finished because of the lack of researchers to work on them. This threatens the capacity to attract new Ph.Ds to sustain our programmes."*

In this context, Dana Drabova declared that the need to offer motivating research subjects should be emphasised: *"The competence requirement across the whole nuclear field will be a problem within the next ten years,* she says. *Especially in radiation protection there is a generational shift and one of the important points is to maintain corporate memory in radiation protection. Nowadays you can meet people who know the subject perfectly, but who do not know the history. They don't know the reasons, and this is a very serious problem. If we are not able to find interesting research subjects for them to get involved in when they graduate from university, the problem will grow."* For Leif Johansson, the quality of delegation, communications and personal relationship plays a pivotal part: *"We currently suffer from people leaving us, with young people saying, "You are too heavily controlled, there's nothing for us in this business". We must improve delegation and increase or improve vertical communications from the floor level - up and down, understanding as well as listening. We should encourage a no-blame culture so we don't kill the messenger, or the next one will never show up. I think we can improve trust: trust is the key word in all human interactions."* For his part, Jean-François Lacronique concluded with a more confident view of the future:

"We lack teams of students or researchers to maintain and support programmes in radiation protection. This is a fascinating field: the interaction between radiation and living bodies, living organisms is something that is very useful. It also helps us to understand how cancers can develop and affect DNA for instance, and I hope that in the future we'll be able to revive or see some revival in interest." ■

STAKEHOLDER INVOLVEMENT

purposes and conditions

■ In several European countries, the involvement of the different categories of population concerned by such issues as the construction and operation of nuclear plants, the management of radwaste, the consequences of an accident on man and the environment, etc. is becoming a general trend. Some countries - in particular the UK - have long gained valuable experience in consultation and stakeholder involvement whereas others are at earlier stages. What are the prerequisites for fruitful consultation? What are the key factors for success and... what can come out of such process? The feed back from consultation processes carried out in the UK provides interesting answers.

"People's change of mind about nuclear power has to come from outside the nuclear industry, declared Vincente Serradell. *Otherwise people think a particular interest and not the general good is being defended. The industry - along with politicians and opinion-makers - have to say it from outside the nuclear industry."* This opinion was shared by Mycle Schneider, who described the conditions for real dialogue: *"Populations living in the vicinity of a nuclear facility deserve careful consideration, particularly in countries like France. Contrary to Anglo-Saxon countries, France has no tradition of this sort of social dialogue and I think we need to create different levels of dialogue with the population and the various stakeholders. In fact we want these dialogues to be genuine ones where contradictory views can be expressed. Sessions should not be incorporated into the decision-making process, but we would like to participate in decision-making processes, where we can really play a part."*

Asked about the consultation process initiated by BNFL three or four years ago, when the company was considering how to get the widest possible input into its environmental policy and its environmental direction, Roger Coates first focused on the diversity of the stakeholders: *"We discussed the way forward with an organisation known as the environment council in the UK, which is a charitable foundation specialising in the facilitation of what may be cluster challenging dialogues in the environmental field. The country, our unions, workforce and the* ➜

PRECAUTION VS. DECISION

in search of the right balance

local communities were well represented. The regulators, government, customers and pressure groups, including Green pressure groups, disarmament orientated pressure groups at both local and international levels were there." Then he recalled the tense atmosphere of the first meeting: *"When we first started the dialogue, there were a lot of nervous people sitting around a room. About 100 people, who for the last 20 years had been acting largely in an antagonistic way, who were going to start to find a way through."* Five key issues were on the agenda at that first meeting: discharges, solid waste, management aspects related to reprocessing, plutonium and... trust. It was agreed that four of those key issues could be dealt with in small working groups: *"Initially I said there were five issues for working groups, the fifth was trust. You can't have a working group on trust. Sharing knowledge helps to build up trust."* The key lessons that came out of the dialogue process were firstly that the people involved have to feel that they're engaged with a real problem and secondly, that working together over a period of time builds up trust. Step by step, the consultation process modified the operator's view on issues such as waste management: *"Now, Roger Coates, we have a much clearer understanding and a surprising amount of common ground in terms of how we believe we should manage solid waste. It's important to make sure we move quickly to get the solid waste conditioned and stored in proper conditions, with emphasis on whether that involves final disposal underground being very much a secondary issue. Previously, the company has focused more on getting the waste into a final form for disposal."* ■

■ Quoting a French MP, GRS chairman Birkhofer concluded the round tables with these words: "*Precaution should not lead to paralysing decisions*". Throughout the afternoon, the term "precaution" was obviously interpreted in very different ways according to the speaker: the spectrum ranged from a moratorium on operations until any uncertainty has been removed right through to the need to of continue activities while carrying out research aimed at better understanding the nature of risks in order to prevent accidents and mitigate their consequences. The contributions below give an idea of how far apart points of view can be.

"The key debate really is how does society make decisions at very low levels of risk, Roger Coates assessed. There are uncertainties, but will the resolution of those uncertainties be enough to make a real difference? There will always be work for the research community and we can spend money and resources on improving assessment of risks such as radiation risk. But in all probability more is known

about radiation risk than most pollutants. The linear no-threshold debate will continue, and in a sense that has to be a priority. But I don't think it should stop us engaging with the real debate, which is how society responds and manages the wide spectrum of low-level risks."

Expressing a totally different point of view, Mycle Schneider declared: *"Regarding the need to carry out research work and the precautionary principles, we had a recent example with decisions that had to be made regarding La Hague. Nobody could say what would happen if a large aircraft crashed on a station. Even the best experts couldn't tell. All we knew was that the consequences would not be acceptable and that's what matters. It is not an order of magnitude, but the fact that the consequences were not acceptable. In my opinion, if consequences are not acceptable, then the principle of precaution prevails. We have to do our utmost to protect and increase safety and security. Even if over the next few years we are not able to develop accurate scenarios as to what is going to happen if it falls on the plutonium site, or if it falls on high-level waste or pools. So why not have a moratorium while the research is carried out, if there is research to be done?"*

Would research be used in order to procrastinate? Certainly not, André Oudiz stressed: *"Research is a way of fine-tuning our response on the basis of knowledge and assumptions. If we consider the current state of our knowledge, we take appropriate measures but because we don't know exactly what happens with low doses, we use the no-threshold principle. We cannot stop and shut down all power plants. It has nothing to do with the principle of precaution."*

Finally Dana Drabova offered an example of what she sees as the reasonable application of the precautionary principle, providing a realistic balance between precaution and decision: *"Application of linear no-threshold theory is a very good example of precautionary advances in practice, she said, because you make an assumption, since you have no better information. So you are very conservative, you stay very much on the safe side when applying linear no-threshold theory with regard to radiation effects."* ■

> "One responsibility of the IAEA being the development of safety standards, participation in meetings such as Eurosafe is a good opportunity to present what we are doing and to get feedback from various stakeholders - research centres, safety institutions, regulatory bodies, operators, opponents... This interactive process proves beneficial since it provides each participant with a good barometer of where we stand and contributes to the convergence of safety standards and practices. Moreover, the debate between professionals, specialists and the broader society is necessary for making the complex scientific and social issues accessible to the public, thus adding to the credibility of authorities and scientists."
>
> *Philip METCALF*
> *International Atomic Energy Agency.*

FEEDBACK FROM THE ROUND TABLES DOES NOT STOP HERE

Other topics, such as the consequences of deregulation in the energy sector (a burden or an opportunity?), the need for appropriate procedures to avoid routinely jeopardising the safety culture, the predictive power of models, the importance of feedback from operators in top management decisions came out as recurrent themes throughout the round table debates as well as in the background to the lectures given during the seminars. These themes will undoubtedly be addressed in future issues of the Eurosafe Tribune.

Nuclear installation safety assessment: strengthening the effectiveness of safety management

In Europe, as in several countries around the globe, the production and distribution of electric power has experienced a dual evolution over the last decade. Firstly, the construction and commissioning of nuclear power plants virtually came to a complete stop. Secondly, the liberalisation and deregulation of the sector introduced tough competition between operators on domestic and international markets.

Faced with this situation, utilities started considering how to enhance the cost-effectiveness of their existing facilities. From a safety point of view, operating a nuclear power plant over a long period of time requires knowledge and competence to be maintained, lessons from operational feedback to be learnt, and major aspects - such as ageing components, changing regulations and standards and technical and organisational alterations to the facility - to be reassessed. In this context, intensified collaboration among the institutions in charge of safety in the various European countries where nuclear facilities are operated contributes to strengthening the effectiveness of safety management through the alignment of approaches, methods and tools. In most countries where NPPs are operated, the age of the facilities is highly variable: some were commissioned 40 years ago, others much more recently. In the meantime, technological developments impacted the instrumentation and control of the reactors: many systems shifted from analogue to digital technology, screens increasingly replaced synoptic boards, man-machine interfacing was gradually improved. As new facilities were directly equipped with the latest technology, the back-fitting of older ones had to be studied, the introduction of state-of-the-art technologies to older designs leading in many cases to increased system complexity. While nuclear utilities put growing pressure on costs as a response to deregulation, the continuous search for high-level safety draws upon the ability to identify with ever greater accuracy what does and does not contribute to safety, to enable better allocation of resources. The challenge consists in using this process to strengthen rather than weaken the safety culture [1]. The expert contributions cited below give an overview of some of the programmes conducted in a bi- or multilateral framework.

The NEA's Senior Group of Experts on Safety Research established in 1992 identified medium- and long-term research leads:

- plant life management, including ageing of components, systems and structures (hardware), ageing of analytical tools and documentation (paperware), application of modern standards to older plants, life extension and back-fitting;
- optimisation of operating margins, including power uprating, higher fuel burn-up, etc;
- severe accidents, including the need to develop practical accident management procedures further and design solutions for future plants.

Read *The role of research in a regulatory context* by G. Frescura (NEA).

› Ever closer collaboration between safety institutions from different countries. Efficient safety assessment requires methods and tools to be continuously improved and an adequate level of safety research to be sustained. As explained by G. Frescura (Nuclear Energy Agency) in his paper entitled *The role of research in a regulatory context* [2], both government and industry funding of safety research has decreased in many countries, mainly due to the belief that the research needed to operate existing plants and to prevent and manage accidents is largely complete. Many countries recognise that reduction in safety research may have gone too far and have taken steps to ensure that essential research capability is available. For its part, the

OECD's Nuclear Energy Agency (NEA) promotes international co-operation following research leads identified by its Senior Group of Experts on Safety Research. The results of several safety assessment programmes - increasingly frequently carried out collaboratively by two or more countries - were presented at the Eurosafe 2001 Forum. Let us take three examples:

■ the safety assessment, using the Iris irradiation device implemented in the French Siloe reactor, of a new type of fuel (U3Si2) to be loaded in Munich technical university's FRM II research reactor;

On this subject, read *Safety assessments relating to the use of new fuels in research reactors: applications to the case of FRM II reactor fuel* by H. Abou Yehia, G. Bars and P. Tran Daï.

■ the safety assessment of digital instrumentation and control (I&C) systems by a German-Ukrainian team which resulted in the re-evaluation of Ukrainian I&C assessment standards and the addition of requirements concerning software-based digital I&C safety systems;

On this subject, read *German-Ukrainian Collaboration in the Assessment of Digital I&C Systems for Safety Applications in NPPs* by M. Yastrebenetsky, D. Wach, B. Mulka and S. Vinogradskaia.

■ the development by GRS of a data bank model for the statistical assessment of reported events at operating NPPs in Germany. Now ready for practical application, the model will help improve the statements concerning trends in safety aspects, especially those related to vigilance.

On this subject, read *Frequencies and trends of significant characteristics of reported events in Germany* by G. Farber and H. Matthes.

It should be noticed that the assessment programmes conducted on various subjects throughout Europe, from Germany to Ukraine and from France to Russia, are carried out in growing collaboration between the different safety institutions, thus broadening the scope and enhancing the effectiveness of nuclear safety knowledge and experience acquisition.

› A widespread practice: periodic safety reassessments. Performed in addition to ongoing operational inspections, scheduled tests and predictive maintenance, periodic safety reassessments enable the current state of facilities to be compared with their original reference document, drifts to be identified and dealt with; the reference document to be updated in compliance with the latest safety requirements and the facility to be back-fitted in accordance with the updated reference document. Such safety reassessments are carried out for three main reasons:

■ component capability to carry out safety functions can be impaired by operating processes, higher fuel burn-up, irradiation, corrosion. Embrittlement due to irradiation, for instance, is an important factor in reactor core ageing or cable isolation;

■ NPP commissioning was licensed in compliance with regulations and standards which have since been updated under the influence of developments in knowledge, techniques, and society;

■ the changes made to facilities following incidents or to meet the needs expressed by operators impact not only equipment but also organisational patterns. With a view to cutting costs, many operators thus reduced personnel and outsourced some functions.

Besides nuclear power plants, fuel cycle facilities and research reactors also undergo periodic safety reassessments. ■

(1) The management of knowledge and upgrading of competencies was addressed during the Round Table session of the Eurosafe Forum. Please read the corresponding article in this issue of the Eurosafe Tribune.

(2) The papers mentioned in this text are available on the Eurosafe Web site: www.eurosafe-forum.org

Mycle SCHNEIDER

Executive Director, WISE-Paris
Chief Editor,
Plutonium Investigation.

"Inviting people with different opinions to participate in the Eurosafe Forum was a good initiative. But unfortunately, the problem of a real discussion with partners belonging to the amazingly consensual nuclear community remains unchanged: there is no willingness for open controversy, for public debate. Such thorny issues as the consequences of Chernobyl on health or the application of the precautionary principle to nuclear facilities - and the plutonium factory at La Hague in particular - were addressed by speakers in a provocative way without any reaction from the audience. Few contributions and questions came from the floor and no controversial debate was possible. Just an example: ground-to-air missiles were installed at La Hague following the September 11th terrorist attacks in the USA -spectacular as a simple application of the precautionary principle - but the technical question of the potential radiological consequences of a large passenger aircraft crashing onto the plant was simply not addressed.
And amazingly, this did not seem to frustrate any of the participants."

Nuclear installation safety research: getting closer to reality

■ Formerly, nuclear safety models were designed with wide margins in order to allow for uncertainties between theory and reality and conservative scenarios were taken as a basis for regulation and standard setting. These margins were progressively used by operators to sharpen their competitive edge in the context of deregulation. At present, the development of increasingly powerful calculation systems and precise measurement tools enables safety models to be designed with a much more accurate representation of reality.

In this respect, the development of realistic models based on and validated through experiments is a general trend which gives institutions like GRS and IPSN that are capable of both conducting research and assessing safety a pivotal role in the improvement of nuclear facility safety.

Today, ongoing safety research is a necessity in ensuring vigilant implementation of safety regulations (accounting for unexpected events), coping with facility evolutions such as ageing, and seeing to it that operating practices do not change at the expense of overall safety. The search for steady improvement in nuclear installation safety requires low probability incidents to be surveyed so as to:

- better understand the circumstances potentially conducive to such incidents. This enables the safety measures taken by nuclear operators to be examined in order to diminish the probability of such incidents still further;
- limit the consequences of such incidents thanks to emergency plans implemented by nuclear operators inside the plant and external plans set up and implemented by public authorities.

Carried out for over twenty years, chiefly via international co-operation, surveys and research programmes enabled high safety levels to be reached in most western countries. Significant advances include:

- the probability of occurrence and the potential consequences of incidents taken into account in designing facilities are validated;
- appropriate methods for monitoring equipment and operating procedures are developed;
- additional measures for limiting the consequences of accidents conducive to reactor core melting are set up, as are emergency plans aimed at protecting the public in the event of an accident.

Some safety issues dealt with in the research programmes presented at the Eurosafe 2001 Forum are reviewed below. The corresponding experiments show that the development of increasingly powerful calculation systems and precise measurement tools enables safety models to be designed that more closely accord with the facts than was previously the case.

› The behaviour of high burn-up fuel under Loss-of-Coolant-Accident conditions.

IPSN and several other safety organisations apply a three-tier method for their

reactor safety research. The first step consists of computer code developments from the existing data bases. The second step involves small-scale, out-of-pile experiments, which provide the additional data bases requested by the code developments and their preliminary assessments. But, as the reactor phenomenology cannot be totally reproduced in such small-scale experiments, a third step consisting of integral in-pile experiments using real materials is essential for comprehensive accident analysis. Their results allow the final code assessment in terms of reactor applicability and simulation completeness.

The evolution of the light water reactors observed since the seventies:

- increase in reactor power: from 900 MWe to 1,400 MWe;
- increase in fuel burn-up: from 33,000 GW/day/tU to 60,000 GW/day/tU in the near future;
- introduction of new types of fuel - from UO2 to MOX -, of cladding and control rods; creates a permanent need to reassess reactor safety studies, which implies improving the associated knowledge and upgrading the corresponding calculation tools.

Higher fuel burn-up for instance may induce specific effects under Loss-of-Coolant-Accident (LOCA) conditions, whereas the current regulatory safety criteria still in use in most countries are derived from acceptance criteria issued by the US Atomic Energy Commission (USAEC) in 1973. This is why IPSN is preparing a research programme called APRP Irradié which would include in-pile experiments aimed at investigating the behaviour of fuel and cladding in conditions representative of a reactor during a LOCA sequence. Performed at the Phebus facility located at Cadarache (France), the in-pile experiments would involve bundle geometry. A feasibility study for such an experimental programme is underway and should soon result in a finalised project including cost and schedule aspects.

On this subject, read *An IPSN Research Programme to Resolve Pending LOCA Issues* by A. Maillat, C. Grandjean and B. Clément.

Catherine LECOMTE
IPSN

"As technical experts working for their country's safety authorities, GRS and IPSN carry out in-depth research aimed at strengthening their technical expertise and independent judgement capability. They are therefore in a position to recommend significant safety improvements in nuclear facilities with a view to protecting both professionals and the public."

› The behaviour of high burn-up fuel during Reactivity Insertion Accidents.

Besides in-pile experiments, benchmarking is another important way of evaluating calculation code uncertainties and providing best-estimate approaches. With the increase of core fuel burn-up, one of the major issues is the evaluation of the deposited energy in the event of a rod ejection accident in a pressurised water reactor (PWR) or a rod drop accident in a boiling water reactor (BWR). In this context, the US NRC's Brookhaven National Laboratory (BNL), the Russian Kurchatov Institute (KI) and IPSN initiated a collaboration focused on the neutronics aspects of reactivity insertion accidents. 3D modelling of the TMI-1 (Three Mile Island 1) central ejected rod accident was carried out using three different methods of calculation: the neutronics codes Parcs (BNL), Cronos (IPSN) and Bars (KI). It showed that one of the sources of uncertainty is the fuel pin representation. In the majority of the codes, the fuel assembly is thus described in a homogeneous way, not taking into account the inter-assembly, which can lead to a significant underestimation of the fuel enthalpy. The 3D best-estimate approach used in this benchmark should be completed by →

→ an evaluation of the result uncertainties induced by modelling and input parameters uncertainties.

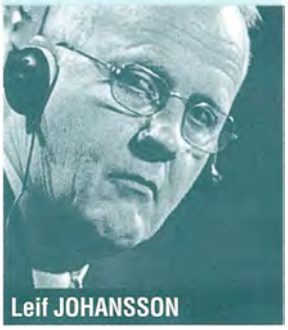
On this subject, read *3D core modelling of RIA transient: the TMI-1 benchmark* by P. Ferraresi, E. Studer, A. Avvakumov, V. Malofeev, D. Diamond and B. Bromley.

› Aerosol depletion under severe accident conditions in light water reactors. During an unmitigated severe light water reactor (LWR) accident, radioactive fission and activation products are released into the containment area and to a great extent absorbed in aerosols, while the containment building serves as a final barrier to the environment. Thus, a detailed understanding of fission products and aerosol behaviour and an apposite analytical predictive capability are of great importance in evaluating possible release into the environment, e.g. by venting or leakage. Jointly developed by GRS and IPSN, the integral code called Accident Source Term Evaluation Code (Astec) aims at getting a fast-running code for the simulation of the complete sequences of severe accidents in LWR from the initiating event up to the possible fission product release into the environment. For aerosol depletion, the Astec results were in general overall agreement with the data measured during the tests carried out in the Kaever (Kernschmelz Aerosol Versuche) facility located at the Eschborn site at Battelle in Germany. The code overestimation of hygroscopic water uptake by the aerosols means slight improvement to the model is required as the next step.

On this subject, read *Astec participation in the International Standard Problem on Kaever* by P. Spitz, J-P. van Dorsselaere, B. Schwinges and S. Schwarz.

› The simulation of oil and cable fires. The simulation of severe accident development, progression and potential consequences in containment of NPPs is required under conditions as realistic as possible for assessing the efficiency of severe accident management measures. The Containment Code System (Cocosys) developed by GRS is primarily aimed at providing a mechanistic model-based code system for the comprehensive simulation of all relevant processes and plant states during severe light water reactor (LWR) containment accidents, also covering design-related accidents. Being a high priority, the simulation of oil and cable fires implemented in Cocosys was successfully tested using the HDR E41.7, E42 and VVER-1000 cable fire experimental results. The tests showed the capabilities of the current Cocosys pyrolysis models, on which additional calculations for model validation should be performed in the future.

On this subject, read *Application of Pyrolysis Models In Cocosys* by W. Klein-Heßling, M. Röwerkamp and H-J. Allelein.



Leif JOHANSSON

Vice president
Ringhals AB.

"In countries where deregulation is the driving force, where the nuclear industry is - just like any other industrial sector - no longer allowed to be in the red, there much can be expected from showing an open attitude towards company employees.
By promoting a no-blame culture and showing confidence in their staff, company managers contribute to effective information feed-back from the bottom up.
In this respect, a pragmatic balance between numerous and strict procedures and good vertical communications significantly helps improve both safety and profitability."

› A challenge for the future of research. *"One of the key challenges for regulatory bodies,* G. Frescura of the NEA writes, *is to maintain the proper balance between confirmatory research such as that conducted to validate methods, and anticipatory research such as that conducted to anticipate potential problems and improve knowledge. Clearly with a decreasing budget and very little commitment to building new plants, it is always easier to justify the need for confirmatory research at the expense of anticipatory research."* ■

Waste management: making the long-run acceptable

■ Final disposal of radioactive waste is a delicate issue, however it's looked at. From a technical point of view, dealing with such issues as the modelling of rock mechanics over thousands and ten thousands of years is obviously complex work. From a social point of view, initiating a process of discussion between the stakeholders in the regions prospected for the installation of underground laboratories - and potentially of underground disposal facilities - is no easy task. From a political point of view, governments and policy-makers generally seem reluctant to trigger decisions which they know are unavoidable and will involve future generations.

The multiple facets of the radwaste disposal issue and the diversity of national contexts were highlighted at the Eurosafe 2001 Forum through contributions from experts, notably those working for French, German and Ukrainian safety institutions.

› Designing an international framework for radioactive waste management. Research on geological radwaste disposal is increasingly carried out in a framework of international co-operation. In this respect, the International Atomic Energy Agency (IAEA) headquartered in Vienna (Austria) launched a programme aimed at creating a corpus of internationally accepted radioactive waste safety standards. The Agency set up a group dedicated to establishing principles and criteria for the "geological disposal of radioactive waste". The Group adopted nine principles concerning:

- protection of human health;
- protection of the environment;
- protection beyond national borders;
- protection of future generations;
- prevention of any undue burden on future generations;
- provision of an appropriate legal framework;
- minimisation of waste generated;
- consideration of interdependencies between different stages of waste management;
- safety of waste management facilities.

In accordance with these principles, the group worked on recommendations for building, implementing and assessing safety strategy. Work is presently focused on the following issues: a common safety-based framework for radioactive waste disposal, appropriate timeframes for safety assessment, different possible indicators of long-term safety, the safety implications of reversibility and retrievability, the assessment of possible human intrusion into the repository, the role and limitations of institutional control, establishing reference critical groups and biospheres for long-term assessment, and what is meant by "compliance" with the standards.

On this subject, read *Developing International Safety Standards for the Geological Disposal of Radioactive Waste* by Phil Metcalf. ➜

SEMINAR 3

› Modelling geochemical processes. Granite, clay, salt... Different types of rocks are studied with a view to modelling their geochemical behaviour over a long period of time and deciding whether or not they might be appropriate candidates for hosting eventual radioactive waste disposal facilities. One of the key factors determining the choice of a site is the spatial setting of the fracture system and its potential evolution over time. Natural fractures are of different scales: major regional faults that limit blocks, secondary fault and fractured zones that affect the blocks, and local fractures and microfractures. These discontinuities are studied from the surface analyses, transversal boreholes and drifts. The projects carried out in different countries consist of investigating the likelihood of fault activity (which could lead to seismic events) and fault growth (which could create connected fluid pathways) over time periods of the order of thousands of years. German scientists who studied excavation-disturbed rocks in the nearfield of underground cavities established for example that rocks like rock salt that show plastic behaviour, have the potential of healing when the stress state disturbed by excavation reverts to an advantageous state.

Several projects are aimed at developing and validating computer codes for modelling radionuclide transfer in the geosphere. The computer code TRAPIC (Transport of Pollutants Influenced by Colloids) was thus developed to simulate one or two-dimensional colloid facilitated contaminant transport in porous media. Applied to describe the europium (Eu) migration in column experiments with humic-rich groundwater, the code enabled general agreement to be obtained by simulating the migration experiments with sorption parameters taken from batch experiments and from literature. Another computer code named HYTEC was developed for modelling the interactions between such industrial materials as concrete or cement (the extensive use of which may be required for the disposal of radioactive wastes in clay formations) and the host rock. The reactive transport code HYTEC enables geochemical behaviour modelling for time scales and a geometry representative of disposal projects. The pH evolution, a key parameter in element mobility, is studied more specifically.

On these subjects, read *Reactive transport modelling of interaction processes between claystone and cement* by L. De Windt, D. Pellegrini and J. van der Lee; *Modelling of the colloid facilitated actinide transport in the geosphere with the computer code TRAPIC* by Ulrich Noseck; *Self-healing of excavation-disturbed rocks in the nearfield of underground cavities - exemplary measurements in rock salt and interpretation of preliminary results* by K. Wieczorek, P. Schwarzianeck and T. Rothfuchs; *Spatio-temporal evolution of fault networks: implications for deep radioactive waste disposal sites* by Kathryn Hardacre and Oona Scotti; *Corrosion of cementitious materials under geological disposal conditions with resulting effects on the geochemical stability of clay minerals* by H.-J. Herbert and Th. Meyer.

› Building on the Chernobyl experience. The waste dump sites created in 1986-87 during emergency clean-up activities at the Chernobyl Nuclear Power Plant contain about 10 million m3 of low-level waste. These waste dumps pose radiological risks to the environment. Of particular concern is hydrogeologic migration of strontium-90 (90Sr), which shows high mobility in soils and groundwater systems.

The main processes involved in radionuclide transport from the waste site to the surrounding environment give rise to two major lines of research. Firstly,

"In Central Europe, nuclear research used to be highly respected and attracted a lot of resources. Today, as deregulation stimulates competition between operators, and public demand for high-level safety is voiced more loudly, research centres and safety institutions are faced with a major challenge: to strengthen co-operation with their peers to perform better with fewer resources. In this context, participating in the Eurosafe forum is an opportunity to save time, meet people who are hard to access, discuss co-operation and, ultimately, head for harmonised practices. Common areas of concern emerge from discussions, such as the need to pass the accumulated knowledge on to the next generation effectively and quickly, at a time when the nuclear sector is - in most countries - no longer perceived as sufficiently attractive by young graduates. Increased co-operation will help us explain to graduates why this discipline can give them the satisfaction and social recognition they expect."

Jiří ŽDAREK

Director, Integrity and Technical Engineering Division Nuclear Research Institute Řež plc.

the Chernobyl Pilot Site Project is focused on the study of the dissolution mechanisms of fallout fuel particles and geochemical interactions between the soil and the dissolved radionuclides. Secondly, the project is focused on the study of the hydrodynamics of water and associated dissolved radioactive elements transport in the unsaturated zone and in the aquifer underlying the waste burial.

The project is scheduled for 1999 - mid 2003 and comprises three main stages:

- site characterisation involving collection and analysis of radiological, hydrogeological and geochemical data;
- development of a set of sub-models and global model of the waste site, and planning of model validation (confirmation) experiments;
- setting up, carrying out and interpreting model validation tests. Work performed to date shows that, though off-site risks caused by groundwater transport are expected to be low, contaminated groundwater is likely to be potential source of significant on-site risk, including timescales extending beyond the institutional control period for waste facilities (e.g., 100-300 y). Conceptual understanding, adequate modelling and long-term forecast of radioactive contaminant attenuation mechanisms in subsurface environments are therefore of importance in analysis and planning of waste managing strategies and measures aimed at remediation and rehabilitation of contaminated land and the geo-environment at Chernobyl. ■

On this subject, read *Radionuclide dispersion from a waste burial in the geosphere* by D. Bugai, L. Dewiere, V. Kashparov and N. Ahamdach.

Site selection for final disposal of radioactive waste: a focus on Germany's current situation

In Germany, the intention is to dispose of all types of radioactive waste in deep geological formations. In the past, the Gorleben salt dome in the north east of Lower Saxony has been investigated for its suitability to host a deep repository for all types of radioactive waste, mainly for high-level waste originating from reprocessing and spent fuel elements, while waste with negligible heat generation was intended to be disposed of separately.

After the federal elections in September 1998, the new Federal Government made a pronounced change in energy policy, the most important feature of which is the abandoning or phasing out of nuclear energy. The new policy also comprises important alterations in radioactive waste management.

Since the government has doubts regarding the suitability of the Gorleben site, the investigation of the Gorleben salt dome will be interrupted for at least three but not more than 10 years, until conceptual and safety-related questions have been clarified. Further sites in different host rock formations are to be investigated.

This investigation process has to be carried out with respect to technical suitability and safety as well as public acceptance. For this reason, in February 1999 the Federal Ministry for the Environment (BMU) has established a Committee on Disposal Site Selection Procedures (Arbeitskreis Auswahlverfahren Endlagerstandorte, AkEnd). Its two main tasks are the definition of site selection criteria and the development procedure for public participation.

This Committee recommended several decisions for the development of the procedure for one site:

- all kinds of radioactive waste should be considered;
- the disposal concept should be based on the 'Concentrate and Contain' principle;
- disposal should take place only in deep geological formations at least several hundred metres below ground;
- the repository should be built as a mine in accordance with state of the art practices;
- the isolation period should be of the order of magnitude of one million years;
- a robust multi-barrier system in a favourable integral geological setting is pursued.

On the basis of international experience and evaluation of existing safety assessments, the Committee recommended the following requirements as characterising a favourable integral geological setting:

- no or only slow groundwater movement at repository level;
- favourable hydro-chemical conditions;
- high retention potential of the rocks regarding pollutants;
- good compatibility of the rocks with gas generation;
- low tendency to build new pathways;
- favourable configuration (e.g. spatial extension) of the rock formations;
- location allowing good spatial characterisation of the rock formation;
- location allowing a reliable prognosis of the long-term stability of the favourable conditions of the rock formation;
- good compatibility of the rocks with temperature changes.

Regions which offer relatively more favourable conditions for a repository than others must be identified within the areas. In order to do so, once again a comprehensive set of geo-scientific and social-scientific criteria has to be developed. The criteria at this level have the function of weighting criteria. The significance of geo-scientific and social-scientific criteria must be evaluated so that a ranking of the regions and sites can be performed.

On this subject, read *Development of Site Selection Criteria for Radioactive Waste Disposal in View of Favourable Geological Settings in Germany* by B. Baltes and W. Brewitz.

Environmental and radiation protection: getting stakeholders involved in decisions

■ Taking short-term countermeasures following a severe accident in a PWR, being faced with the contamination of the food chain, considering the remediation of contaminated former mining sites...whatever environmental and radiation protection issue is to be dealt with, a common denominator remains: the public.

As the communications initiatives aimed at "reassuring" the public concerned by the capability of industrial operators to keep risks under control and of public authorities to monitor the process did not prove a success, the need for consultation went on growing. Room for dialogue between experts from institutions and associations and non-experts thus had to be made, to enable the respective points of view to be mutually understood and, to some extent, decisions to be made in common. The Eurosafe 2001 Forum introduced the experience gained by various European countries in this domain.

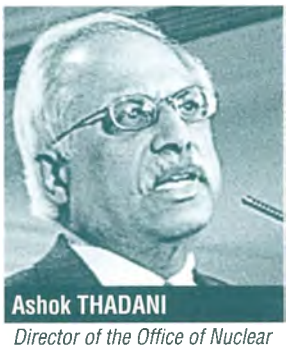
› The pivotal role of associations in consultation. Associations take advantage of consultation to access certain documents, raise certain issues and question government or company representatives directly. It is also a way to air problems and remind operators of their commitments. Consultation may not prevent actions like demonstrations or petitions from taking place. These actions show that consultation is not necessarily aimed at extending a plant's operational life. A wide gap remains between the knowledge, competencies and means at the administration's and operators' disposal, and those of the associations. Nevertheless, the actions and competencies of associations in legal, political or technical issues complement each other. At a local level, associations gain experience in the field and can prove very responsive to local developments or potential incidents in a plant. At a regional level, associations frequently provide expertise – in particular on environmental issues – and are often in a position to train their own members or those of local associations.

Key factors for successful consultation are as follows:

■ consultation should not be restricted to an occasional exchange of views with the parties involved but extended to the entire decision-making process, from project design through to evaluation in operation;

■ consultation should be part of decision-makers' usual practices throughout this process: government and operators should include consultation procedures in their corporate structures;

■ consultation should be truly capable of impacting the decision. To this purpose, several options for the same project should be submitted for the stakeholders' consideration.



Ashok THADANI

Director of the Office of Nuclear Regulatory Research
US Nuclear Regulatory Commission.

"Since about 80% of nuclear power plants are based on light water technology, the safety issues that most of us face - e.g. higher fuel burn-up levels, extended plant life-time, shorter outage times, etc. - are common. The world has shrunk: an accident taking place somewhere has an impact everywhere. This is why conferences like the Eurosafe Forum and publications like the Eurosafe Tribune are important. They are the most effective way to bring together technology experts and senior managers, to share experience, to learn a lot in a short period of time... and to trigger bilateral and multilateral co-operation programmes."

› The benefits of networking: a European initiative built on UK achievements. Whereas widespread contamination of the food chain following a nuclear accident could have considerable consequences for European the farming and food industries, experience following the Chernobyl accident shows that a wide range of effective countermeasures exists. For the purposes of contingency planning, it is important to bring together the diverse stakeholders who would be involved in intervention so that strategies can be developed for maintaining agricultural production and food safety.

Drawing upon the experience gained in the UK through the setting up of the Agriculture and Food Countermeasures Working Group (AFCMWG), the European Commission funds a stakeholder network called Farming (Food and Agriculture Restoration Management Involving Networked Groups). Established in Belgium, Finland, France and Greece, this network involves more than 50 individual stakeholders.

The AFCMWG membership was selected on the basis of four criteria: adequate representation of the interests and concerns of each stakeholder type; a reasonable balance between governmental organisations (GOs) and non-governmental organisations (NGOs); participation from individuals with responsibility for input in policy-type decisions and with a broad knowledge of the issues; willingness to participate.

The topics discussed can be divided into the following broad areas: background information on nuclear emergency arrangements; radionuclide transfer in the food chain and countermeasure strategies; realistic accident scenarios and stakeholder response; findings from complementary/supporting studies and the work of subgroups; international activities. Building on the achievements of AFCMWG, the Farming network is expected to provide four major benefits:

- improved communication and debates: the practicability of restoration strategies will be debated by stakeholders taking into account regulatory views, social and political factors and industrial constraints. Governments will thus take advantage of high-level authoritative advice, with the possibility of making more timely strategic decisions and maintaining the public's confidence;
- wider dissemination of information on restoration strategies: the Farming web site (www.ec-farming.net) will enable information exchange on practicable as well as impracticable strategies, thereby avoiding duplication in research effort as well as the implementation of inappropriate techniques;
- application to non-nuclear contaminants: the network in place can potentially deal with other types of contamination events involving the generation of food considered unsuitable for human consumption;
- sustainability: once the benefits of the network are realised, national stakeholder groups are likely to be self-sustaining even when EC funds are withdrawn.

On this subject, read *Stakeholder involvement in the management of rural areas after an accident* by A.F. Nisbet.

› Stakeholder involvement: a pragmatic approach to site remediation. Such activities as radium painting, watch-making or the flint industry generated ➜

From information to consultation

In Europe and in the US, the steps taken by industrial operators or government organisations to inform the neighbouring populations about the state of industrial sites remain insufficient to establish a climate of confidence. It becomes increasingly obvious that consultation should not be regarded as a mere tool for communications purposes but as an effective way of involving all stakeholders in a decision-making process that can result in a project being significantly altered or even turned down altogether. Initiated by government organisations, consultation practices were adopted by private operators prior to decisions on investment or a plant in operation.

The Aarhus convention on *"Access to information, public participation in decision-making and access to justice in environmental matters"* adopted by the EC countries in 1998 is the signal for more active stakeholder involvement. Some countries have conducted innovative experiments at a local level, with public participation in decisions pertaining to industrial facilities.

One example is Sweden's high-level waste management policy.

Read *Consultation around industrial sites* by G. Heriard-Dubreuil and S. Gadbois.

→ contamination with long-lived radionuclides in several industrial sites. The method used for the assessment and management of the radiation risks associated with these sites was recently developed in France at the request of the authorities. The aim is to provide all the stakeholders (administration, elected representatives, engineering companies, operators, associations and protection organisations) with a guide describing how to proceed. There are six stages – removal of doubt, pre-diagnosis, initial diagnosis, simplified risk study, detailed risk study and assistance in the selection of a remediation strategy – which are partially or totally implemented depending on the "complexity" of the site.

The selection of the appropriate strategy presupposes the identification of several alternate strategies which must be characterised in terms of the reduction of dosimetric impact, contamination, costs and associated nuisances. Whether or not the search for an appropriate remediation strategy is accompanied by a discussion on the choice of the future use of the site, there should be in-depth consultations with all the stakeholders. These consultations make it possible for those involved to "appropriate" the strategies and therefore to support choices that are likely to modify some of the local habits. They encourage the population to have a more realistic understanding of radioactivity, its nature, its components and risks. They help maintain the long-term vigilance of the population with respect to a residual risk that is collectively assumed. ■

On this subject, read *Management of industrial sites contaminated with radionuclides and stakeholder involvement* by A. Oudiz, B. Cessac, J. Brenot, J-P. Maigne, P. Santucci.

Nuclear material security: dealing with threats

■ Actions taken in the area of nuclear material security pursue two main objectives: the first concerns the prevention and detection of theft or unauthorised removal of nuclear material usable for the fabrication of nuclear weapons. The second pertains to the prevention of malevolent actions against nuclear facilities or nuclear material which could result in the release of significant quantities of radioactive material.

An issue of concern for many countries, nuclear material security is amply discussed in international workgroups such as the Group of Six set up by EU member states. International forums like Eurosafe 2001 are also major opportunities for collecting and consolidating the experience gained by various countries. The French experience in this field is one example.

› The Group of Six, an inter-state contribution to physical protection. Following an approach by the US calling for a revision to the Convention on Physical Protection of Nuclear Material and the invitation of the IAEA to a meeting of experts, several EU member states wished to meet in an informal way to exchange views on the physical protection of nuclear material and nuclear facilities. These European states - Belgium, France, Germany, Spain, Sweden and the United Kingdom - form the so-called Group of Six.

The Group suggested fundamental security principles for designing and implementing a physical protection system:

■ the former include the definition of a legislative and regulatory framework, the designation of a competent authority, the determination of the responsibilities of the entities involved as well as the selection of an approach (compliance-based or performance-based);

■ the latter pertain to the identification

of the threat against which protection has to be provided (known as Design Basis Threat), the definition of a Defence in depth concept (i.e. a concept used to design physical protection systems that require an adversary to overcome or circumvent multiples obstacles, either similar or diverse, in order to achieve his objective), the establishment of a comprehensive quality assurance programme (covering the design, manufacture, implementation, operation and maintenance of the protection and control systems) as well as the setting up of confidentiality rules.

› Inventory exercise in France: training facilities to keep track of nuclear materials. The crisis situations for nuclear materials in nuclear facilities are provided for in French law. The decree of 12 May 1981 specifies that "In any circumstances, the Ministry of Industry may order a physical inventory of the materials and its comparison with the accountancy records". Such an inventory can be ordered in facilities holding category I nuclear materials, in case of theft, for example. The operators must be able quickly to establish if the stolen materials come from their facility. To test the system at operator and competent authority level respectively, five exercises have already been carried out.

An inventory exercise is organised without prior notice over one day chosen during a fortnight settled in advance with the operator. It is triggered by a fax from the authority crisis centre to the crisis centre(s) of the licensee(s) concerned, specifying the type of nuclear material or the type of item sought. Before proceeding to the physical inventory itself, the facility crisis centre must carry out preliminary steps such as counting, identification and checking of seals, tags on non-sealed containers, gross weighing, gross quality checking, fine quality checking, etc.

These exercises must be carried out in circumstances as close as possible to real crisis conditions. Exercises of increasing complexity have thus been organised since 1993, involving respectively a test fuel fabrication laboratory, a uranium metal processing workshop, a research centre for Defence, a research reactor, a research laboratory and a pilot reprocessing facility under decommissioning. For 2001, an exercise is envisaged in a nuclear materials storage facility, which poses the problem of checking a lot of items in a very short period of time. A physical inventory involving two different sites at once is planned for the year 2002.

The feed-back from each exercise helped identify and improve organisational issues: write reflex sheets annexed to facility procedures, draw up a list of telephone and fax numbers used for the exercise, make a data base accessible out of working hours, establish a procedure concerning communications methods needed to transmit classified data, etc. Moreover, the main events which might occur in a crisis situation have been tested and the increased complexity of the exercises made it possible to develop the preparedness of installations as well as authority readiness for a real crisis.

On this subject, read *Inventory of nuclear materials in case of emergency* by J.L. Portugal and S. Zanetti. ➔

Taking threats as a basis for design

The characteristics of adversaries and the means at their disposal, in particular the likelihood of their being assisted by one or more individuals with authorised access to the facilities, the tactics employed by these groups, their technical competence and size, and the equipment available to them for use in any attack constitute the threat known as Design Basis Threat.

For instance, the Design Basis Threat dealing with the theft of nuclear material could include theft performed by an insider as well as theft performed by outsiders. Likewise, different types of threat could be taken into account to cope with the sabotage of nuclear facilities. This threat could include internal or external actions. In the second case, assistance by an insider must be taken into account.

Excerpt from: The fundamental principles of the physical protection: the Group of Six point of view by L. Carnas, M. Claeys, J-B. Fechner, A. Fontaneda González, S. Giménez González, A. Hagemann, S-G. Isaksson, C. Price, G. Robeyns, G. Rommevaux, R. Venot, K. Wager.

› The French physical protection system: the concept of defence in depth. The French approach to reducing the risk of internal or external malevolent actions consists in determining the sensitiveness of each zone and estimating the vulnerability of the most critical zones to each type of attack. Sensitiveness can be defined by the level of the radiological consequences resulting from a malevolent action. Countermeasures are intended both to minimise sensitiveness and make it more difficult to carry out the envisaged attack. To this end, the emphasis is placed on the defence in depth approach, organised around prevention, management and mitigation measures.

Threats are associated with the risk of attack and the means used by malevolent people. These means are taken as basic assumptions in the studies performed to assess the existing or potential protection measures (see box). Taking into account malevolent actions against nuclear facilities requires being able to define precisely the characteristics of the threats concerned. In order to appreciate an adversary's motivation and means, it was decided to collect information in relation to these kinds of actions, regardless of their success. A specific list was thus made, compiling events related by the media and French intelligence agencies or reported by facility staff.

In addition, since 1996 the competent authorities have asked operators to use a specific form to make their declarations. This form contains the following items: description and chronology of the event, the kind of threat, evaluation of the consequences, actions undertaken to avoid such an event happening again, preliminary analysis and lessons learned. Today, this list contains around 600 events which have occurred in France and concern nuclear facilities.

In France, regulatory bodies have adopted a performance-based approach which gives operators the flexibility to choose the means and measures which have to be taken. This approach enables a better adaptation to the risks which might occur in each type of facility and allows safety institutions to improve physical protection techniques on a continual basis.

The French physical protection system is mainly based on the concept of defence in depth which is organised around prevention, management of the event and mitigation as regards the theft of nuclear material or the sabotage of nuclear facilities. It takes the form of several lines of defence including both administrative aspects (such as procedures, instructions, sanctions, access control rules, confidentiality rules, etc.) and technical aspects (multiple barriers fitted with detectors and delaying devices). ■

On this subject, read *Protection of nuclear facilities and nuclear materials against malevolent actions* by P. Cornu, J. Aurelle and J. Jalouneix.

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