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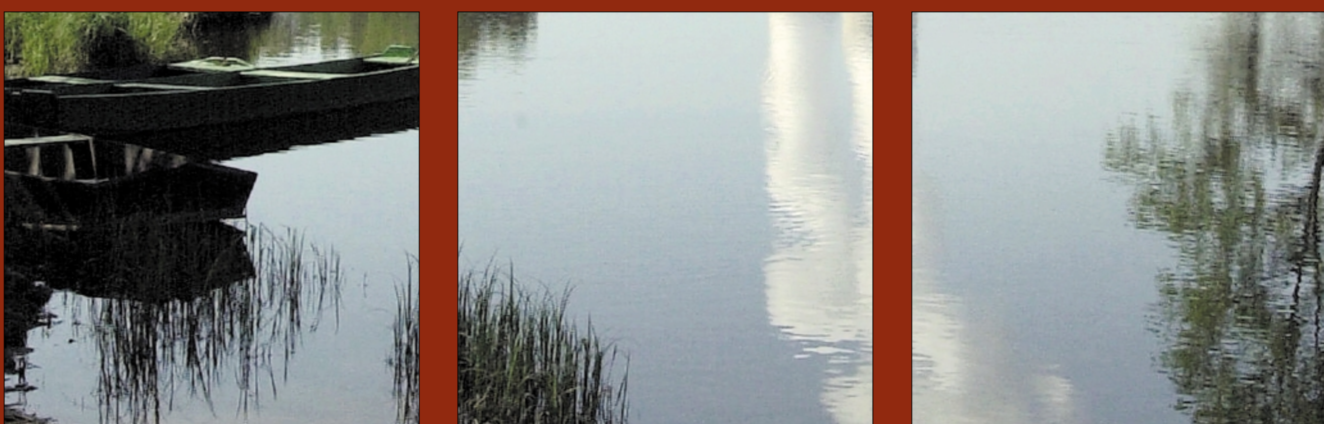

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NEA News

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The OECD Nuclear Energy Agency (NEA) was established in 1958 as the OEEC European Nuclear Energy Agency and took its present designation in 1972 when its membership was extended to non-European countries. Its purpose is to further international co-operation related to the safety, environmental, economic, legal and scientific aspects of nuclear energy. It currently consists of 28 member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, Norway, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission takes part in the NEA's work and a co-operation agreement is in force with the International Atomic Energy Agency.

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Cover page: View of Civaux 2 from the riverside, France (Source: EDF).

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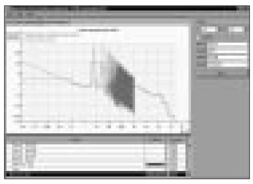

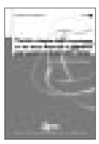

editorial

Maria Durisova, Bohunice NPP, Slovak Republic

Main control room with the newly installed panels of safety systems at the Bohunice nuclear power plant in the Slovak Republic.

Minimising and managing risk

The nuclear industry, like any other industrial activity, carries with it a certain amount of risk. The key issue is whether that risk can be maintained at a level which experts and civil society consider acceptable. A further step on the responsibility ladder involves making sure that adequate countermeasures, and in some instances compensation, are provided in cases where risk has materialised in the form of an accident.

The industry's nuclear safety experts are continuously striving to minimise the possible risk and extent of a nuclear accident, while nuclear regulatory authorities work to ensure that all safety requirements are met. Relying on a combination of deterministic and probabilistic approaches, they are obtaining positive results in terms of both risk-informed regulation and nuclear safety management. The lead article of this issue of NEA News *addresses this aspect of risk management, as well as the management of radiation exposure risk.*

The same article looks into nuclear emergency planning, preparedness and management, and stresses the importance of co-ordinating potential protection approaches and providing effective communication should a nuclear accident occur. A responsible approach in such a scenario also requires the provision of compensation to victims. The major improvements made during the recent revision of the "Paris Convention" on Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention in terms of amounts of compensation, geographical coverage, and number of beneficiaries are described in the article on page 8.

Updates and news briefs on other aspects of the Agency's ongoing work are, as customary, provided in the pages that follow.

Luis E. Echávarri
NEA Director-General

T. Lazo, B. Kaufer *

A global approach to risk management:

Lessons from the nuclear industry

Although the nuclear industry has focused primarily on its own needs in assessing and managing risk, many of the lessons it has learnt can be adapted to broader classes of risk and other contexts.

Governments are endeavouring to manage not only the interdependencies and interactions among hazards, between various systems and the forces influencing the overall context of risk management, but also the increasingly important international dimension of risk. The sheer complexity of these variables requires a holistic approach to the subject of risk.

Many conventional risks look set to take on new forms, and new hazards are emerging, some of which are characterised by considerable uncertainty on the one hand and the possibility of extensive and perhaps irreversible harm on the other. In particular, these trends point to a marked increase in the future in the probability of vital systems (technological, infrastructural, ecological, etc.) being damaged by a single catastrophic event (natural or man-made) or a complex chain of events. From the point of view of highly organised modern societies, such potential damage to the systems on which society increasingly depends (health services, transport, energy, food and water supplies, information and telecommunications, safety and security) could have serious and global consequences.

The experience needed to build a holistic approach is being drawn from various sectors of activity, many of which have been addressing their own sectorial risk assessment and management for some time. The nuclear industry is one of the sectors that has extensive experience to share.

From its earliest days, risk assessment and management has been at the heart of the nuclear industry. Attempts to assess and manage nuclear risks have recently begun to be viewed by nuclear regulators in the context of comparisons to other, broader risks. Several key aspects have emerged from ongoing studies that should be useful in looking at more complex risks and risk interactions. Broadly, these key aspects may be found in:

- the assessment and management of nuclear safety;
- the assessment and management of radiation exposure to the public, the environment and workers;

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- the planning, preparedness and management necessary in case of a nuclear emergency.

Although the nuclear industry's experience in these areas may not directly involve global-scale risks or complex, interlocking aspects, much of what it has learnt can still be applied in such scenarios.

Risk-informed regulation and nuclear safety management

Nuclear safety regulation is traditionally deterministic, with prescriptive rules about plant design, operation and quality assurance. In general, conservative assumptions are used in order to compensate for the lack of knowledge of the events considered and the physical processes involved. Such an approach in many cases leads to substantial safety margins. The rules and regulations currently in place were conceived at a time when probabilistic safety assessment (PSA) was not well developed. Probabilistic considerations were nevertheless used to conclude that certain accidents need not be considered in the design basis (e.g. pressure vessel rupture).

Improved computing power over the years has allowed PSA to mature. With time, plant accidents and plant-specific PSAs have identified limitations in the deterministic process. A main limitation is that in the identification of defence-in-depth measures (such as independent function of multiple safety systems), the lack of quantitative insights on risk makes it impossible to assess the adequacy of such measures. Therefore, the deterministic approach tends to apply excessive conservatism in certain areas and inadequate conservatism in others. For example, the assumption of single failure is not conservative in sequences where multiple-component failures are shown to be likely and should be given consideration in the design. Furthermore, although deterministic assumptions may largely be valid for designing equipment, they do not provide the operational and systemic insights necessary to support safe operation and maintenance. Because of these reasons, it is now recognised that PSA is an essential complement to the deterministic process both in the design and operational support of nuclear power plants.

From a nuclear safety point of view, probabilistic safety assessment is used during both the design and the operating stages of a nuclear power plant to identify and to analyse every possible situation and sequence of events that might result in severe damage to the reactor core. To the extent that PSA outcomes and insights can have an impact on the design and operation of nuclear power plants, they can also have an effect on regulation. Regulatory bodies are often faced with licensee submittals in which the results of PSA studies played a large role, such as the relaxation of technical specifications. Another example is where PSA has been used in planning the outage period. The widespread use of PSA in a regulatory context has, however, met with more or less acceptance in different countries.

JAERI, Japan

View of a nuclear safety test facility in Japan.

Both deterministic and probabilistic approaches have their strengths and weaknesses. Used in combination along with sound engineering, they can form a valuable tool for the nuclear industry and its regulatory decision-making process, as well as the basic methodologies for improving industrial safety generally.

Assessing and managing radiation exposure

A key aspect of assessing and managing the risk to an individual from radiation exposure is science's ability to estimate the health detriment that is – or could be – caused by such exposure. The risk/dose relationship is only a hypothetical assumption used by scientists and regulators to place an upper limit on possible health effects. Yet it is an essential tool in managing an exposure situation.

Specifically, an individual's exposure can be estimated for situations that are planned, that already exist, or that could result from an accident situation. Planned situations would include the development of a new facility (hospital, research laboratory, nuclear reactor, etc.) that would expose workers, and that would or might release radioactive materials to the environment that would then expose members of the public. Situations that already exist would include legacies such as abandoned or formerly used factories or research facilities that were contaminated with radioactive materials during their operation. Situations that could result from an accident would include a fire or explosion in a research or industrial facility using radioactive material, or a serious accident at a nuclear power plant, which could result in exposure to both workers in the proximity of the accident and to members of the public from the radioactive materials released. In all these situations, individual exposure can be estimated in an *a priori* sense, measured directly using radiation measurement devices, or "reconstructed" after the fact, using environmental measurements and estimates of the individual's location and habits over time.

From these exposure assessments, the health risks for exposed individuals can be estimated. Here, "health risk" refers to the occurrence of some types of radiogenic cancer or leukaemia. While developing cancer or leukaemia following radiation exposure is not a certainty, the greater the individual's exposure, the greater the risk that he or she will develop cancer.

It is this assessment of risk that can be used in a comparative fashion to determine how best to manage the risk. Management, in radiological protection terms, has for some time been expressed as keeping exposures as low as reasonably achievable (ALARA). The factors that are routinely considered when making these judgements include such basic items as the cost of reducing the exposure by a specified amount, and the amount of exposure (worker and public) that would be saved by the protection measures proposed. More complicated are the aspects that decision makers use when judging what is meant by "reasonably achievable" in each specific case. This depends upon many less tangible or quantifiable factors, such as the inherent value of the dose-causing activity – both for those exposed and society as a whole. In recent years, the process of optimising radiological exposure to levels that are ALARA has begun to integrate various forms of stakeholder involvement. In this way, there is more chance that the final decision will enjoy acceptance. The type and number of stakeholders involved in such processes vary from case to case.

A key aspect of this process is distinguishing between the science of risk assessment (quantification, discussion of uncertainties, elucidation of possible protection options, etc.) and the social aspects (relating to the acceptance of risk). Both elements play important parts in the decision-making process.

Maria Durisova, Bohunice NPP, Slovak Republic

Monitoring radiation in the vicinity of the Bohunice nuclear power plant in the Slovak Republic.

The notions of risk assessment and management described here, and which are applied in radiological protection at nuclear power plants, industrial facilities, hospitals and research laboratories, could be applied to many other types of risk, systemic or otherwise.

Nuclear emergency planning, preparedness and management

Another important area in which the nuclear industry has developed significant experience that is applicable in a wider framework is that of nuclear emergencies. Because of the risk of large reactor accidents causing large off-site release of radioactive materials, the nuclear community has, particularly since the Three Mile Island and Chernobyl accidents, substantially increased its ability to prepare for and, if necessary, react to nuclear accidents. Efforts have addressed several areas, but the most applicable to a broader context are the areas of harmonisation and communication.

It has been repeatedly demonstrated, through exercises and studies, that responses to the release of radioactive materials need to be harmonised because there can be so many actors and/or variables. Primarily, this concerns how and when various levels of government authorities will implement protective measures. For example, what criteria should be used to decide whether to evacuate a potentially exposed population, or to provide such a population with stable iodine tablets for the protection of the thyroid gland in case of a release of radioactive iodine? Should an accident have the potential for transboundary effects, modern communications (press, TV, radio, internet) will rapidly inform populations in the affected regions of any protection measures being implemented, and discrepancies may appear. Co-ordinating potential protection approaches among responsible officials before an accident occurs, and achieving a well-harmonised response afterwards would be instrumental in avoiding such situations. The public's perception, valid or not, of a conflicting or biased approach could lead to a lack of acceptance of protection measures, along with a general erosion in its trust of government. Even if a particular situation does not create physical transboundary effects, the way in which governments address such issues will still be questioned outside the country where the accident took place. National decisions, particularly regarding the import and export of food and goods and the protection of people passing through or near any affected areas will have international implications.

The internet is increasingly being tested and used for emergency communications.

The other key issue, related closely to harmonisation, is the need to quickly and effectively communicate. This includes communication within government decision-making structures, from government to the public, from national government to other national governments, and from government to relevant international organisations. To facilitate these exchanges, it is necessary to have pre-established lines and means of communication so that governments and experts can communicate rapidly. Emergency communication to the public is a central role of government, but may need to be reconsidered in the context of large or specific emergencies. In the nuclear community, international conventions and treaties have been established to describe when and how such emergency communications should be made, as well as what essential information should be included in the initial notification. A structure for communications, through the International Atomic Energy Agency (IAEA), was established under the international Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency in 1986.

It is widely accepted through the experiences from emergency exercises and studies, that such notification and communication structures are essential to appropriately manage an emergency situation. The institutional implications, both national and international, of the need and obligation to communicate include the need to allocate appropriate resources to this task, as well as the need to account, structurally, for these lines of communication. Such communication lines could also facilitate the national decision-making processes in other types of emergency situations. ■

J. Schwartz*

Liability and compensation for nuclear damage:

The revision of the Paris Convention and the Brussels Supplementary Convention

The negotiations to revise the Paris and Brussels Supplementary Conventions aimed to improve the existing international nuclear liability regime, and the texts of the two amending Protocols resulting from those negotiations have been finalised. Their entry into force will provide a higher level of compensation to more victims for a broader range of nuclear damage, should an accident occur.

The 1986 accident at Chernobyl demonstrated that damage resulting from a nuclear incident can have seriously detrimental effects upon people, property and natural resources in neighbouring countries. In response to that accident, a major international effort was undertaken to modernise the existing international nuclear liability regime with the intent of ensuring that victims in all countries affected by a nuclear accident would be accorded equitable compensation for damage suffered. Within a little more than ten years, two significant initiatives had been completed: the adoption, in 1988, of the Joint Protocol[1] relating to the Application of the Vienna Convention and the Paris Convention, and the adoption, in 1997, of the Protocol to Amend the Vienna Convention[2] ("Vienna Amending Protocol") and the Convention on Supplementary Compensation for Nuclear Damage[3] ("Supplementary Compensation Convention").[4]

The most recent initiative in this ongoing international effort is the current revision of the Paris[5] and Brussels Supplementary[6] Conventions. The parties to the Paris Convention began their revision exercise only months after the Vienna Amending Protocol had been adopted, a matter of no great surprise given that the amendments effected by that protocol would inevitably have an impact upon the Paris Convention through their linkage by the 1988 Joint Protocol.[7] At the same time, the Paris Convention States wanted to ensure that modifications to their convention would not impede any future adherence to the new regime established by the Supplementary Compensation Convention, a commitment they had made during the latter's negotiation. Some

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two years into that revision exercise, the parties to the Brussels Supplementary Convention agreed to revise that convention as well, and thereafter the negotiations for the revision of both conventions proceeded in tandem, both for practical reasons and because of the close substantive links between the two.

The contracting parties to the two conventions have now successfully concluded their negotiations and approved the final texts of the amending protocols for both. It is expected that these instruments will be opened for signature at a special conference to be convened at OECD headquarters within the coming months, following which the signatories will commence whatever ratification, acceptance or approval procedures are required by their national law to bring those instruments into force. The major features of the revised conventions are summarised below.

Victims will have access to larger amounts of compensation

Under the revised Paris Convention, the amount of a nuclear operator's liability will surge from its current maximum of 15 million Special Drawing Rights (SDRs)[8] to an amount not less than €700 million. This is a very significant increase, even taking into account the 1990 NEA Steering Committee Recommendation encouraging Paris States to adopt an operator liability amount of at least 150 million SDRs.[9] It also more than doubles the 300 million SDR liability amount called for under the Vienna Amending Protocol. In addition, the amended convention will recognise, for the first time, that a state with an unlimited liability regime may still participate in the convention.

Paris Convention States will continue to be able to fix minimum reduced liability amounts for low-risk nuclear installations and transport activities, but those amounts will be raised from the current 5 million SDRs[10] to €70 million for low-risk installations and €80 million for transport activities.

Operators will still be required to provide financial security in the amount for which they are liable, but for states with unlimited liability regimes, that amount must equal either the full minimum liability amount or a minimum reduced liability amount, whichever is applicable. States party to the revised Paris Convention will also be required to ensure the payment of nuclear damage claims where the operator's financial security is unavailable or insufficient, up to the liability amount specified in the convention.

Victims may claim compensation for a wider range of damage suffered

The amended Paris Convention will finally contain a definition of "nuclear damage" permitting, but not requiring, coverage for a broader range of damage than is contemplated under the existing convention (personal injury and property damage). The new definition is almost identical to that found in the Vienna Amending Protocol and the Supplementary Compensation Convention, with specific references to economic loss, the cost of measures of reinstatement of a significantly impaired environment, loss of income resulting from that impaired environment and the cost of preventive measures and loss or damage caused by such measures.

The Paris Convention will soon also apply to nuclear installations that are in the course of being decommissioned and *all* nuclear installations for the disposal of nuclear substances, not just those in the pre-closure phase as is currently the case.[11] Nevertheless, Paris States may exclude a particular disposal facility in the post-closure phase from the application of the convention where it no longer poses a significant risk and is therefore no longer under active surveillance.

There was also agreement that the term "nuclear incident" should be interpreted as including emissions occurring in the normal course either of a nuclear installation's operation or the transport of nuclear substances where those emissions cause nuclear damage, even if they are within prescribed limits under national law.

More victims will be entitled to compensation

Under the existing Paris Convention, a nuclear incident must occur in the territory of a contracting party and damage must be suffered there before the convention will apply. That rule was relaxed by two NEA Steering Committee Recommendations made in 1968 and 1971 respectively,[12] suggesting that the convention cover nuclear incidents occurring or nuclear damage suffered on the high seas, and that it apply to damage suffered in a Paris State even if the nuclear incident occurs in a state not party to the convention. In the future, the Paris Convention will also apply to any nuclear damage suffered in a non-convention state (including its territories and maritime zones) if: a) it is a party to the Vienna Convention and the 1988 Joint Protocol, b) it has no nuclear installations in its territory or in any of its maritime zones, or c) its nuclear liability legislation affords equivalent reciprocal benefits and is based on principles identical to those contained in the Paris Convention.

This approach is somewhat different from that adopted under the Vienna Amending Protocol which applies to nuclear damage wherever suffered, subject to permitted *exclusions* for damage suffered in a non-convention state which has a nuclear installation but offers no equivalent reciprocal benefits.

Victims will have more time within which to make their claims

As with the Vienna Amending Protocol, under the revised Paris Convention prescription and extinction periods for nuclear damage claims will be extended to 30 years for actions respecting loss of life and personal injury, while remaining at 10 years for other types of damage. Longer periods are possible if the operator has appropriate financial security and where actions brought within that period do not affect the compensation rights of victims who have instituted their actions within the original 30 and 10-year periods respectively. Unlike the Vienna Amending Protocol, however, no "priority" rule will be included in the revised Paris Convention, and where the compensation amount is insufficient to cover the damage suffered, the competent court will determine whether priority is to be given to claims for loss of life and personal injury and if so, during what period of time.

Recognising the special concerns of coastal states

As with the Vienna Amending Protocol and the Supplementary Compensation Convention, the amended Paris Convention will recognise the concerns of coastal states with maritime shipments of nuclear substances through their waters by including provisions to ensure that where a nuclear incident occurs in the exclusive economic zone (EEZ) of a Paris State (or in an area not exceeding the limits of such a zone were one to be established), jurisdiction over claims for nuclear damage arising from that incident shall lie only with the courts of that coastal state.

Additional compensation under the Brussels Supplementary Convention

For those Paris Convention States that have joined the Brussels Supplementary Convention, additional compensation, made up of public funds, will be available to compensate victims of nuclear

Liability and compensation levels for nuclear damage under the revised Paris Convention and the Brussels Supplementary Convention

Paris Convention	*Before revision*	*After revision*
➩ basic liability or "reference" amount	15 million SDRs maximum *(≈ €19 million)*	€700 million minimum
➩ reduced liability amounts		
• for transport	5 million SDRs minimum *(≈ €6 million)*	€80 million minimum
• for low-risk nuclear installations (e.g. small research reactors)	5 million SDRs minimum *(≈ €6 million)*	€70 million minimum
Brussels Supplementary Convention	*Before revision*	*After revision*
➩ first tier	national limit *(5 million SDRs minimum)*	€700 million minimum
➩ second tier	difference between the first tier and 175 million SDRs	€500 million
➩ third tier	125 million SDRs *(≈ €156 million)*	€300 million

damage where the amounts under the Paris Convention are insufficient. The revised Brussels Supplementary Convention will maintain its basic three-tier compensation system but with significantly increased amounts: the first tier will continue to come from the operator's financial security, will comprise at least €700 million and will be distributed in accordance with the Paris Convention; the second tier will be provided by the installation state and comprise up to €500 million; and the third tier will be made available by all of the contracting parties and comprise up to €300 million. Thus, the total amount of compensation available to victims of a nuclear incident under the combined Paris-Brussels regime will be not less than €1.5 billion.[13]

Under the revised Brussels Supplementary Convention, a large degree of flexibility will be allowed between the first and second tiers, enough, in fact, to permit a nuclear operator to assume liability for both. As for the third tier, the formula for calculating contributions will change from one based equally on gross national product and installed nuclear capacity to one based 35% on gross domestic product and 65% on installed nuclear capacity, reflecting the greater responsibility placed upon nuclear power generating states. The third tier will increase, albeit only slightly, in the event that new states adhere to the convention.

Compensation under the Brussels Supplementary Convention will continue to be made available only to victims in states party to that convention. The rationale for this principle is simply that, as compensation under the convention (second and third tiers) is essentially "public" money, it should only be used to compensate victims in states that have agreed to participate in the supplementary regime.

Conclusions

This complex revision process, with the extension of the scope of geographic coverage and significant raising of the compensation amounts for the benefit of a broader range of potential victims, represents a major milestone in the development of comprehensive, modern, legal instruments to guarantee equitable compensation of damage resulting from the operations of a nuclear installation. Although the revision process is not quite yet complete, all of the Paris and Brussels States who have participated in it should be proud of their efforts and the results that their efforts have produced. ■

References

1. The Joint Protocol extends to states adhering to it, the coverage provided under the convention to which it is not already a contracting party. Thus, where a nuclear incident occurs in a state that is party to the Paris Convention/Joint Protocol, and damage is suffered in a state that is party to the Vienna Convention/Joint Protocol, victims in the latter state may claim compensation for damage against the liable Paris Convention operator as if they were victims in a Paris Convention State. In force as of April 1992, the Joint Protocol has 24 contracting parties, of whom 16 are party to the Vienna Convention and 8 are party to the Paris Convention.
2. On 5 December 2001, there were 15 signatories/4 contracting states to the Vienna Amending Protocol.
3. On 14 November 2000, there were 13 signatories/3 contracting states to the Supplementary Compensation Convention.
4. For informative articles on the Vienna Amending Protocol and on the Supplementary Compensation Convention, see respectively, Lamm, V., "The Protocol Amending the 1963 Vienna Convention" and McRae, B., "The Compensation Convention: Path to a Global Regime for Dealing with Legal Liability and Compensation for Nuclear Damage" both in *Nuclear Law Bulletin*, No. 61, June 1998.
5. The Convention on Third Party Liability in the Field of Nuclear Energy of 29th July 1960, as amended by the Additional Protocol of 28th January 1964 and by the Protocol of 16th November 1982. Its 15 contracting parties are Belgium, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Turkey and the United Kingdom.
6. The Convention of 31st January 1963 Supplementary to the Paris Convention of 29th July 1960 on Third Party Liability in the Field of Nuclear Energy, as amended by the Additional Protocol of 28th January 1964 and by the Protocol of 16th November 1982. Its 12 contracting parties are Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Slovenia (for which the convention will enter into force on 5 June 2003), Spain, Sweden and the United Kingdom.
7. The Joint Protocol applies to the Vienna and Paris Conventions, as amended.
8. The Special Drawing Right is a unit of account defined by the International Monetary Fund (IMF) based upon the US dollar, the euro, the Japanese Yen and the Pound sterling. According to the IMF exchange rate on 24 April 2003, SDR1 = US$1.38 and SDR1 = €1.25. The amount of 15 million SDRs is thus approximately US$20 million or €19 million.
9. Based upon the IMF exchange rate cited above, this approximates US$207 million or €188 million.
10. Based upon the IMF exchange rate cited above, this approximates US$7 million or €6.3 million.
11. See the 1984 Decision of the NEA Steering Committee [NEA/NE/M(84)1].
12. Recommendation of the NEA Steering Committee of 24 April 1968 [NEA/NE/M(68)1] and Recommendation of the NEA Steering Committee of 22 April 1971 [NEA/NE/M(71)1].
13. This amount cannot compare with the approximately US$9 billion of compensation that would be made available under the United States' Price-Anderson Act, but this much higher amount is used to cover claims handling costs as well as compensation, which is not the case under either the Paris or the Brussels regime.

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Public involvement in radioactive waste management:

Current approaches and experiences

Institutions involved in radioactive waste management are facing a rapidly evolving environment stemming from societal changes, including new information technologies and new roles for the media. At the same time, some national programmes are moving from research and development to site selection and implementation, while other countries are reviewing and defining their policies in the waste management area. As in many other fields in which environmental and risk considerations are involved, demand for public participation in radioactive waste management decision making calls for new approaches towards involving stakeholders.

A recent survey[1] by the NEA Forum on Stakeholder Confidence has collected information on specific stakeholder involvement initiatives, the institutions and publics concerned and the tools used, and presents this in tabular form. Countries' experiences are discussed and the outcome of each approach reflected in some detail.

Public perception and confidence are critical issues when seeking approval to develop facilities for long-lived radioactive waste at specific sites. This raises the question of how best to achieve confidence regarding the ethical, economic, political and technical aspects of a waste management strategy, and in particular disposal. In addition, the "public" is not a homogeneous group, with its various components and concerns that need to be identified and understood.

General approaches to public participation

Over the last decade the need for nuclear waste management programmes to become more communication-oriented, rather than relying on one-way releases of information, has increased. This is largely due to the introduction of legal requirements for public consultation, often under the umbrella of an environmental impact assessment (EIA) or other provisions in national or international laws. This need has also been triggered by advances in national programmes to the phase of site selection and the necessary involvement of regional and local bodies as well as concerned citizens.

In general, a licence for a repository for radioactive waste needs not only a technical or regulatory decision but also a political decision, which in turn requires broad public consent. Explicit requirements often exist for consultation with affected parts of the public, especially those living close to a potential facility. In most countries, members of the public have the opportunity to respond or

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object to a proposed nuclear installation at certain phases in the decision process.

In Canada, for example, the *Nuclear Safety and Control Act* that established the Canadian Nuclear Safety Commission (CNSC) imposes requirements for public notification and participation. In the Czech Republic, representatives of the public sit on the Radioactive Waste Repository Authority (RAWRA) Board. In this way, they participate directly in the decision-making process.

Switzerland, with its federalist structure, has a long tradition of involving the public in decision making at all political levels. The public decides in a binding fashion on factual questions through communal, cantonal and federal referenda. The licensing procedure for each licence includes two public consultations, which give opportunity for the public to comment on or object to the project at hand. In other countries, referenda at the local level are also used, although they are not always obligatory.

In Finland and Sweden, it is stipulated that the local municipal council has the right to veto a siting proposal (although in Sweden a veto may in principle be overruled by the government under certain conditions). In Sweden, the siting process is based on voluntary participation and the feasibility studies take place only in municipalities that have given their consent.

Another incentive for public information and participation stems from international legal instruments. International conventions are binding on states that have ratified them. A number of them are relevant for public information and consultation policies, for example: the *UN Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters* (Aarhus Convention); the *UNECE Convention on Environmental Impact Assessment in a Transboundary Context* (Espoo Convention); and, embedded in the *UN Conference on Environment and Development*, the *Rio Declaration* and *Agenda 21*.

Credibility and effective means of communicating

Public confidence must be built through two-way communication. An important role of meetings, information centres and internet sites is, indeed, to obtain feedback from the public in order to identify and later address issues of public and social interest.

Communication can only be effective if all parties in the process are interested in it and if the legitimacy and the roles of all parties are acknowledged. One pitfall of earlier communication approaches was the emphasis by waste management experts on technical and scientific issues to the detriment of wider social issues. Effective communication requires the ability to discuss all issues of interest to the public, even controversial social or philosophical issues.

Experiences and initiatives to inform and involve stakeholders

Changes being decided in an overall waste management programme, in particular as a result of substantial public concern or political opposition, may often pave the way to improved communication or involvement of stakeholders in the future. For example, in France and the United Kingdom, earlier negative experiences in site selection have led to re-evaluation and redirection of the overall national programmes.

In France, the 1991 law on radioactive waste management research instituted a new approach to radioactive waste management research in general, and site selection in particular, with responsibility, transparency and democracy as lead principles.

A debate at the French National Assembly.

The new approach to site selection looks for consensus with, and actively involves, responsible territorial communities. The law provides for the establishment of a local information and monitoring committee for each underground laboratory site. An important aspect of the French approach is the responsibility taken by Parliament, which will debate the state of research in 2006 and eventually decide whether to pursue the development of a repository in the vicinity of one of the laboratory sites. A key element in the French programme is that other options (near-surface storage, transmutation) are being kept open until the Parliament decides otherwise.

In the United Kingdom, a parliamentary enquiry recommended in 1999 that the Government proceed with underground disposal, but that its policy must be comprehensive and have public support. The Government replied that it would seek public views as well as consider all waste management options before endorsing a particular one.

Experiences in site selection

In Finland, a site was recently proposed by the Posiva radioactive waste management organisation for detailed investigation of the underground disposal of spent fuel, and the municipality has given its consent. This is consistent with the "Decision in Principle" taken on the national political level and with the environmental impact assessment (EIA) as the key tool for communication with concerned municipalities and the general public. The site has now been approved pending confirmatory research.

In Sweden, the EIA has also been a key tool for the dialogue between the radioactive waste management organisation SKB, the government authorities, municipalities, counties and the public. Here the regulators have taken an active role in the process, supported by a series of research projects. The municipalities themselves have also taken extensive initiatives in competence building and two-way information.

On the other hand, certain negative experiences have been encountered: for example, in 1997 in the Sellafield case in the United Kingdom for an underground laboratory, where technical discussions did not address the real concerns of the local community, or the Gorleben case in Germany where distrust in "officials" grew and there was "no real public participation" in the decision making, or the negative cantonal referenda on the proposed site at Wellenberg in Switzerland in 1995 and 2002.

Learning about perceptions, values and interests important to stakeholders

Obviously different stakeholders have different interests with regard to nuclear waste management. But all stakeholders share an interest in protecting man and nature against possible harm from radioactive substances. Values in favour of health, environmental protection and safety are progressively gaining importance in our society. Risk perceptions exist concerning radioactivity, nuclear energy and radioactive waste that suggest these values could be threatened. On another level, many can see the utility of centralised, purpose-built, waste disposal facilities; however, they do not want the installations in their region (the "not in my backyard" or NIMBY syndrome).

In respect of disposal facilities, a central concern of many stakeholders is to avoid irreversible decisions and actions. The reason for the concern seems to be mistrust in the judgements of the authorities and the scientists. This has resulted in the request for active control of a disposal facility. This, however, raises another problem which is that of time frames. The general public has difficulties comprehending the very long time periods associated with radioactive waste disposal. There is a need to explain that a waste management solution based uniquely on active control is adequate for a limited period of time but cannot be viewed as the sole long-term solution. Reversibility of disposal measures, and retrievability of disposed wastes are often favoured by stakeholders. However, experiences in the Swedish communities, for example, do not support the conclusion that the public sees retrievability as the main safeguard against possible shortcomings in the disposal method. Citizens focus their demand on clear statements from the regulators and the government that the proposed disposal method is safe. ■

Note

1. Nuclear Energy Agency (NEA), *Public Information, Consultation and Involvement in Radioactive Waste Management: An International Overview of Approaches and Experiences.* Paris: OECD, 2003.

S. Mundigl*

Efficiently protecting nuclear workers from ionising radiation

One of the longstanding activities of the NEA in the field of occupational exposure is the Information System on Occupational Exposure (ISOE), a joint NEA/IAEA programme. Since its start in the early 1990s, ISOE has become a unique, worldwide programme to discuss, promote and co-ordinate international co-operative undertakings for the radiological protection of workers at nuclear power plants. This includes providing a forum for discussing occupational exposure management issues and the world's largest database on occupational exposure from nuclear power plants. ISOE is the only programme in the field of occupational exposure to enjoy active participation of radiological protection experts from both utilities and national regulatory authorities.

ISOE Participation

ISOE has grown in participation over the years and has become the largest network concerned with the radiological protection of workers. The system currently includes information on occupational exposure levels and trends at 461 reactor units (407 in operation and 54 in various phases of decommissioning), operated by 72 utilities in 29 countries. This database thus covers some 93% of the total number of nuclear power reactors (438) in commercial operation throughout the world. In addition, the regulatory authorities of 25 countries participate actively in ISOE.

ISOE advantages

The ISOE programme offers a variety of products in the occupational exposure arena, such as:

- *The world's largest database on occupational exposure of workers in nuclear power plants* – The ISOE databases include:
  - dosimetric information from commercial nuclear power plants, including for each participating unit, e.g. annual collective dose for normal operation, maintenance/refuelling outage doses, collective dose for unplanned outage periods, annual collective dose for certain tasks and worker categories;
  - plant-specific information pertinent to dose reduction, such as materials, water chemistry, start-up/shutdown procedures, cobalt reduction programme, etc.;
  - experience reports on specific operations, jobs, procedures, equipment or tasks, for

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example an effective dose reduction, an effective decontamination, or the implementation of work management principles.

- *A yearly analysis of dose trends and an overview of current developments, through ISOE annual reports* – The annual reports summarise recent information on levels and trends of average annual collective dose at the reactors covered by the database, and provide special data analyses and dose studies, outage experience reports, summaries of ISOE workshops and symposia, as well as information on principal events in ISOE participating countries.
- *Detailed studies and analyses, as well as information on current issues in operational radiological protection, through ISOE information sheets* – Dosimetric and other data from nuclear power plants provide an ideal basis for studies on dose related to certain jobs and tasks, such as refuelling, steam generator replacement and insulation work. These studies are published as ISOE information sheets and distributed to ISOE participants.
- *A system for rapid communication of information on radiological protection* – Anytime a utility wishes to share experience on good practices, radiological problems or other technical issues, the ISOE network may be used to request or send information through the e-mail system. This allows rapid responses and interaction between interested participants. The experience reports are subsequently stored in the ISOE database, and can be retrieved via a search routine using keywords.
- *A forum for discussing occupational exposure management issues through ISOE workshops and symposia* – Each year, an international workshop or symposium on occupational exposure management at nuclear power plants is organised in Europe and North America on an alternating basis. The objective of these workshops and symposia is to provide a forum for radiological protection professionals from the nuclear industry and regulatory authorities to exchange information on practical experience with occupational exposure issues in nuclear power plants.

International conference on occupational radiological protection

In recent years, ISOE has become increasingly recognised as a centre of excellence for the radiological protection of workers in nuclear power plants. In August 2002, the first International Conference on Occupational Radiological Protection: Protecting Workers Against Exposure to Ionizing Radiation was organised, with sponsorship by several international organisations including the NEA. The conference findings and recommendations explicitly cited the ISOE system:

> *For nuclear power plants, ISOE is a very useful mechanism for disseminating information, examples of good practice and lessons learnt. There are no similar mechanisms in other areas, and it would be helpful to develop complementary systems.*

In addition, the conference stressed the fact that occupational radiological protection in the nuclear fuel cycle has received more attention than occupational radiological protection in any other practice. The main driving force for occupational exposure control has been application of the optimisation (ALARA) principle, which is now part of normal job planning and almost second nature. The results over the past few decades in terms of reductions of all indicators – average doses, collective doses per unit of energy generated and numbers of people receiving high individual doses – are well documented. International databases and mechanisms such as the ISOE and ALARA networks are very important in maintaining this situation. Concern is still warranted over the control of exposures of itinerant workers and contractors.

Radiological protection in the 21st century

The International Commission on Radiological Protection (ICRP) has recently embarked upon a broad programme of consultation in order to collect concepts, ideas and views regarding how radiological protection should be managed at the start of the 21st century. The NEA, through its Committee on Radiation Protection and Public Health (CRPPH), has pursued a dialogue with the ICRP over the past several years in order to contribute actively to the development of new ideas and approaches that could help the internationally accepted system of radiological protection respond better to the needs of policy makers, regulators and practitioners. With regard to occupational radiological protection, the NEA will undertake – through the ISOE network – a discussion with radiological protection practitioners in nuclear installations investigating the implications of any new recommendation on the protection of workers.

Regarding the management of occupational exposures, the current system of radiological protection seems to work rather well, without requiring major modifications. Nevertheless, any evolution of the system of radiological protection should ensure that particular attention is given to the most exposed workers, e.g. transient workers, medical professionals and decommissioning workers. In doing so, a worldwide, agreed-upon, standard level of protection (dose limit) is considered essential for the credibility of the system. It should correspond to a risk comparable to other industries. As an important principle of radiological protection, optimisation is seen as the main tool for efficient dose reduction. Concern has been raised that the well-established concept of optimising doses to become "as low as reasonably achievable" (ALARA) could be weakened in the future system. An open issue to be addressed by any future system of radiological protection is the appropriate management of occupational exposure to natural radiation.

Practical issues in occupational radiological protection

The Third ISOE European Workshop on Occupational Exposure at Nuclear Power Plants, which was held in April 2002 in Portoroz, Slovenia, focused on the management aspects of occupational exposure reduction programmes. Three major topics were discussed.

- *The impact of deregulation on occupational exposure* – Regarding the impact of deregulation on radiological protection in nuclear installations, the radiological protection specialists recognised that:
  - Management should pay more attention to possible effects from downsizing radiological protection staffs.
  - Regulatory bodies should negotiate with nuclear power plants a minimum number of radiological protection and safety staff necessary to maintain an appropriate level of radiological protection.
  - Utilities need to maintain regular investments in radiological protection and safety culture.
- *The definition of goals and radiological protection indicators* – Setting up goals and radiological protection indicators is an important management tool, all the more so given current pressures stemming from competition and deregulation. Goals must be measurable, realistic and challenging. They must be communicated to all stakeholders, and correspond to long-term goals set up by the management. Any deviation from a goal should require appropriate follow-up.
- *The definition and use of dose constraints* – In addition to the above-mentioned goals and radiological protection indicators, dose constraints are introduced as planning tools for the optimisation of worker protection, e.g in planning work tasks. Some harmonisation of dose constraints could facilitate the optimisation of radiological protection of contractors and itinerant workers.

In January 2003, the 2003 International ISOE ALARA Symposium was held in Orlando, Florida, United States. After a half-day discussion on the general future of radiation safety, the conference concentrated on practical ALARA applications and lessons learnt. A major part of the presentations and discussions focused on current and past experience with reactor vessel head inspection, repair and replacement. The issue of reactor vessel head degradation is a very good example for showing the potential of the ISOE information exchange system to disseminate quickly experience on good/bad practice in radiological protection actions.

Challenges facing ISOE

ISOE is mainly used by radiological protection practitioners – for whom the system was originally created and designed – working in nuclear installations or in national regulatory authorities. In order to enhance the visibility of ISOE, broader support must be gained by promoting the system at a higher level of management. In the same context, another important concern for the future of ISOE is the establishment of liaisons with other international organisations, such as the World Association of Nuclear Operators (WANO).

Conclusions

The Information System on Occupational Exposure offers a unique, worldwide programme to discuss, promote and co-ordinate international co-operative undertakings for the radiological protection of workers. For nuclear power plants, ISOE is a very useful mechanism for disseminating information, examples of good practice and lessons learnt. Similar systems could be usefully developed for other areas of occupational radiological protection. ■

P. Smith, P. de Preter, S. Voinis*

The handling of timescales in assessing post-closure safety of deep geological repositories

Geological repositories are sited, designed and operated to protect humans and the environment from the hazards associated with radioactive waste. Most challengingly, they are required to provide protection after their closure and over timescales that are considerably in excess of those commonly considered in most engineering projects, often up to several thousand or even a million years. This requirement is laid down in international guidance and in many national regulations.

Protection is achieved by locating repositories deep underground, thus isolating the waste from the human environment. In addition, sites and designs are chosen that provide highly effective passive barriers to the release and migration of radioactivity, the aim being to ensure that any releases of radioactivity to the human environment are very low.

The accepted approach for arriving at an adequate site and design is one of constrained optimisation.[1] Regulations set the process to achieve protection in terms of design optimisation and application of sound management and engineering practices, as well as maximum acceptable radiological consequences in terms of dose or risk criteria for hypothetical individuals living in the future. Siting, design and implementation proceed in a step-by-step process. At each step a case for safety needs to be made that is adequate to support the decision in hand and to support any licence application required.

Various processes and events could affect the evolution of a repository and its environment, and hence the containment and possible release of radioactivity from the repository and its migration to the surface. These processes and events are characterised by timescales ranging from a few tens or hundreds of years for transient processes associated with, for example, the resaturation of the repository and its immediate surroundings following closure, to perhaps millions of years for changes in the geological environment. The figure shows an example of the division of future time into a number of phases, or time frames, for safety assessment purposes. The figure shows how, in each time frame, different phenomena or "safety functions" are emphasised in the safety case. In this example, a "latent function" is one that only operates if other safety functions (unexpectedly) fail to operate. A "reserve function" is one that may well enhance the level of safety, but uncertainties are such that it cannot be relied upon with confidence within a given time frame.

Safety assessments must also consider whether any releases of radioactivity lead to consequences greater than those targets set by regulation. In order to evaluate compliance with dose or risk criteria, assumptions must be made regarding the habits of

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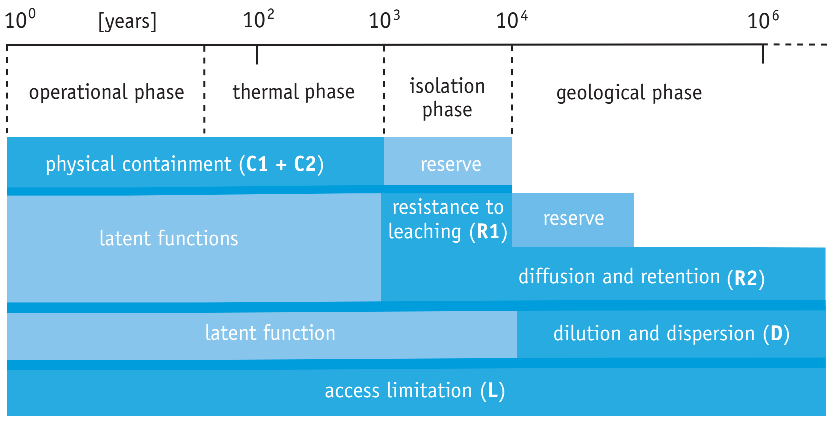

An example from ONDRAF of the four phases of the normal evolution of a repository for high-level waste and the corresponding long-term safety functions. The first two safety functions can each be subdivided into two sub-functions. For the "physical confinement" function, which aims to prevent any release of activity from the waste matrix, the two sub-functions are "water tightness" (C1) and "slow water infiltration" (C2).

potentially exposed groups (e.g. diet, lifestyle and land use), and these may change over timescales of just a few years.

The need to deal with such a wide range of timescales gives rise to a range of issues related to the methods and presentation of safety assessments. In particular:

- Is it really necessary to argue a case for safety over timescales of a million years or more?
- If so, how predictable is the evolution of the repository and its environment over these timescales?
- What types of arguments are available that take account of the inevitable changes and uncertainties associated with long timescales?
- How can public concerns affect the emphasis given to different types of argument at different times?

These issues are of concern to all national programmes and provided the motivation for the IGSC (Integration Group for the Safety Case, set up by the OECD Nuclear Energy Agency) to support and organise a workshop entitled "Handling of timescales in assessing post-closure safety". The workshop was held in Paris on 16-18 April 2002 and was hosted by the French Institute for Radiological Protection and Nuclear Safety (IRSN). The NEA prepared a synthesis of the workshop, which was published in the proceedings.[2] The main findings may be summarised as follows.

- **The timescale over which a safety case needs to be made**

It is an ethical principle that the same or better level of protection for humans and the environment applicable today should also be provided in the future. This implies that the safety implications of a repository need to be assessed for as long as the waste presents a potential hazard. There are no scientific or ethical arguments that justify imposing a definite limit to the period considered by safety assessments. The long timescales addressed in practice in safety assessments arise from the finite, though sometimes long, half-lives of some of the isotopes in the waste and the high degree of effectiveness with which deep geological disposal facilities are expected to contain radioactivity – safety studies for deep geological repositories tend to focus on the distant times when releases eventually occur.

- **Intrinsic quality of the site and the design and limits to predictability**

An important line of argument in safety assessments relates to the intrinsic quality of the site and the design. The safety of any repository depends primarily on the favourable characteristics of the engineered materials and the geological environment – including their predictability over prolonged periods – and these characteristics need to be stressed in safety cases. As regards the geological environment, evidence for stability and other favourable characteristics often comes from *in situ* observations and measurements. More generally, thermodynamic, kinetic, mass balance and palaeohydrogeological arguments can play a role. Arguments for the feasibility, in principle, of safe geological disposal can also be made based on the existence of natural analogues and, in particular, natural uranium deposits.

Another aspect of the intrinsic quality of the site and the design for most repositories is the fact that multiple barriers or processes contribute to safety. This is termed the "multi-barrier" and/or "multi-function" concept. As conditions in the repository and its environment evolve over the course of time, some components can cease to perform certain functions and new functions come into operation.

Nevertheless, in order to maintain credibility within the scientific community as well as with other stakeholders, it is important to acknowledge the limits of predictability of the repository and its environment in both regulations and in safety cases.

- **Arguments for safety in different time frames**

Multiple lines of argument, with an emphasis on different types of argument and different indicators of performance and safety in different time frames, some of which are more qualitative in nature, are useful for building a convincing safety case. Safety assessments are increasingly taking into account the full range of arguments for safety that is available, as well as the safety and performance indicators that can be used to complement dose and risk; regulations are increasingly providing guidance regarding their use.

As discussed above, well-supported statements regarding the radiological consequences can be made that cover a prolonged period provided a repository is well designed and a suitable, geologically stable site is selected. A less rigorous assessment of radiological consequences is likely to be adequate at times when the stability of the geological environment can no longer be assured, on account of the strongly decreased radiological toxicity of the waste that is expected at these times.

- **Stylised approaches**

Given that changes in human society, technology and the surface environment are likely, and are largely unpredictable over the time period of interest in safety assessments, there is international consensus that radiological doses and risks calculated for hypothetical human groups dwelling in the future, but with habits and technology similar to that of the present day, are appropriate as indicators of repository safety. More generally, "stylised approaches" are commonly applied as a means of addressing the evolution of the surface environment and the nature of future human actions. Such approaches involve defining a range of alternative "credible illustrations" or "stylised situations", including, for example, different possible future climate states, agricultural practices and exposure pathways, and analysing the resultant dose or risk for hypothetical critical groups. This avoids open-ended speculation on issues that in any case should not impact unduly on the decisions taken on repository development.

- **Complementary safety and performance indicators**

The use of dose and risk as primary safety indicators does not preclude the use of other additional indicators of safety or performance. The use of safety and performance indicators other than dose and risk can help circumvent both the limited predictability of the surface environment and, on a far longer timescale, the limited predictability of the geological environment. They provide useful complementary arguments for safety if accepted reference values or criteria for comparison can be agreed upon. Natural systems may often provide the basis for such reference values or criteria.

Arguments based on complementary indicators can sometimes be more accessible to a non-specialist audience than those based primarily on dose or risk calculations. Furthermore, even for a technical audience, the presentation of dose or risk as a function of time is not, on its own, an effective way to convey the message that deep geological repositories provide an appropriate level of safety. For example, they tend to focus attention on the small releases that may eventually occur, rather than on the fact that most radioactivity is isolated and contained within the repository and its immediate surroundings, where it decays. It can thus be useful to complement graphs of dose or risk as functions of time with additional graphs or tables giving indicators that more directly illustrate the performance of the different repository barriers and combinations of barriers.

- **Addressing public concerns**

Irrespective of timescale, documents aimed at the public should highlight arguments that the public might find persuasive. The presentation of safety cases for the period of a few hundred years following emplacement of the waste may, however, deserve particular attention, with greater emphasis on the fact that, for most repository concepts, zero release of radioactivity is expected in this period. Monitoring during the operational and immediate post-closure period may potentially contribute to public confidence.

Notes

1. ICRP, *Radiation Protection Recommendations as Applied to the Disposal of Long-lived Solid Radioactive Waste*, ICRP Publication No. 81. Pergamon Press: Oxford and New York, 2000.
2. NEA, *The Handling of Timescales in Assessing Post-closure Safety of Deep Geological Repositories. Workshop Proceedings, Paris, France, 16-18 April 2002*. OECD: Paris, 2002.

C. Nordborg*

International co-operation in nuclear data evaluation

Nuclear data play a fundamental role in all calculations and simulations necessary for the design and operation of nuclear installations. The precision and reliability of these data are of vital importance, not only at the design stage, but also for the calculation of safety margins. Highly accurate nuclear data can help improve the prediction of reactor and fuel performance parameters, with potentially large economic benefits while maintaining strict safety margins.

However, the large amount of detailed nuclear data available, either from theoretical calculations or from experiments, is difficult to use directly in nuclear applications. Furthermore, the basic data are not always consistent and have to be critically analysed to obtain data values that can be used with confidence. This work of "condensing" large amounts of nuclear data into so-called evaluated data libraries is performed by evaluators, who are normally scientists with experience in both experimental and theoretical physics.

Throughout the world there are a handful of significant projects on data evaluation for nuclear energy applications. The most important ones within the OECD area are:

- the US Evaluated Nuclear Data File (ENDF) project;
- the European Joint Evaluated Fission and Fusion (JEFF) project;
- the Japanese Evaluated Nuclear Data Library (JENDL) project.

In addition, there are similar projects in Russia (the BROND project) and in China (the CENDL project). The International Atomic Energy Agency (IAEA) has also developed an evaluated nuclear data library specifically for nuclear fusion applications: the FENDL library.

Background

In 1989, the OECD Nuclear Energy Agency (NEA) started a collaborative activity between the three major nuclear data evaluation projects mentioned above, i.e. the ENDF, JEF/EFF and JENDL projects. The established group was named the Working Party on International Nuclear Data Evaluation Co-operation (WPEC). The main reason for launching this co-operative effort was the limited manpower available within each separate project to make all the needed improvements to the data libraries.

The possibility of merging the projects was considered, but not judged to be feasible for geographical, financial, programme objective and timescale reasons. However, the benefits of closer co-operation were recognised. Each project agreed to make its evaluations available to the other projects and to provide information about new evaluations being undertaken and planned. In this way duplication of labour by the sparse evaluation resources could be avoided; convergence of the data libraries was considered an ultimate goal.

In 1991, the WPEC decided to allow observers from non-OECD countries to participate. The

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invited projects were the IAEA FENDL project, the Russian BROND project and the Chinese CENDL project. The IAEA is supporting the participation of these evaluation projects from countries outside the OECD area.

The Working Party's main goal is to assess and improve the quality and completeness of the different data libraries and to select outstanding, common nuclear data evaluation problems that would benefit from being resolved in a collaborative effort. The selected subjects are studied in detail in technical subgroups.

The WPEC contributes actively to federate activities. It provides motivation for participants who work together on goals of common interest while helping to promote the exchange of technical information among specialists. Results of benchmark studies are made available to all WPEC members. These results provide valuable information when deciding on priorities for data improvements.

Organisation

The Working Party on International Nuclear Data Evaluation Co-operation consists of 16 core members, 4 from each participating region, according to the figure below. It meets annually to discuss progress within each evaluation project and to assess common needs for nuclear data improvements. The importance of nuclear data measurements has been recognised in that at least one member of each evaluation project should be an experimentalist.

The identified needs for data improvements are addressed by initiating joint evaluation and/or measurement efforts. The work is performed in specially established subgroups, consisting of experts from the different evaluation projects. The results of these subgroups are published in reports issued by the NEA.

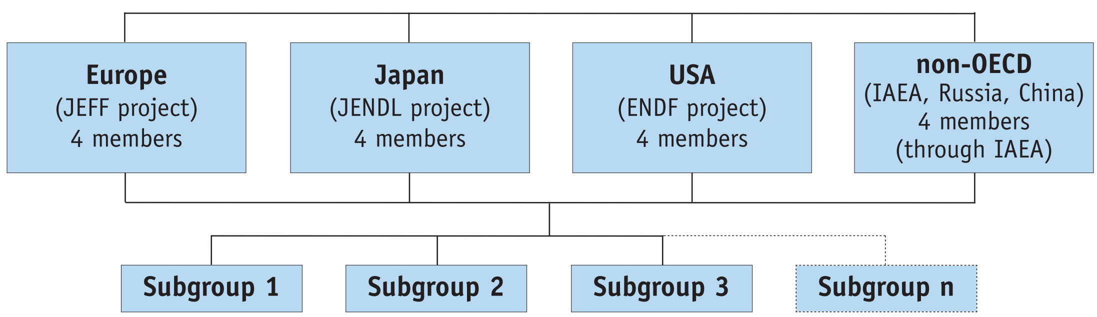
Past achievements

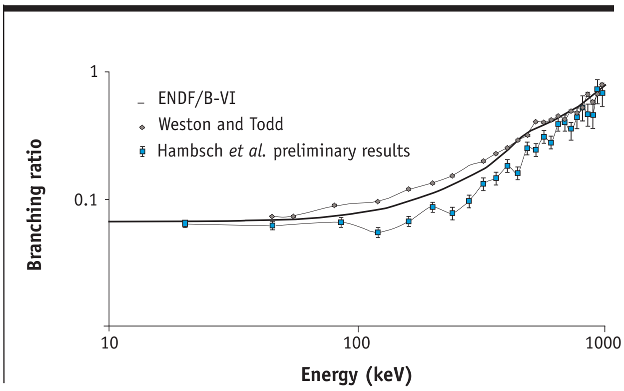
In total, 15 expert groups have completed their work and published their results since the establishment of the WPEC. A complete list of the titles can be found in the table.

Vol.	Title
1.	*Comparison of Evaluated Data for Chromium-52, Iron-56 and Nickel-58* (1996).
2.	*Generation of Covariance Files for Iron-56 and Natural Iron* (1996).
3.	*Actinide Data in the Thermal Range* (1996)
4.	*^{238}U Capture and Inelastic Cross-sections* (1999).
5.	*Plutonium-239 Fission Cross-section Between 1 and 100 keV* (1996).
6.	*Delayed Neutron Data for the Major Actinides* (2002).
7.	*Nuclear Data Standards* (Forthcoming).
8.	*Present Status of Minor Actinide Data* (1999).
9.	*Fission Neutron Spectra* (Forthcoming).
10.	*Evaluation Method of Inelastic Scattering Cross-sections for Weakly Absorbing Fission-product Nuclides* (2001).
11.	To be attributed.
12.	*Nuclear Models to 200 MeV for High-energy Data Evaluations* (1998).
13.	*Intermediate Energy Data* (1998).
14.	*Processing and Validation of Intermediate Energy Evaluated Data Files* (2000).
15.	*Cross-section Fluctuations and Self-shielding Effects in the Unresolved Resonance Region* (1996).
16.	*Effects of Shape Differences in the Level Densities of Three Formalisms on Calculated Cross-sections* (1998).
17.	*Status of Pseudo-fission-product Cross-sections for Fast Reactors* (1998).
18.	*Epithermal Capture Cross-section of ^{235}U* (1999).

Printed copies of these reports can be obtained (subject to availability) free of charge on request from the NEA Data Bank nuclear data services or via the generic E-mail address: nea@nea.fr. The reports can also be found on the WPEC homepage at *www.nea.fr/html/science/wpec/*. A CD-ROM of the reports mentioned in the table is available.

The Working Party on International Nuclear Data Evaluation Co-operation





The figure above of the $^{10}B(n,\alpha)$ branching ratio gives an example of new, in this case preliminary, data that shows the need to review the earlier standards evaluations, specifically around and above 100 keV.

Ongoing activities

Current activities are divided into long-term activities, dealing with more basic or fundamental issues, and short-term activities to resolve specific data problems. The sections below provide brief information on WPEC activities in progress.

Long-term activities

- *Nuclear model codes*

A number of different research groups are presently developing modern statistical model codes, mainly for the calculation of intermediate energy (~20-300 MeV) nuclear data. These groups are co-operating within the framework of a WPEC subgroup, both on the exchange of code modules and code inter-comparisons. More details about the work of this subgroup can be found at www.nndc.bnl.gov/nndcscr/model-codes/modlibs/.

- *Formats and processing*

Evaluated nuclear data are stored in a well-defined format, called the ENDF format, to enable the application codes to read the data in an unambiguous way. The format was developed and is maintained by the US Cross Section Evaluation Working Group (CSEWG). However, as the format is used universally, the WPEC felt that international co-ordination of user feedback would be useful. It was thus decided to establish a subgroup to collect, review and transmit new format proposals from the international community to the CSEWG. A number of corrections and proposals for the ENDF utility and processing codes are being channelled through the WPEC subgroup and proposals for modifications or extensions to the ENDF format are being collected.

- *High priority request list for nuclear data*

The "High Priority Nuclear Data Request List" is a compilation of expressed nuclear data requirements for different application areas. The list contains requests from Europe, Japan, the United States, Russia and China. The purpose of the list is to provide a guide for those planning measurements, or nuclear theory and evaluation programmes. Each request contains information about the quantity, the energy interval and the accuracy requested, as well as the originating country and the priority assigned to the request. The requests are grouped according to application area, such as fission reactor technology, medical and industrial applications, and fusion technology, but selective retrieval of requests can also be performed as the information is stored in a database accessible directly online at www.nea.fr/html/dbdata/hprl/. The subgroup members continuously review the list and propose additions, modifications and deletions at the annual WPEC meetings.

Short-term activities

- *Nuclear data standards*

The nuclear data standards are a set of data for a few specific nuclear reactions, used by experimentalists who perform measurements relative to these standards. Nuclear data evaluators use these standards to normalise the available information to ensure consistency in the evaluated data files. It is important that the nuclear data standards are accepted internationally to guarantee that all evaluation projects are using the same basis. The last complete evaluation of these standard reactions was performed about 15 years ago. Considering the amount of new information available for these standards, the WPEC has decided to establish an expert group to re-evaluate the main data standards. This expert group is working in close collaboration with a recently started, IAEA-sponsored, co-ordinated research project (CRP) on standard evaluations.

- *Fission neutron spectra*

Following a discussion of observed discrepancies between the microscopic and macroscopic data for the fission neutron spectrum of ^{235}U at thermal energies, it was decided to establish a subgroup to try to resolve this inconsistency. The subgroup carefully analysed a large number of differential and integral measurements and a new prompt fission neutron spectrum matrix for the n+^{235}U system has been calculated. This new fission spectrum has been tested against experimental data with good results. The report on this work is scheduled for publication in mid-2003.

- *Activation cross-sections*

The Subgroup on Neutron Activation Cross-section Measurements from Threshold to 20 MeV for the Validation of Nuclear Models and their Parameters was launched in the beginning of 2001 with the main objective to improve nuclear model calculations by benchmarking these model calculations against recent and newly measured data. The group will measure a large number of neutron-induced activation cross-sections and validate statistical, pre-compound nuclear models used in a number of codes. The final report is expected in 2003.

- *Evaluation and processing of covariance data*

The possibility of including uncertainty (covariance) information in evaluated data files has existed for a long time. However, this possibility has not always been fully exploited by the evaluators. This subgroup was established in spring 2001 with the objectives of recommending evaluation methods and a suitable data representation for the uncertainty information, and developing practical guidelines on how to process covariance information in evaluated data libraries. The subgroup will produce uncertainty files for a few important isotopes as examples to illustrate the methods and formats proposed. The final report is expected in early 2004.

- *Assessment of evaluations for the bulk of fission products*

The acknowledged need to assess the quality of the neutron cross-section evaluations for the bulk of fission products led to the establishment of a subgroup in the spring of 2001 to compare fission product evaluations contained in the main evaluated data libraries. Activities will comprise graphical inter-comparisons and a review of the physics and methods used in the evaluations. Recommendations are planned to be made regarding which evaluations are considered the best. The final report should be published in late 2003 or early 2004.

- *Nuclear data for improved, low-enriched uranium LWR reactivity predictions*

Extensive validation studies reviewing existing evaluated data files for ^{235}U have demonstrated that the new evaluations significantly improve many aspects of reactor calculations. However, it has also been demonstrated that the reactivity prediction for low-enriched uranium light water reactors is significantly underestimated with this new set of nuclear data. Integral validation studies have shown a discrepancy between the differential and integral information concerning the ^{238}U resonant capture, which seems to be overestimated. The purpose of the WPEC subgroup is to address this problem. It will closely associate the nuclear data evaluators and the reactor physicists.

Future plans

The WPEC will continue establishing co-operative efforts on common nuclear data evaluation problems. These co-operative efforts are playing an increasingly important role as the resources available within each of the participating evaluations projects are diminishing.

Continued efforts will be devoted to the three ongoing, long-term activities on Nuclear Model Codes; Formats and Processing; and the High Priority Request List for Nuclear Data. The WPEC will also stimulate exchange of information and encourage co-operation between laboratories involved in measuring nuclear data.

Many nuclear energy application areas are in need of more accurate data. For example, the planned life extension of nuclear reactors will need improved data related to radiation damage of structural materials; high burn-up nuclear fuel will require better, higher actinide and fission product data. In addition, improvements are still needed for the major actinides, such as ^{235}U, ^{238}U and ^{239}Pu.

The data needs are also very pronounced in other application areas such as nuclear waste transmutation, production of medical isotopes and astrophysics.

Conclusion

The NEA Working Party on International Nuclear Data Evaluation Co-operation serves as a forum for the exchange of information on required improvements to evaluated nuclear data libraries used in all nuclear application areas. The main objective is to identify the major discrepancies in existing evaluated data libraries and to resolve these discrepancies in specifically established expert groups. The long-term goal is to have converging evaluated data libraries. This co-operative effort is very successful. It has resolved a number of outstanding nuclear data problems and has issued 15 reports in support of the studies undertaken jointly. ■

News briefs

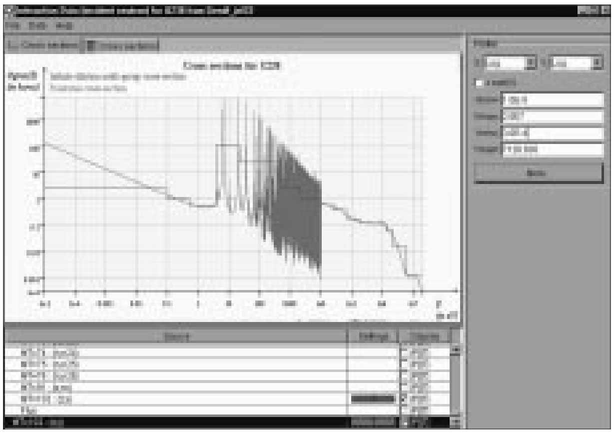
New release of JANIS (Java-based nuclear data information services) software

One of the main missions of the OECD/NEA Data Bank is to provide nuclear physics data services to users in research laboratories, universities and industry. The means used for providing these services have greatly evolved over the decades, starting with printed materials (known in the sixties and seventies as "barn books") and continuing with a variety of electronic products based on the latest information technology. In the last decade, these services have developed along two parallel paths, namely: the use of the Internet and the distribution of dedicated software. Each approach has its advantages. For instance, the Internet option enables the user to access centralised (and thus up-to-date) databases. However, the display of the data is limited by the capabilities of HTML-like pages. Likewise, software running on the user's

Features of the first release of JANIS

The user of JANIS 1.0 could access evaluated and processed data such as decay data, fission yields and interaction data (including cross-sections, multiplicities, uncertainties, resonance parameters, energy, angle and correlated energy-angle distributions) as well as experimental data (EXFOR). This data could be displayed in three different modes, namely: textual mode, tabular form and graphical plots. The software offered powerful navigation tools, including search capabilities, and provided means to manipulate the data (computation, weighting...).

A JANIS example: Comparison of pointwise and multigroup cross-sections

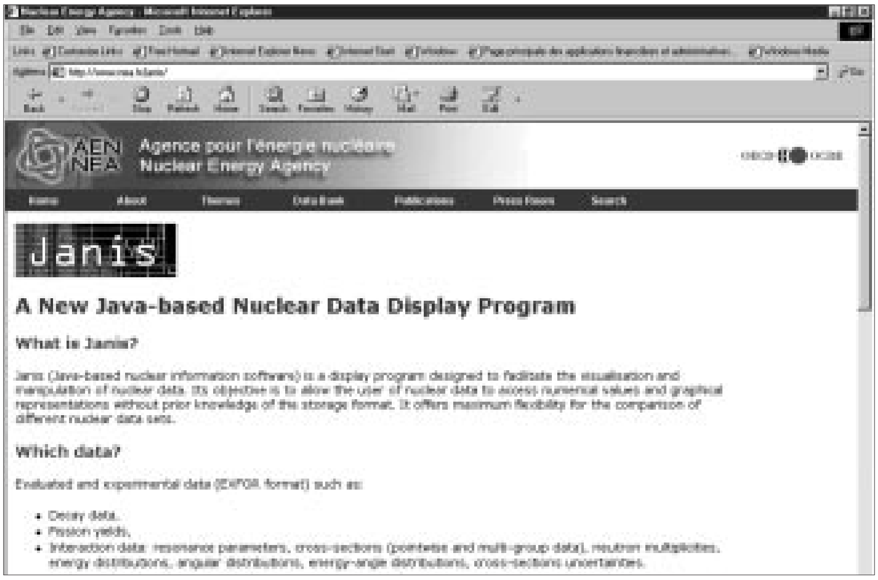


New features

Additional data are available in the new release. This includes activation data, which describe the production of radioactive materials, photon production data (cross-sections, multiplicities and energy-angle distributions) and bibliographical data (CINDA). The data are now structured into a relational database and connectivity is provided through the user's interface to local and remote databases. The computation feature has been extended to allow the combination of various types of data (cross-sections, energy-angle distributions...).

personal computers can implement advanced, user-friendly interfaces enabling the display of complicated structures. Yet, the data distributed in conjunction with a given release of the software cannot be updated easily.

An attempt to combine the benefits of these two options started with the development of JANIS software (JANIS stands for Java-based nuclear data information services). The first version of this software was released in October 2001 and distributed to more than 700 users. The new version, which was released in spring 2003, benefits from the experience and feedback accumulated during the past 18 months. A step forward has been accomplished in the integration effort by implementing a connection to local and remote relational databases. The adoption of Java programming language has proven to be a good choice as its performance has improved with new versions while preserving cross-platform compatibility.



For more information about JANIS or to order a free copy of the CD-ROM, please contact A. Nouri (*ali.nouri@oecd.org*) or visit www.nea.fr/janis/. ■

TDB III: A new phase of the NEA Thermochemical Database Project

In order to assess the safety of a radioactive waste repository, it is essential to be able to predict the potential migration of its components into the environment. Numerical simulation and/or modelling of processes that affect the behaviour of radionuclides in natural and man-made systems are integral parts of a radiological assessment methodology. Some of the basic information is provided by speciation calculations using general chemical thermodynamic data which are not site-specific. The value of the results of geochemical modelling as a predictive tool is strongly dependent on the quality of the thermodynamic data used to calculate the chemical speciation.

Given these needs, which are common to many OECD member countries, the NEA Thermochemical Database (TDB) Project was initiated with the objectives:

- to make available a comprehensive, internally consistent, internationally recognised and quality-assured chemical thermodynamic database of selected chemical elements;
- to meet the specialised modelling requirements for safety assessments of radioactive waste

disposal systems centred on performance assessment (PA) technical needs;

- to maintain and update a database of chemical thermodynamic data;
- to provide the data obtained to the OECD/NEA member countries through direct online services;
- to promote an exchange of information on activities of relevance to the TDB Project in member countries.

Since its establishment in the mid-1980s, the TDB Project has enjoyed great success within the fundamental and applied scientific communities. The Project's critical review methodology (documented in the "TDB Guidelines") provides useful guidance to scientific authors and serves the quality assurance requirements of performance assessment activities in the field of radioactive waste management. As a result, the Project has benefited from the collaboration of experts with the highest international reputation in the field of chemical thermodynamics.

During the first phase of the TDB Project, databases arising from five major reviews of inorganic compounds and complexes of uranium, neptunium, plutonium, americium and technetium were published. The second phase of the Project has focused on the update of the TDB Phase I databases, as well as on new reviews of inorganic compounds and complexes of selenium, nickel and zirconium and of a new database for organic compounds and complexes of uranium, neptunium, plutonium, americium, selenium, nickel, technetium and zirconium with selected ligands (EDTA, citrate, oxalate and isosaccharinic acid).

In 2002, a survey of interest to pursue TDB activities after Phase II showed a large majority in favour of continuing the Project for a further period of four years. TDB III will focus on new reviews of inorganic complexes and compounds of thorium, iron, tin and molybdenum. These reviews will be performed following the same methodology as previous phases. It will also take into account the new requirements stemming from the progress in underground repository concepts and the gaps observed in the process of performance assessment since the last formulation of the Project programme of work in 1998.

As in the previous phases, the NEA Secretariat acts as co-ordinator of the Project. Otherwise, the resources for TDB III are largely external to the NEA. For TDB III, the following agencies and regulatory bodies in OECD member countries are contributing to the TDB effort.

Agencies participating in the TDB Project

ONDRAF/NIRAS	*Belgium*
RAWRA	*Czech Republic*
POSIVA	*Finland*
ANDRA	*France*
FZK	*Germany*
JNC	*Japan*
ENRESA	*Spain*
SKB	*Sweden*
SKI	*Sweden*
HSK	*Switzerland*
NAGRA	*Switzerland*
PSI	*Switzerland*
BNFL	*United Kingdom*
NIREX	*United Kingdom*
DoE	*United States*

The deliverables from the TDB Project are:

- the books in the TDB Chemical Thermodynamics Series (four volumes published, five more in preparation) that serve as extensive reference material documenting the sources and procedures followed in order to select the recommended data and therefore meeting high standards of transparency and traceability;

- the electronic files containing the thermochemical data selected in the reviews, available form the NEA Data Bank.

The TDB database enjoys an outstanding reputation among specialists as a reference database. As such it is at the root of many more applied databases, developed for site-specific analyses. ■

Survey on nuclear regulator communication activities

In 2002, a survey was distributed by the Working Group on Public Communication of Nuclear Regulatory Organisations (WGPC) to the members of the Committee on Nuclear Regulatory Activities (CNRA) to obtain information regarding activities and topics of interest in the field of nuclear regulatory communication. A total of 15 member countries provided answers to the survey questions. The results of the survey have assisted in determining future WGPC activities. The member countries' main replies are partially reproduced below.

The goal of nuclear regulator communication activities

Based on the results of the survey, nuclear regulatory organisations have a wide spectrum of goals for their communication activities. The survey revealed two predominantly shared goals among nuclear regulatory organisations:

- informing the public about nuclear safety and radiation protection;
- building public confidence in nuclear regulatory organisations.

Other main goals include:

- improving public awareness of nuclear regulatory organisations;
- improving transparency;
- communicating with various organisations including civil society, international organisations and the media.

Other country-specific communication goals include involving the public in the regulatory process; informing the public about nuclear energy policy; achieving public confidence through safety indicators for nuclear power plants; educating the public on nuclear matters; and keeping staff informed about regulatory activities and events.

The main communication issues

Half the member countries participating in the survey stated the storage, disposal and transportation of nuclear waste and nuclear fuel to be the main focus of national communication activities. They also supported the development of the following two topics in CNRA work:

- measuring public confidence in regulatory organisations;
- measuring the credibility of regulatory organisations.

Several member countries expressed interest in exploring the following specific topics:

- the amount, type and extent of information to be made available to the public;
- reacting to incorrect, incomplete or biased information;
- interaction with local and regional elected officials, communities and civil society organisations;
- long-term communication strategies;
- the language of safety communication;
- crisis management and public communication;
- encouraging responsible media reporting.

Public confidence workshop

As a result of the survey and further discussions, the CNRA will organise a workshop in May 2004 on "Building, Measuring and Improving Public Confidence in the Nuclear Regulator". The workshop will address the following questions, in line with the results of the survey:

- What is public confidence and why is it important? Which factors influence public confidence? What are we trying to achieve?
- How much does a regulator have to communicate?
- How do regulators measure public confidence?
- What are effective techniques for restoring lost confidence in the regulator?
- What are the best practices for communicating technical issues to the general public?
- How does the regulator effectively involve the public in its activities?

For further information regarding the work of the WGPC, see *www.nea.fr/html/nsd/cnra/wgpc.html*. ■

New publications

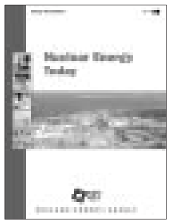
Economic and technical aspects of the nuclear fuel cycle

Nuclear Energy Data – 2003

ISBN 92-64-10326-0 – Price: € 21, US$ 24, £ 14, ¥ 2 700.

This new edition of *Nuclear Energy Data*, the OECD Nuclear Energy Agency's annual compilation of essential statistics on nuclear energy in OECD countries, offers additional textual and graphical information as compared with previous editions. It provides the reader with a comprehensive but easy-to-access overview of the status of and trends in the nuclear power and fuel cycle sector. This publication is an authoritative information source of interest to policy makers, experts and academics involved in the nuclear energy field.

Nuclear Energy Today



ISBN 92-64-10328-7 – Price: € 21, US$ 24, £ 14, ¥ 2 700.

Energy is the power of the world's economies, whose appetite for this commodity is increasing as the leading economies expand and developing economies grow. How to provide the energy demanded while protecting our environment and conserving natural resources is a vital question facing us today. Many parts of our society are debating how to power the future and whether nuclear energy should play a role.

Nuclear energy is a complex technology with serious issues and a controversial past. Yet it also has the potential to provide considerable benefits. In pondering the future of this imposing technology, people want to know: How safe is nuclear energy? Is nuclear energy economically competitive? What role can nuclear energy play in meeting greenhouse gas reduction targets? What can be done with the radioactive waste it generates? Does its use increase the risk of proliferation of nuclear weapons? Are there sufficient and secure resources to permit its prolonged exploitation? Can tomorrow's nuclear energy be better than today's?

This publication provides authoritative and factual replies to these questions. Written primarily to inform policy makers, it will also serve interested members of the public, academics, journalists and industry leaders.

Nuclear regulation and safety

The Regulatory Challenges of Decommissioning Nuclear Reactors

ISBN 92-64-02120-5 – Free: paper or web versions.

The purpose of this report is to describe the broad range of safety, environmental, organisational, human factors and public policy issues that may arise during the decommissioning of nuclear reactors and that the regulatory body should be prepared to deal with in the framework of its national regulatory system. The intended audience is primarily nuclear regulators, although the information and ideas may also be of interest to government authorities, environmental regulators, nuclear operating organisations, technical expert organisations and the general public.

Regulatory and Industry Co-operation on Nuclear Safety Research

Challenges and Opportunities

ISBN 92-64-02120-5 – Free: paper or web versions.

Regulator-industry co-operation in nuclear safety research has potential advantages as well as disadvantages. This report provides research managers in industry, regulatory organisations and research centres with information on current practices in collaborative safety research in OECD member countries. It identifies means of establishing effective industry-regulator collaboration and provides indications on how to overcome difficulties that can arise. It also advises on possible areas of concern. The report addresses in particular the issue of regulator independence, means to preserve it and ways to demonstrate it to the public while undertaking collaboration with industry.

Radiation protection

A New Approach to Authorisation in the Field of Radiological Protection

The Road Test Report

ISBN 92-64-02122-1 – Free: paper or web versions.

The NEA Committee on Radiation Protection and Public Health (CRPPH) has been very active in developing its own suggestions as to how the system of radiological protection, as based on the Recommendations of the International Commission on Radiological Protection (ICRP), should evolve to better meet the needs of policy makers, regulators and practitioners. One of those suggestions is that a generic concept of "regulatory authorisation" of certain levels and types of exposure to radiation should replace the current and somewhat complicated concepts of exclusion, exemption and clearance. It has also been suggested that by characterising emerging sources and exposures in a screening process leading into the authorisation process, regulatory authorities could develop a better feeling for the type and scale of stakeholder involvement that would be necessary to reach a widely accepted approach to radiological protection.

In order to verify that these suggestions would make the system of radiological protection more understandable, easy to apply, and acceptable, independent consultants have "road tested" the CRPPH concepts of authorisation and characterisation. Their findings, which show that applying these concepts would represent significant improvement, are reproduced in this report. Specific approaches for the application of the new CRPPH ideas are also illustrated.

Chernobyl: Assessment of Radiological and Health Impacts

2002 Update of *Chernobyl: Ten Years On*

ISBN 92-64-18487-2 – Free: paper or web versions.

The international radiological protection community performed a major status review of the situation around the damaged Chernobyl reactor on the 10-year anniversary of the accident. Since then, studies of the accident site and the contaminated territories continue to be undertaken, which have yielded new scientific results and highlighted important social and health aspects. This report is a complete update of the NEA's earlier publication, *Chernobyl: Ten Years on*. In particular, it offers the reader the most recent information on the significant new experience gained in the areas of emergency management, long-term environmental behaviour of radioactive materials and health effects.

Radioactive waste management

Engineered Barrier Systems and the Safety of Deep Geological Repositories

State-of-the-art Report

ISBN 92-64-18498-8 – Free: paper or web versions.

Repositories for the disposal of radioactive waste generally rely on a multi-barrier system to isolate the waste from the biosphere. This multi-barrier system typically comprises the natural geological barrier provided by the repository host rock and an engineered barrier system (EBS). The EBS project being conducted by the NEA Integration Group for the Safety Case (IGSC) seeks to clarify the role that an EBS can play in the overall safety case for a deep geological repository. It is in this context that the European Commission and the NEA have prepared the present report, which describes the state of the art for engineered barrier systems and provides a common basis of understanding from which to plan future programmes. It is based on answers to a questionnaire received from 13 countries and 17 organisations.

The Handling of Timescales in Assessing Post-closure Safety of Deep Geological Repositories

Workshop Proceedings, Paris, France, 16-18 April 2002

ISBN 92-64-09911-5 – Price: € 49, US$ 49, £ 31, ¥ 5 700.

A workshop entitled the "Handling of timescales in assessing post-closure safety" of deep geological repositories for radioactive waste was organised in Paris on 16-18 April 2002 and hosted by the French Institute for Radiological Protection and Nuclear Safety (IRSN). These proceedings include the presentations made at the workshop as well as a summary of the discussions held. They will be of interest to radioactive waste repository managers and engineers.

Radiological Protection of the Environment: The Path Forward to a New Policy?

Workshop Proceedings, Taormina, Sicily, Italy, 12-14 February 2002

ISBN 92-64-09969-7 – Price: € 52, US$ 52, £ 33, ¥ 6 050.

The international system of radiological protection is currently being revised with the aim of making it more coherent and concise. During the revision process, particular attention is being given to the development of an explicit system for the radiological protection of the environment in addition to that of human beings. In order to support the ongoing discussions of the international community of radiological protection experts, these proceedings try to answer the questions: Is there an international rationale behind the wish to protect the environment from radiation? Do we have enough scientific information to develop and define a broadly accepted policy? What are the socio-political dynamics, beyond science, that will influence policy on radiological protection of the environment? What are the characteristics of the process for developing a system of radiological protection of the environment? These proceedings comprise the views of a broad range of invited speakers, including policy makers, regulators, radiological protection and environmental protection professionals, social scientists and representatives of both industry as well as non-governmental and intergovernmental organisations.

Radiological Protection of the Environment

Summary Report of the Issues

ISBN 92-64-18497-X – Free: paper or web versions.

SAFIR 2: Belgian R&D Programme on the Deep Disposal of High-level and Long-lived Radioactive Waste

An International Peer Review

ISBN 92-64-18499-6 – Free: paper or web versions.

This report presents the common views of the International Review Team established by the NEA Secretariat on behalf of the Belgian Government to perform a peer review of the SAFIR 2 report, produced by the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) to describe the research, development and demonstration activities in the Belgian programme on the disposal of high-level and long-lived radioactive waste in a deep geological repository excavated within an argillaceous formation.

Nuclear law

Indemnification of Damage in the Event of a Nuclear Accident

Workshop Proceedings, Paris, France, 26-28 November 2001

ISBN 92-64-09919-0 – Bilingual – Price: € 90, US$ 90, £ 58, ¥ 11 050.

The Workshop on the Indemnification of Damage in the Event of a Nuclear Accident, organised by the OECD Nuclear Energy Agency in close co-operation with the French authorities, was held in Paris from 26 to 28 November 2001. These proceedings contain a comparative analysis of legislative and regulatory provisions governing emergency response and nuclear third party liability, based upon country replies to a questionnaire. This publication also includes the full responses provided to that questionnaire, as well as the texts of presentations made by special guests from Germany and Japan describing the manner in which the public authorities in their respective countries responded to two nuclear accidents of a very different nature and scale.

Nuclear Law Bulletin No. 70 + Supplement (Germany)

Volume 2002/2

2003 Subscription (2 issues + supplements) – ISSN 0304-341X – Price: € 80, US$ 80, £ 50, ¥ 9 400.

Supplement – ISBN 92-64-19974-8 – Price : € 20, US$ 20, £ 12, ¥ 2 300.

Nuclear science and the Data Bank

Burn-up Credit Criticality Benchmark

Phase IV-A: Reactivity Prediction Calculations for Infinite Arrays of PWR MOX Fuel Pin Cells

ISBN 92-64-02123-X – Free: paper or web versions.

Phase IV-B: Results and Analysis of MOX Fuel Depletion Calculations

ISBN 92-64-02124-8 – Free: paper or web versions.

The OECD/NEA Expert Group on Burn-up Credit was established in 1991 to address scientific and technical issues connected with the use of burn-up credit in nuclear fuel cycle operations. Following the completion of six benchmark exercises with uranium oxide fuels irradiated in pressurised water reactors (PWRs) and boiling water reactors (BWRs), the present reports concern mixed uranium and plutonium oxide (MOX) fuels irradiated in PWRs.

Physics of Plutonium Recycling

Volume VII: BWR MOX Benchmark – Specification and Results

ISBN 92-64-19905-5 – Price: € 45, US$ 45, £ 29, ¥ 5 500.

The commercial recycling of plutonium as PuO_2/UO_2 mixed-oxide (MOX) fuel is an established practice in pressurised water reactors (PWRs) in several countries, the main motivation being the consumption of plutonium arising from spent fuel reprocessing. Although the same motivating factors apply in the case of boiling water reactors (BWRs), they have lagged behind PWRs for various reasons, and MOX utilisation in BWRs has been implemented in only a few reactors to date. One of the reasons is that the nuclear design of BWR MOX assemblies (or bundles) is more complex than that of PWR assemblies. Recognising the need and the timeliness to address this issue at the international level, the OECD/NEA Working Party on the Physics of Plutonium Fuels and Innovative Fuel Cycles (WPPR) conducted a physics code benchmark test for a BWR assembly. This volume reports on the benchmark results and conclusions that can be drawn from it.

Pressurised Water Reactor Main Steam Line Break (MSLB) Benchmark

Volume III: Results of Phase II on 3-D Core Boundary Conditions Modelling

ISBN 92-64-18495-3 – Free on request.

This benchmark is based on a well-defined problem concerning a pressurised water reactor (PWR) main steam line break, which may occur as a consequence of the rupture of one steam line upstream of the main steam isolation valves. This report summarises the results contributed by international participants concerning Phase II of the exercise: a coupled 3-D neutronics/core thermal-hydraulics response evaluation using inlet and outlet core transient boundary conditions.

VVER-1000 Coolant Transient Benchmark

PHASE 1 (V1000CT-1) – Vol. I: Main Coolant Pump (MCP) Switching On – Final Specifications

ISBN 92-64-18496-1 – Free: paper or web versions.

In the field of coupled neutronics/thermal-hydraulics computation there is a need to enhance scientific knowledge in order to develop advanced modelling techniques for new nuclear technologies and concepts, as well as current applications. Recently developed best-estimate computer code systems for modelling 3-D coupled neutronics/thermal-hydraulics transients in nuclear reactor cores and for the coupling of core phenomena and system dynamics need to be compared against each other and validated against results from experiments. International benchmark studies have been set up for this purpose. The present volume describes the specification of such a benchmark. The transient addressed is caused by the switching on of a main coolant pump when the other three are in operation. It is based on an experiment that was conducted by Bulgarian and Russian engineers during the plant commissioning phase at the VVER-1000 Kozloduy Unit 6.

Utilisation and Reliability of High Power Proton Accelerators

Workshop Proceedings, Santa Fe, New Mexico, USA, 12-16 May 2002

ISBN 92-64-10211-6 – Price: € 90, US$ 90, £ 60, ¥ 11 500.

Both accelerator scientists and reactor physicists gathered together at an NEA workshop to discuss, *inter alia*, the reliability of the accelerator and the impact of beam interruptions on the design and performance of the ADS; spallation target design characteristics and their impact on the subcritical system design; safety and operational characteristics of a subcritical system driven by a spallation source; and test facilities. These proceedings contain all the technical papers presented at the workshop as well as summaries of the discussions held during each technical session.

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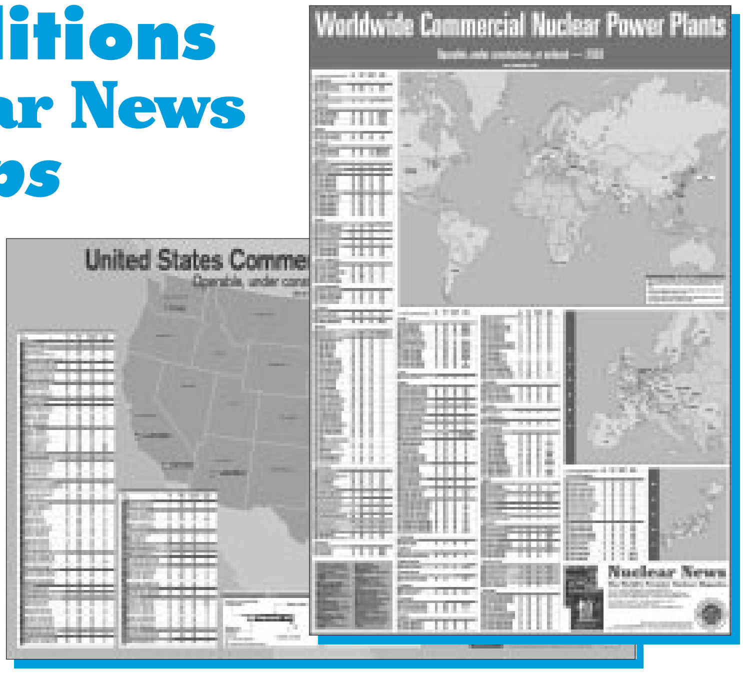

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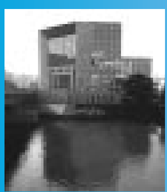

Vacancies occur in the OECD Nuclear Energy Agency Secretariat in the following areas:

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