

NEA



annual report 2004

annual report



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N U C L E A R • E N E R G Y • A G E N C Y

Organisation for Economic Co-operation and Development

The NEA in Brief

- 28** member countries
(22 in the Data Bank) Governing body:
the Steering Committee for Nuclear Energy
- 46** years of international service
- 7** standing technical committees
- 14** international joint projects
funded by participants
- 72** professional and support staff
- 564** national experts participating in NEA committees
- 3 500** experts participating annually, on average, in policy
and technical meetings organised at OECD headquarters
- €9.8** million budget for the NEA in 2004,
supplemented by voluntary contributions
- €2.7** million budget for the Data Bank in 2004,
supplemented by voluntary contributions
- 80** publications produced in 2004

The NEA and its Mission

The Nuclear Energy Agency (NEA) is a semi-autonomous body within the Organisation for Economic Co-operation and Development (OECD), located in the Paris area in France. The objective of the Agency is to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.

The European Commission (EC) takes part in the work of the NEA. A co-operation agreement is in force with the International Atomic Energy Agency (IAEA). The NEA also maintains contacts with several non-member countries as well as the nuclear industry and a number of civil society organisations.

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Message from the Director-General

Nuclear power is now generally recognised by many countries as an economically competitive energy source, offering the added benefits of security of supply, price stability (even in spite of recent increases in the price of uranium), and compatibility with sustainable development goals, notably as regards reduction of greenhouse gas emissions. As demand for energy grows, and projections of demand continue to rise as well, OECD/NEA member countries are weighing the different options available. Given the elements above, nuclear energy is a candidate receiving serious consideration for further future development in a number of countries. Research and development initiatives such as the Generation IV International Forum (GIF) attest to the significant interest being shown.

NEA member countries are also investigating additional uses of nuclear energy which provide potential benefit, including the production of hydrogen. This was, in fact, the theme of the October 2004 policy debate organised in conjunction with the semi-annual meeting of the Steering Committee for Nuclear Energy. During the debate, Delegates also evoked the use of nuclear power for desalination of seawater. And although not addressed during the debate itself, one may similarly wish to note the medical application of radioactive isotopes, most of which are generated by research reactors in countries which do, and do not, have recourse to nuclear power for the production of electricity.

Solutions still need to be put in place, however, for the long-term management of spent fuel and radioactive waste, even if it is considered that the solutions have already largely been found in terms of concepts and technology. Likewise, appropriate solutions must be adopted and implemented to secure the funding of decommissioning programmes in the years to come.

The NEA programme of work addresses both the current and future aspects of nuclear energy use and development. An overview of this work is presented in the pages that follow.



Mr. Luis Echávarri
NEA Director-General



Nuclear Power in 2004

Nuclear energy development

As of 31 December 2004, 352 reactors were in operation in OECD countries constituting about 84% of the world's total nuclear electricity generating capacity, and some 24% of the total electricity supply in the OECD area. During 2004, one reactor (960 MWe net) was started up in Korea, and another in Japan (1 325 MWe net). Four units were under construction in OECD countries, with a net capacity of about 4.2 GWe. After being in layup since 1997, the Bruce-3 reactor was reconnected to the grid in Canada. In the United Kingdom, the four 50 MWe net reactors at Chapelcross were permanently shut down.

In Japan, 17 units were shut down for inspections after quality-assurance issues were discovered in 2003. Sixteen were progressively returned to service by the end of 2004. In the United States, all pressurised water reactors were ordered in 2003 to undergo extensive inspections of their reactor pressure vessel heads as a result of corrosion discovered in the pressure vessel head of the Davis-Besse plant. The consequences of this order extended into 2004 as these plants underwent the inspections, and many needed to replace their pressure vessel heads as a result. Due to these extended shutdowns, there was a decrease in the amount of electricity generated in the United States and Japan during 2004, which in turn lowered the total generated in OECD member countries.

During 2004, Europe continued to be a region marked by two divergent opinions on the role to be played by nuclear energy. On the one hand, some countries continued to plan on including nuclear energy in their future energy mix, e.g. Finland and France. In Finland, TVO applied for a construction license at Olkiluoto, with the expectation that the government would grant the construction permit early in 2005. In France, EDF announced its decision to build a European pressurised reactor near Flamanville in the *Basse Normandie* region.

On the other hand, several other countries (such as Belgium, Germany, the Netherlands and Sweden) currently have phase-out plans, some of which remain under discussion. During 2004, the Swedish government announced that the Barseback-2 reactor would close in 2005. This would be the second reactor to close in Sweden as a result of its policy to phase out nuclear energy. Power uprates to several other reactors operating in Sweden are expected to make up for the reduction in installed capacity and

thus minimise the impacts of this shutdown in the near term.

The Far East continued to be the major nuclear energy growth region, with new reactors having come on line in both Korea (Ulchin-5) and Japan (Hamaoka-5). Additional reactors – one in Korea and two in Japan – were under construction. The most significant operating incident (in terms of human life) that occurred in 2004 was in the Far East as well. In August, five workers were killed and six injured when a steam leak occurred at the Mihama-3 plant in Japan during preparations for maintenance inspections. Although this incident did not involve the nuclear part of the plant (similar incidents have occurred at industrial facilities in the past), it raised concerns about the adequacy of maintenance records. All of the 22 other PWRs in Japan were instructed to have their maintenance records reviewed to prevent any similar occurrences.



Korea Hydro & Nuclear Power Co. Ltd., Rep. of Korea

From left to right: Ulchin 1 to 6, Republic of Korea. Unit 5 came on line in 2004; Unit 6 will be completed in June 2005.

In parallel, renewed interest in the construction of new nuclear reactors continued to grow in the United States. In November 2004, the US Department of Energy (DOE) announced that it had awarded US\$13 million in initial funding to support two consortia of nuclear industry vendors and utilities seeking to demonstrate the US Nuclear Regulatory Commission's (NRC's) combined construction and operating licensing process. The NRC granted final design approval to Westinghouse Electric's AP1000 advanced reactor, a design under consideration by one of the consortia. In a further bid to encourage construction of a new reactor, the DOE

2004 Nuclear Data Summary (as of 31 December 2004)

Country	Operational reactors	Installed capacity (GWe net)	2004 uranium requirements (tonnes U)	Nuclear share of 2004 electricity production
Belgium	7	5.8	845	55.2
Canada	22	12.0	1 700	15.1
Czech Republic	6	3.5	598	31.8
Finland	4	2.7	536	26.5
France	59	63.4	7 184	78.1
Germany	18	20.6	3 000	30.1
Hungary	4	1.9	512	38.5
Japan	52	43.9	7 140	30.0
Mexico	2	1.4	181	4.2
Netherlands	1	0.5	65	3.8
Republic of Korea	19	15.9	3 200	38.0
Slovak Republic	6	2.5	501	55.5
Spain	9	7.5	2 040	22.7
Sweden*	11	9.5	1 600	50.6
Switzerland	5	3.2	317	39.4
United Kingdom*	23	11.9	1 600	20.0
United States	104	99.7	24 143	20.0
Total	352	305.9	56 108	23.5

* Estimates

also announced that it will co-operate with the Tennessee Valley Authority (TVA) in a feasibility study on the construction of advanced boiling water reactors at the TVA's Bellefonte site. Additionally, work to restart the TVA's Browns Ferry-1 reactor remains on schedule, with operation to recommence in 2007 (after having been shut down in 1985).

Furthermore, license renewal and power uprating of existing reactors continue to add capacity and extend the operating life of the reactor fleet in the United States, even without new construction. In 2004, US utilities submitted applications for power uprates that, if granted, would add about 1 GWe net in capacity. The NRC also authorised in 2004 the extensions of operating licenses to 60 years for 7 reactors, in addition to the 23 authorised in previous years. Applications for extension are under review for yet another 16 reactors.

Uranium production, conversion and enrichment

Over the past several years there has been a significant and sustained increase in the market price of uranium. Since the beginning of 2001, the price of uranium has steadily risen from lows not seen since the early-1970s, and had almost doubled by the end of 2004. A variety of reasons have been put forward

to account for this rise, including: an October 2001 fire that destroyed the solvent extraction facility at the Olympic Dam mine in Australia; flooding in the McArthur River mine in Canada, which stopped production for three months in the summer of 2003; leaks that led to a four-month shutdown of the Converdyn uranium conversion facility in early 2004; and uncertainties on the future availability of the Rössing mine in Namibia.

With reactor requirements to be increasingly met by primary production in the coming years, it is necessary to ensure that sufficient new discoveries of uranium are made to permit expansion of production capability as secondary sources decline. Thus, increased exploration activity will be needed to build new or expand existing production capability. Low uranium prices over the past decades have led to limited exploration expenditure during that time. However, an analysis of historical information indicates that past price increases have resulted in increased exploration. Recent price increases, and therefore greater potential for profitability, can thus be expected to trigger the increased exploration needed.

In December 2003, the uranium conversion facility at Metropolis, Illinois (USA) was shut down due

to a leak of fluorine that travelled off site, which followed a series of smaller leaks in August and September. As a result, Honeywell performed several corrective actions and had to obtain NRC approval prior to being allowed to restart operations. The plant began a phased restart in March 2004. During the shutdown, Converdyn met the Metropolis commitments by using stored inventory and/or rescheduling deliveries. This incident increased perceptions of fragility in the uranium supply chain that likely contributed to increases in the price of uranium.

In 2004, the worldwide trend continued towards using centrifuge technology as the dominant enrichment method. Two separate efforts remain under way to create a commercial centrifuge enrichment capability in the United States: one by the US Enrichment Corporation (USEC), and the other by Louisiana Energy Services (LES). The NRC has accepted for detailed review their applications for construction and operation of enrichment plants. Both groups are planning on a 24-month review, with construction projected to begin in 2006. The USEC plant would be constructed in Ohio, while the LES plant would be located in New Mexico. In October, the European Commission conditionally approved AREVA's plans to acquire 50 per cent of Urenco's enrichment technology company as a



JNFL, Japan

Centrifuge technology will be the dominant enrichment method in the years to come.

means to gain access to Urenco's centrifuge technology, and to use it to replace the ageing Georges Besse gaseous diffusion plant.

Nuclear safety and regulation

Overall, the safety performance of nuclear power plants in OECD countries continues to be very good, as reflected in a number of published performance indicators. The current safety record is built upon a mature regulatory system and a foundation of research. There is a general consensus that safety research can improve the efficiency and effectiveness of a regulatory system by helping to identify the items most important to safety and by anti-

patting future regulatory challenges, thus allowing resources to be focused on the most significant concerns.

In 2004, some significant events took place, drawing attention to such areas of concern as erosion-corrosion of secondary system piping and its inspection; vulnerabilities of nuclear power plants to loss of off-site power events; and disturbances caused by foreign material entering the primary cooling system. These three areas all represent well-known recurring phenomena, and illustrate the continuing need to respond to operating experience and to implement an appropriate and timely corrective action programme. Learning processes from prior events, and maintaining both competence and a high priority on safety, remain among the main challenges for the different parties involved in nuclear safety.



JNES, Japan

The pipe failure at Mihama Unit 3 in August 2004 led to instructions to review the maintenance records of all of the 22 other PWRs in Japan.



OECD nuclear safety and nuclear regulatory authorities were active in revealing and resolving issues in this field with the aim of continuously improving nuclear safety in OECD countries and beyond. They have established several additional joint activities and research projects to this effect.

Radiological protection

In the area of radiological protection, the development of new recommendations by the International Commission on Radiological Protection (ICRP) continued to be a central issue in 2004, with a clear and significant contribution from various stakeholder constituencies. Originally planned for completion in 2005, the first publicly available draft recommendations were presented by the ICRP Chair in May 2004,

during the 11th International Radiological Protection Association Congress (IRPA-11) in Madrid. This was followed by the release of the draft recommendations in July 2004 on the ICRP website for open review and comment. Despite open discussions on this subject since 1999, the draft recommendations have triggered significant reactions within government and industry. As a result, the final approval of the new recommendations has been postponed until no earlier than 2006, when it is hoped that further clarity on several key issues will have been developed. These key issues include dose constraints (their nature, relationship with dose limits, and numerical values), the matrix expression of the collective dimension of group dose (previously collective dose), the characterisation of the individual (previously the critical group), and the nature and order of the Commission's three main principles (justification, dose restriction and optimisation). This dialogue and the current schedule demonstrate the extent to which the ICRP now values the input of radiological protection stakeholders. This new consultative process, while more lengthy than the previous ICRP "closed expert group" approach, should result in new ICRP recommendations that more appropriately address the needs of radiological protection policy makers, regulators and practitioners.

Work also continued this year to address the radiological aspects of national and international planning and preparedness to respond to chemical, biological, radiological and nuclear (CBRN) incidents, should they occur. In the radiological protection area much of the knowledge and experience needed to address radiological incidents already exist in national nuclear incident response organisations. Nonetheless, all walks of the radiological protection community (government, research and industry experts) spent significant efforts during 2004 to assure national readiness for terrorist attacks as well. This included organising and analysing large-scale response exercises; developing research programmes to address large-scale, rapid radiological contamination and dose assessment tools; and analysing the best approaches to address contamination and irradiated victims in urban environments. While there is broad agreement that national preparations as well as national and international guidance for radiological terrorist attacks are adequate, there is also a general understanding that, as with any safety preparations, continuing refinement has its use.

Finally, scientific studies of the effects of radiation on organisms are beginning to suggest some new and interesting challenges. For example, the model (linear no-threshold, LNT) currently used to relate radiation exposure to health risk (mainly cancer induction) seems to overestimate the risk of

bone cancer, liver cancer and leukaemia for low alpha doses. In fact, some studies of human and animal populations that have been exposed to inhaled and/or ingested alpha emitters seem to indicate that there is a threshold dose below which there is no risk. As such, the question is raised of whether current risk estimate techniques appropriately estimate risks from chronic exposures. The answer may indicate that our current understanding is correct, but it could also pose significant challenges to the management of radiological protec-

Emergency training with local and plant personnel at Southern California Edison Co., United States.



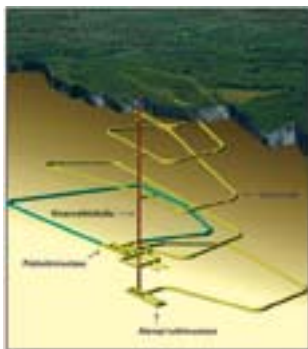
NEI, United States

tion in the future. New and ongoing research will need to be appropriately oriented to address both policy and regulatory questions and concerns.

Radioactive waste management

One of the world's most important radioactive waste repository projects, Yucca Mountain in the United States, came under discussion in 2004 when a US court rejected, for formal reasons, a safety standard of the Environmental Protection Agency (EPA) guiding the long-term safety evaluation of the repository. The Yucca Mountain case revived the worldwide discussion on how to handle the very long timescales involved in radioactive waste disposal safety assessments, a discussion to which the NEA has actively contributed.

Another disposal programme of note is the deep geological repository project in Olkiluoto, Finland. Posiva Oy, the implementing organisation, started construction work on the ONKALO underground characterisation facility at the site of the foreseen repository just one year after the repository project received authorisation to proceed from Parliament. The over 500-meter deep tunnel leading down to the characterisation facility is expected to be completed by 2010. Research conducted at ONKALO will provide information to define the characteristics of sections of rock identified as being suitable for final disposal.



Posiva Oy, Finland

The ONKALO underground characterisation facility at the site of the foreseen repository in Finland.

The "nuclear package" proposed in 2003 by the European Commission (EC), which *inter alia* would have required EU countries to consider geological disposal and to establish a timetable for the long-term management of radioactive waste, was not adopted by the European Council in 2004. However, the Commission made a revised proposal for the package in September 2004 and the Council has set up an Ad hoc Working Party on Nuclear Safety to discuss a number of issues raised in the package.

Regarding stakeholder involvement, a specific concept of local partnerships set up in Belgium among three potential host municipalities and the waste management organisation ONDRAF/NIRAS, showed encouraging results in 2004. Reports issued by two of the municipalities led the partnership organisation to propose to host an integrated repository for low-level and intermediate-level waste, either as a surface or a deep geological facility. Once the municipalities have agreed on the conditions for a possible repository on their territory, the concrete implementation of the local conditions will be discussed. A comparable decision-making process was followed in Canada, when in October the municipality of Kincardine in Ontario and Ontario Power Generation (OPG) obtained the endorsement by the municipal Council of a hosting agreement for a deep geological repository for low- and intermediate-level waste.

Nuclear science

Over the past few years there has been marked interest in studying advanced reactor concepts and related fuel cycle strategies with the aim of improving their economics, safety and non-proliferation aspects as compared with current reactors, while at the same time minimising the generation of nuclear

waste. Specific emphasis has been given to systems with one or more of the following criteria: fast neutron spectra, high temperatures and closed fuel cycles. Many of the proposed new reactor and fuel cycle concepts represent very advanced or completely new concepts, requiring a wide range of scientific feasibility studies, especially for the validation of core designs and for the development of new fuels and high-temperature materials.

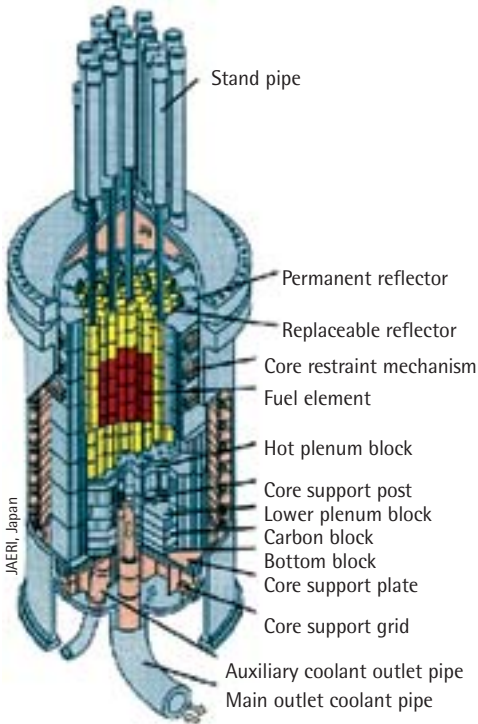
This interest in advanced reactor concepts in combination with, for example, an ageing workforce and falling student interest in nuclear disciplines has triggered an awareness of the need for better preserving the knowledge accumulated in the field of nuclear science and technology. A number of national and international initiatives, including the preservation of technical information in databases and strategies to transfer tacit knowledge, have been taken with the goal of safeguarding and sharing existing knowledge, and facilitating the transfer of that knowledge to future generations.

Nuclear data and software

The assessment of calculation tools and the validation of nuclear data performance are crucial issues in reactor and fuel cycle design studies, but are also of considerable importance for improving the performance of existing nuclear power plants. The notable increase in computing power, allowing Monte Carlo techniques and calculations of full three-dimensional models using best-estimate methods, are now being performed regularly, thus enhancing the accuracy of the results by eliminating earlier approximations in the codes.

In addition to more advanced computing techniques and models, more information about the accuracy of the associated nuclear data is also

Structure of the high-temperature engineering test reactor (HTTR) at the JAERI Oarai Research Establishment, Japan.



required to better assess the precision of the calculations. Most of the data libraries that are now being developed are, as far as possible, trying to incorporate uncertainty information in the form of covariance matrices. This nuclear data uncertainty information, together with proper sensitivity analysis and advanced nuclear model codes, will help nuclear physicists to better evaluate the confidence bounds of the calculated parameters (including reactor safety margins), providing prospects of improving the economics of current nuclear power plants.

Nuclear law

OECD countries have shown increasing concern in ensuring that adequate and equitable compensation is available to victims who suffer damage as a result of a nuclear incident taking place at a nuclear installation or during the transportation of nuclear substances. The adoption, in 2004, of Protocols to amend both the Paris Convention and the Brussels Supplementary Convention reflects the trends in member countries to significantly increase the amount of compensation to be made available to victims, to broaden considerably the scope of damage that will be subject to compensation, and to ensure that a much larger number of victims will be entitled to compensation than ever before. As for OECD countries not parties to the Paris or Brussels

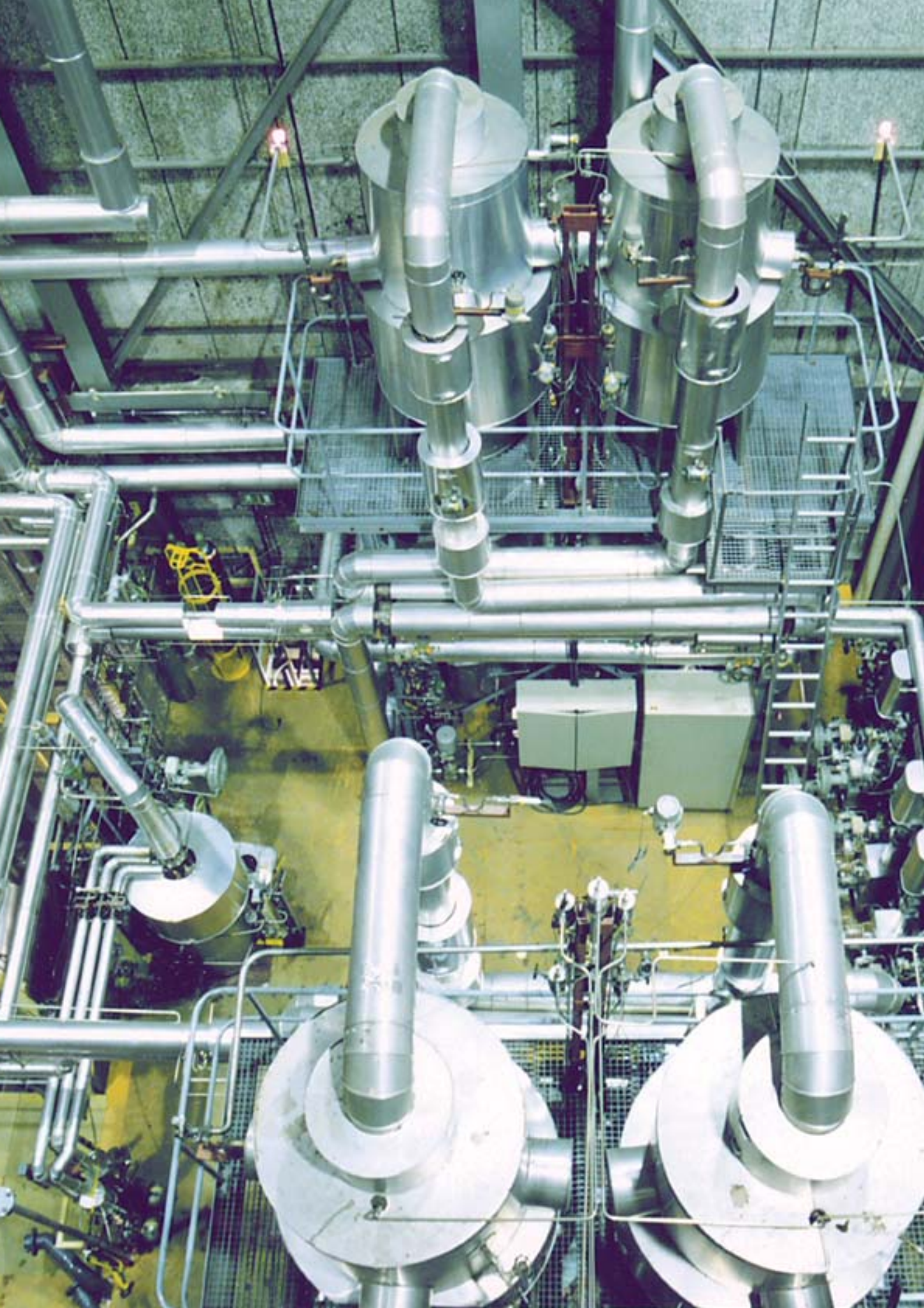
Supplementary Conventions, it is anticipated that several of them may soon amend their national nuclear liability legislation to reflect these same trends.

Member countries also wish to continue working to eliminate or minimise legal impediments to the safe use of nuclear energy and, to the greatest extent possible, harmonise legislation governing the peaceful uses of nuclear energy. To that end they continue to focus their attention on the impact of major events with international implications, such as terrorist acts, and on the need to develop new mechanisms for resolving issues which, until now, have not been studied from this perspective, such as harmonising legislation governing liability and compensation for damage arising from radioactive sources. Those goals will become increasingly challenging in light of the recent expansion of European Union membership.

The establishment of a University Diploma in International Nuclear Law at the University of Montpellier 1 in tandem with the International School of Nuclear Law further confirms the interest in maintaining and strengthening this specialised educational programme, which meets the concerns of OECD member countries to ensure that nuclear education and training are maintained at a high level, including in the field of nuclear law.

Signing the Protocols to amend the Paris and Brussels Conventions, Paris, France. From left to right: Mr. P. Reynders, Head of NEA Legal Affairs; Mr. D. Johnston, OECD Secretary-General; Mr. H. Rustand, Chair, Paris/Brussels Revision Group; and Mr. L. Echávarri, NEA Director-General.





Technical Programmes

Nuclear Development and the Fuel Cycle

Nuclear Development Committee (NDC)

The NDC continues to support member countries in the field of nuclear energy policy, addressing issues of relevance for governments and the industry at a time of nuclear technology renaissance and sustained government interest in ensuring long-term security of energy supply, reducing the risk of global climate change and pursuing sustainable development.

Nuclear policy issues

Several studies over the past years showed that education and training has been decreasing, perhaps to problematic levels. A new NEA publication entitled *Nuclear Competence Building* presents the results of a study that is a follow-up to the 2000 NEA study on nuclear education and training. This new study addresses the question of infrastructure as a whole in order to identify good practices and to help governments in the process of integrating nuclear R&D and education in an international setting. The report also includes a set of conclusions and recommendations for policy makers and other stakeholders.

In addition, the NEA co-sponsored the International Conference on Nuclear Knowledge Management that was organised by the International Atomic Energy Agency (IAEA). The objective of the conference was to reach a common understanding of issues related to nuclear knowledge management for sustaining knowledge and expertise in nuclear science and technology. The papers presented in the conference are available on the IAEA website (www.iaea.org/km/cnkm/index.html).

The NEA also participated in the in-depth energy policy reviews of the Czech Republic and France, carried out by the International Energy Agency (IEA). In those countries, nuclear energy plays a major role in the supply mix and is considered especially important as a means to address the climate change threat. The reviews offered opportunities to analyse national policies in the field of energy and electricity market deregulation, and to identify specific challenges facing governments with regard to the role of nuclear energy.

A report on *Government and Nuclear Energy*, prepared under NDC auspices, was completed at the end of 2003 and was published early in 2004. The report examines the evolution of government's role in the field of nuclear energy from the early 1950s to today, highlighting the challenges raised by electricity market deregulation, the need to ensure security of supply and the commitments of OECD countries to the goals of sustainable development, including alleviating the risk of global climate change. It stresses the importance of international co-operation in the field of nuclear energy and the role of intergovernmental agencies such as the NEA in this regard.

Economics

The study on projected costs of generating electricity carried out jointly with the IEA was completed in 2004 and will be published

early in 2005. Nineteen member countries and three non-member countries contributed to the study and provided data on more than 130 power plants. The coverage of the study includes coal, gas, nuclear, hydro and other renewable source power plants, as well as combined heat and power plants. The study shows that the competitive margin of nuclear energy has increased in most countries which have chosen to rely on this option.



Technology

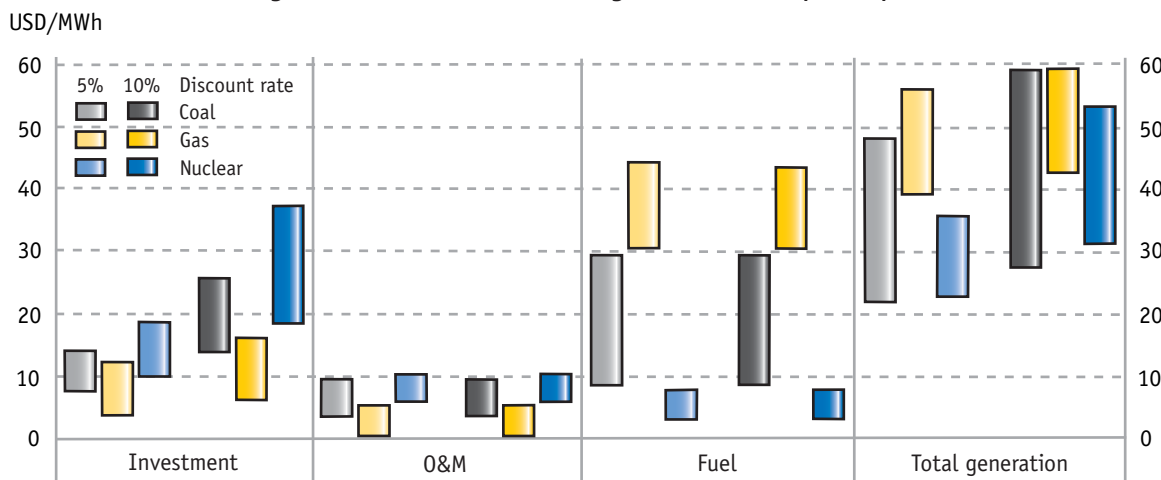
The Eighth Information Exchange Meeting on Actinide and Fission Product Partitioning and Transmutation was held in Las Vegas, Nevada, USA, on 9-11 November 2004. As for earlier meetings, it was organised in co-operation with the NEA Nuclear Science Committee. The local host was the University of Nevada Las Vegas; co-sponsors were the IAEA, the European Commission and the US Department of Energy. More than 70 papers were presented, which are available on the conference website at www.nea.fr/html/pt/iempt8/index.html.

In recognition of the importance of "innovation" in future nuclear development, a study on Innovation in Nuclear Energy Technology was launched in October 2004 in order to obtain guidance on ways and means to achieve maximum nuclear innovation in support of advanced nuclear energy systems.

A report on *Non-electricity Products of Nuclear Energy* was completed and posted on the NEA website at the end of 2004.

- A report on *Nuclear Competence Building* was published, presenting the results of an international survey on initiatives launched during recent years in the area of nuclear education and training.
- The joint IEA/NEA study on *Projected Costs of Generating Electricity* was completed, with contributions from 19 member countries and 3 non-member countries, which provided data on more than 130 power plants.
- The NDC celebrated its 50th meeting with a special session during which invited speakers reviewed the history of the Committee and provided guidance on its future role.
- A report on *Non-electricity Products of Nuclear Energy* was completed and made available on the NEA website.
- The Agency continued to provide technical support to the Generation IV International Forum (GIF).

Range of levelised costs for coal, gas and nuclear power plants



While non-electrical applications of nuclear energy such as desalination, district and process heating, hydrogen production, etc., have been considered since the very beginning of nuclear energy development, they have not been deployed thus far to a significant industrial scale in any country. The report reviews the current status and the future prospects for non-electricity products of nuclear energy, and the capabilities of nuclear energy systems to provide non-electricity products in a viable and competitive manner. The report also discusses strategic issues of relevance for the development and deployment of non-electricity nuclear systems, which would need to be elaborated in a future study.

Data and resource assessment

In the area of uranium resource assessment, the Joint NEA/IAEA Uranium Group pursued its activities with emphasis on the preparation of the 2005 update of the "Red Book", to be published in 2006. The group met once in 2004 to review and approve the questionnaire to be used to collect data for that publication. The group also agreed to implement a more efficient data collection and analysis method relying on an Internet-accessible database called the Red Book Online, which will be

used to collect data for the 2005 update. The 2003 update was published in English and French in the summer of 2004.

The yearly "Brown Book", *Nuclear Energy Data*, provides statistical data on nuclear electricity capacity and generation, as well as nuclear material and fuel cycle service production and demand in member countries. The 2004 edition offered projections to 2020 and country reports highlighting key events in the nuclear energy field. The 2005 edition will extend the projection horizon to 2025.

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Nuclear Safety and Regulation

Committee on the Safety of Nuclear Installations (CSNI)

The CSNI contributes to maintaining a high level of safety performance and safety competence by identifying emerging safety issues through the analysis of operating experience and research results, contributing to their resolution and, when needed, establishing international research projects.

Operating experience

The joint NEA/IAEA Incident Reporting System (IRS) is the only international system providing regulators and government bodies with information about lessons learnt from safety-significant events at nuclear power plants. The IRS co-ordinators exchange information about recent events during their annual meetings and jointly define topics of interest for further work. The subjects of recent IRS topical studies have included electrical disturbances, maintenance issues, material degradation and the issue of how to close the operating experience feedback loop. A new study on refuelling events will soon be undertaken. Apart from these topics, there is continuing concern over the decrease in focus and resources for operating experience activities worldwide, despite stated priorities to the contrary, and the IRS community has taken initiatives to reverse the trend.

The CSNI Working Group on Operating Experience (WGOE), playing an active role in the IRS system, has continued its work to communicate lessons learnt from NPP operating experience to the nuclear safety community, notably in the form of annual technical notes about lessons learnt from recent events. In 2004, the group also continued to focus on recurring events by launching a study on corrective actions against loss of residual heat removal during outages. In addition, the group examined safety-significant events caused by modifications that were initially considered as minor; events caused by contractors; and national processes to analyse and disseminate operating experience. Furthermore, a joint CSNI/CNRA task force held a workshop in Granada, Spain on regulatory uses of safety performance indicators. Another workshop was held together with the Working Group on the Analysis and Management of Accidents (GAMA) on debris impact on sump strainer clogging in Albuquerque, New Mexico, USA.

Analysis and management of accidents

Several CSNI activities in the area of safety assessment and research continue to relate to the analysis and management of accidents. Such work primarily concerns the thermal-hydraulics of the reactor coolant system and related safety and auxiliary systems; in-vessel behaviour of degraded cores and in-vessel protection; containment behaviour and containment protection; and fission product release, transport, deposition and retention.

In the area of thermal-hydraulics, the main objective is to improve and expand the application of best-estimate codes in nuclear power plant safety and design evaluations, including

uncertainty analysis. This also involves the coupling of current thermal-hydraulic system codes with codes in the areas of 3-D neutronics, structure mechanics, computational fluid dynamics (CFD) codes, and the application of these codes to nuclear safety. Extensive reporting on the outcome of these activities took place in 2004, and action plans were implemented. A seminar on the transfer of knowledge generated in CSNI activities in the thermal-hydraulics area (THICKET seminar) was held in June 2004. The seminar was hosted by the French Institute for Radiological Protection and Nuclear Safety (IRSN).

Regarding in-vessel behaviour of degraded cores, after publication of the results of the International Standard Problem on the PHEBUS FPT-1 experiment (ISP-46), a new report has been completed on the progress made on the TMI-2 accident analyses. The report concludes that processes such as in-vessel natural circulation, heat transfer and oxidation during reflooding, melt progression, and behaviour of debris in the reactor lower plenum, need to be treated more accurately in computer codes.

The ISP-47 exercise, based on experiments performed in the TOSQAN, MISTRA and ThAI facilities, remains the main activity in relation to containment behaviour. The objective is to demonstrate the capability of lumped-parameter codes on containment thermal-hydraulics under accident conditions. The work involving the TOSQAN and MISTRA data was completed in 2004 and reporting is in progress. The analysis of the ThAI results is being carried out.

As regards fission product release, transport, deposition and retention, the CSNI approved publication of the ISP-41 (code comparison against CAIMAN and RTF tests). A state-of-the-art report on nuclear aerosols and a status report on iodine chemistry are being prepared.

The Co-ordinated Programme on Steam Explosion Resolution for Nuclear Applications (SERENA) took new steps in 2004 in the assessment of code prediction for selected steam explosion tests and for reactor cases. The latter involved the calculation of loadings on the vessel and/or cavity structure arising from fuel/coolant interaction. The report on these activities is due for completion in mid-2005. The report will contain recommendations as to which improvements need to be made as well as on the possible need for additional experimental work.

In conjunction with the WGOE, a workshop was held in Albuquerque, New Mexico (USA) aimed at reviewing the state of knowledge on the impact of sump clogging on emergency water coolant recirculation capability following a loss-of-coolant accident (LOCA).

- The CNRA and the CSNI, recognising the many common areas of interest, the close interrelationship between the work of the two committees and the need for close co-ordination and co-operation between them, decided to develop a joint CSNI/CNRA strategic plan for 2005-2009.
- The CSNI and the CNRA organised a number of workshops, most notable were the workshops on the regulatory uses of performance indicators, and building, measuring and improving public confidence; the conference on fatigue of reactor components; and the forum on technical support services and contractors.
- In 2004 two new projects, one on PWR thermal-hydraulics – the PKL Project – and one on fuel integrity – the SCIP Project – were started. A number of technical proposals for new NEA joint projects were set forth and discussed during the year.

Integrated assessment of safety margins

Such factors as ongoing power uprates, longer operating cycles, new fuel designs and increased fuel burn-up, combined with plant ageing and plant life extension require a comprehensive, integrated assessment in order to evaluate their potential cumulative safety impact. An extensive Action Plan on Integrated Assessment of Safety Margins has been ongoing since 2002, aimed at developing a methodology for assessment of synergistic safety margin reductions. As a first step, a generalised safety margin concept is being elaborated by an ad hoc group of experts. Once agreed upon, a set of metrics will be defined for quantitative assessment of both the global safety margin and its partial components. The Action Plan is due to be completed by 2006.

Ageing and structural integrity of reactors

The main topics investigated in this area include metal components, concrete structures, seismic behaviour of structures and components and the ageing of wire systems. Four workshops were held and seven reports issued.

Lifetime management remained a key topic for the Working Group on Integrity of Components and Structures (IAGE). Risk-informed in-service inspection methodologies were reviewed in a workshop that gathered key experts and identified several activities with both research and regulatory implications. Activities on fatigue and thermal fatigue were pursued with the organisation in October 2004 of the third International Conference on Fatigue of Reactor Components, in co-operation with the Electric Power Research Institute (EPRI) and the US Nuclear Regulatory Commission (NRC). Reactor pressure vessel integrity was addressed through a benchmark on probabilistic structural integrity methods.

An extensive and educative report on concrete containment integrity addressing instrumentation and monitoring, in-service inspection techniques, response of degraded structures, repair methods and condition assessment was completed. Work on the International Standard Problem on Containment Capacity (ISP-48) continued, and is aiming to provide consensus on containment calculation methods in early 2005. A workshop on the use and performance of concrete in nuclear power plant and fuel cycle facilities provided insights into structural and regulatory issues of interest to the CSNI and the CNRA, as well as the NEA Radioactive Waste Management Committee.

A review of large testing facilities for nuclear power plant seismic design in NEA member countries showed that a suffi-

cient number and array of large testing capabilities were available worldwide. Methods to calculate seismic input motions for nuclear power plants and related uncertainties continued to be explored through close co-operation with geologists and seismologists.

Risk assessment

The main mission of the Working Group on Risk Assessment (WGRisk) is to advance the understanding and utilisation of probabilistic safety assessment (PSA) in ensuring the continued safety of nuclear installations in member countries. While PSA has matured greatly over the past years, further work is still required. WGRisk has been active in several areas, including developing a framework for information exchange on human reliability and software reliability. The working group collaborates with other CSNI working groups in the areas of operational experience, human factors and accident management, with other NEA standing technical committees on regulation and radiation protection, and closely co-ordinates its work with other international organisations.

Two workshops were held during the year. The first examined the state of the art in Level 2 PSA and Severe Accident Management, and the second addressed PSA for Non-reactor Nuclear Facilities. Technical opinion papers were finalised for publication on PSA-based event analysis; the development and use of risk monitors; and living PSA. Workshops on Fire PSA and Uncertainties are being planned. Work continues on the use of risk information in the regulatory process, and incorporating ageing effects into PSA applications.

Fuel safety margins

In 2004, the NEA Special Expert Group on Fuel Safety Margins (SEGFSM) continued the systematic assessment of the technical basis for current safety criteria and their applicability to high burn-up, as well as to the new fuel designs and materials being introduced in nuclear power plants. A Topical Meeting on LOCA Fuel Issues was organised in close co-operation with the US NRC at Argonne National Laboratory in May. It focused on the 17% cladding oxidation criterion and its applicability to high burn-up fuel and new cladding materials. The meeting showed that based on realistic, best-estimate safety analyses, safety margins are adequate in terms of existing acceptance criteria. Nonetheless, further effort is needed to better model and validate high burn-up phenomena as related to internal pressure; transient fission

gas release; collapse of the fuel pellet column after ballooning of the cladding; oxidation and related hydriding; ballooning; and related fuel blockage. The experimental database on actual irradiated fuel claddings requires additional data. Ongoing national and international fuel safety research programmes are expected to fill the existing gaps.

Human and organisational factors

Activities of the Special Expert Group on Human and Organisational Factors (SEGHOF) included a report on systematic methods for safety management; a report on human factors in NPP modifications; investigation into the improvement of NPP maintenance safety by inclusion of human and organisational factors; and the organisation of a session on managing change at the NEA workshop on Safe, Efficient and Cost-effective Decommissioning. A new task was also started on human performance in advanced control rooms.

During the year, a technical opinion paper on managing and regulating organisational change was published. Among the conclusions of that publication were that organisational change has the potential to impact upon nuclear safety in an irreversible way; as such, both the licensee and the regulator need to adopt formal positions on the issue. The approach for managing organisational change should be comparable to the system for managing plant and equipment modifications, and should encourage self-assessment. Consequently, organisational change proposals need to be subject to suitable levels of regulatory scrutiny. Of course, the regulator also needs to be aware of the potential for its actions to restrict the licensee's freedom to manage its own organisation. Particular attention needs to be given to the steps that the licensee has to take to ensure that it retains effective control of its

operations, and that it maintains sufficient knowledge independently of the arrangement chosen.

Fuel cycle safety

A new edition of the publication on *The Safety of the Nuclear Fuel Cycle* was finalised in 2004. Previous editions dated from 1981 and 1993. This new edition provides an updated analysis of the safety aspects of the nuclear fuel cycle. It addresses the safety and technical aspects of fuel cycle operations and supplies information on operating practices. The past decade has seen a number of changes in technical and policy areas, in nuclear power generation and in the associated fuel cycle. No significant event resulted from the operation and maintenance of industrial-scale facilities, although some significant events occurred in areas outside industrial-scale electricity generation. This shows that the fuel cycle industry has now reached full maturity, and that nuclear safety is adequately mastered.

Research facilities for existing and advanced reactors

Following a CSNI recommendation, a group of senior research managers was constituted with the aim of providing the necessary input and elaborating elements of strategy for maintaining key safety research facilities and possibly expanding their use. The group is to revise an earlier CSNI report on the subject, and will address a number of technical disciplines and related facilities, aiming to define priorities for possible joint international initiatives or programmes in the future. The group met twice in 2004 and produced a preliminary report. Extensive consultations – including with industry – as well as report revisions are foreseen during 2005. The report is due for completion in mid-2006.

Committee on Nuclear Regulatory Activities (CNRA)

The CNRA contributes to developing a consistent and effective regulatory response to current and future challenges. These challenges include the shrinking nuclear infrastructure, increased public expectations concerning safety in the use of nuclear energy, industry initiatives to improve economics and safety performance in the production of nuclear power, the necessity to ensure safety over a plant's entire life cycle, and new reactors and technology.

Regulatory decision making

It has been recognised for some years that the nature of the relationship between the regulatory body and the operator can influence the operator's safety culture at a plant, either positively or negatively. An important factor affecting the relationship between the regulator and the operator is the nature of the regulator's decision-making process. It was in this light that the CNRA decided to examine the broad issue of regulatory decision making.

The report on this subject presents some basic principles and criteria that a regulatory body should consider in making decisions and describes the elements of an integrated framework for

making regulatory decisions. It is not a handbook or guide on how to make regulatory decisions. Each country's laws, customs and administrative processes are unique, and the range of circumstances potentially facing a regulatory body is so great that a handbook approach is simply not practical.

The report recalls that the fundamental objective of all nuclear safety regulatory bodies is to ensure that nuclear utilities operate their plants in an acceptably safe manner at all times. In order to meet this objective, the regulatory body should strive to ensure that its regulatory decisions are technically sound, consistent from case to case, and timely. In addition, the regulator must be aware that its decisions and the circumstances surrounding those

decisions can affect how its stakeholders, such as government policy makers, the industry it regulates, and the public, view it as an effective and credible regulator. In order to maintain the confidence of those stakeholders, the regulator should make sure that its decisions are transparent, have a clear basis in law and regulations, and are seen by impartial observers to be fair to all parties.

Although the report stresses the importance of the regulatory body having a structured decision-making process, one must remember that it cannot substitute for the experience and judgement of the senior managers in a regulatory body gained over many years in facing diverse situations and making regulatory decisions. Likewise, the decision-making framework should not be so rigid that it does not allow room for individual judgement and discretion on the part of inspectors and managers in making regulatory decisions. In approving the report, which will be published early in 2005, the CNRA noted that it will provide excellent training to new persons entering the nuclear field, whether in a regulatory body or a licensee organisation.

Nuclear regulators and the public

Transparency is one of the keys to the public acceptance of nuclear energy uses. The workshop on Building, Measuring and Improving Public Confidence in the Nuclear Regulator, held on 18-20 May 2004 in Ottawa, Canada, was organised under CNRA auspices in collaboration with the Canadian Nuclear Safety Commission (CNSC). The objective of the workshop was to provide nuclear regulatory bodies with the opportunity to share information, practices and experience, and to discuss developments, progress and techniques in the area of nuclear regulatory communication with the public.

The workshop showed that cultural differences between countries prevented similar means for communication being effective in all countries. It was also clear that in some countries, the regulators can achieve public confidence more easily than in others. An important factor is general public trust in the government and its representatives. A number of common principles for successful nuclear regulation were nevertheless identified, such as high priority being given to building and maintaining public confidence, and the need to keep an adequate distance from the licensees when communicating with the general public. The NEA Working Group on Public Communication will use the findings from this meeting to continue to assist its members on related matters of regulatory transparency.

Regulatory inspection practices

Inspectors from regulatory bodies meet periodically to exchange information and experience related to regulatory safety inspections processes, discuss commendable inspection practices and carry out related studies. A report was issued on regulatory inspection practices used to bring about compliance. A seventh international workshop was organised in this area, providing inspectors with an opportunity to discuss inspection activities related to risk-informed inspections, inspections of plants at or near end-of-life, and inspections of licensee organisation performance.

In addition, several issues are currently being studied by the working group, including inspection of site selection, pre-

construction and construction; inspection efforts; and updating the report on regulatory inspection philosophy, inspection organisation and inspection practices. Plans were started for the eighth international workshop, which will take place in 2006 and cover the following issues: how regulatory inspections can promote, or not promote, good safety culture; inspection of interactions between the licensee and its contractors; and future challenges for inspectors (new techniques, developing competence, etc.).

Safety of technical support services and contractors

The licensee's ability to maintain control over the nuclear safety aspects of technical support services and contracted work represents a safety concern that cuts across the spectrum of contracting activities. This ability was identified as a topic for which an international exchange of views and experience could bring useful insights to operators and regulators. The regulatory community considered it worthwhile to identify commendable means used by the operators to maintain such control, as well as the type of regulatory oversight (e.g. inspections, assessment, etc.) that allows the regulator to gain assurance of the adequacy of such controls. Recognising the importance of these concerns, the CNRA decided to hold an international forum on this subject in June 2004. Heads of nuclear regulatory authorities were brought together with executives from the nuclear industry to exchange perspectives and experience.

Participants examined three key areas of interest: the overall environment, the licensees' responsibilities and the regulators' responsibilities. Regarding the environment, it became clear that while fewer key suppliers of nuclear components exist, many small expert contractors are available and sufficient competition continues. It is also clear that the use of contractors will continue – what is important is to recognise what work they do and how. Participants reaffirmed that the licensee is always responsible for safety, and as such core activities such as control and supervision of operation, or quality assurance, cannot be contracted out. Further, in order to fulfil their responsibilities, licensees must be "smart buyers" and "intelligent customers". This requires good control, supervision and oversight of contractors' work. On the other side, the regulator needs to provide clear explanations of what is required to the highest management levels of the licensee or its parent organisation, and to closely follow the contractors' actions to ensure safety.

The forum's final panel derived a number of conclusions including: licensees need to develop strategies for dealing with diversified contractors who are becoming more global; regulators need to develop their practices for verifying adequate arrangements between licensees and contractors; and finally, there is a need to develop, with international guidance, a concrete description of what is meant by the statement "the licensee has full responsibility for the safety of the plant".

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Radioactive Waste Management

Radioactive Waste Management Committee (RWMC)

The RWMC is assisting member countries in the area of management of radioactive waste and materials, focusing on the development of strategies for the safe, sustainable and broadly acceptable management of all types of radioactive waste, in particular long-lived waste and spent fuel.

Waste management policy and governance issues

The safety case is a key input to decision making at several steps in the repository implementation process. The RWMC prepared a brochure to provide a point of reference for those involved in the development of safety cases, and for those with responsibility for decision making in radioactive waste management. The Committee also started work to broaden the concept and to provide for an assessment basis to identify best practices in the area.

NEA member countries have chosen different approaches to establish criteria for the control of long-term safety of repositories, to decide how to make regulatory judgements against such criteria, and to express the requirements that flow from these judgements. The RWMC has undertaken to make more transparent the differences between approaches that lead to basically equivalent levels of safety. As a first step, the Committee assembled information on the categories of criteria (risk- or dose-related), and on the targets adopted for protecting the public. Regarding the handling of probability and uncertainty over time, the information recorded suggests that no country has a simple, clearly formulated approach to dealing with these issues.

Storage has long formed part of the management of many types of radioactive waste, especially spent nuclear fuel and waste from reprocessing. Starting from the conclusion that geological disposal and storage should be complementary practices, the RWMC is examining the roles that storage plays in waste management according to current or envisaged practices in member countries. The study aims to establish a common ethical and sustainability framework for these matters, representing the views of organisations with responsibilities for policy development, regulatory control and the practical management of radioactive waste.

International peer reviews

On request from the Swiss Federal Office of Energy (SFOE), the NEA organised an international peer review of a study prepared by Nagra, the Swiss waste management organisation. The study, presenting the safety aspects of a repository project in Swiss clay formations, aimed not only at demonstrating numerical compliance but also at showing the degree of understanding of the system. In its report, the international review

team used a checklist of principles and good practices meant to help the evaluator verify the quality of the safety analysis. The review was presented to and well accepted by the Swiss authorities, and to an audience of representatives from Swiss and German municipalities, counties and the media.

Forum on Stakeholder Confidence

Under the title *Learning and Adapting to Societal Requirements for Radioactive Waste Management*, the Forum on Stakeholder Confidence (FSC) compiled a synthesis of its key findings during the first phase of its work on the governance of long-term radioactive waste management. It addressed basic conditions for waste management policy, social and ethical dimensions, and stakeholder involvement.

In another initiative, the Forum analysed the main features of the concept of stepwise decision making in radioactive waste disposal, i.e. a plan for repository implementation in which development is by steps or stages that are reversible, within the limits of practicability. The findings have been published in a report that highlights important aspects of the decision-making processes, and points to the benefits of a stepwise approach to move ahead in a societally acceptable manner for projects that cover very long time periods.

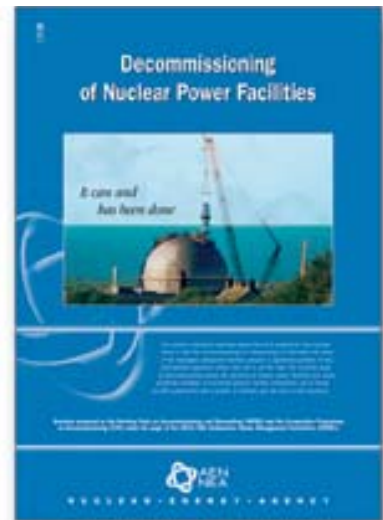
The FSC held its 4th FSC workshop in national context in the Gorleben area of Germany, following the proven scheme of including a "local" partner to facilitate discussion with local stakeholders. Local and national stakeholders, including state parliament, government, counties, municipalities, civil society organisations and "private" citizens, have been participating. The workshop methodology again demonstrated its robustness and capability to adapt to various situations and cultures and gave new insights into how history, and past trauma, will influence a revised process, and how stepwise and reversible approaches could help to overcome a blocked situation.

Repository safety and integration of science

In analysing long-term safety for geological repositories, the post-closure period is often divided into discrete time frames that are characterised by particular types of processes and related uncertainties. Work has begun to review the current status of how these issues are handled. A workshop organised on the Management of Uncertainties: The Role of Risk provided an opportunity to discuss the merits and roles of different

- A reference brochure was produced on the development of post-closure safety cases for deep geological repositories.
- Under RWMC auspices, an international expert team reviewed a safety assessment for geological disposal in Swiss clay formations.
- The integration of process issues in the design and evaluation of engineered barrier systems (EBS) was the topic of the second NEA/EC EBS workshop, held in Las Vegas, Nevada, USA.
- The management of uncertainty and the role of risk was addressed at an NEA workshop held in Stockholm, Sweden.
- The Forum on Stakeholder Confidence (FSC) compiled a synthesis of its key findings on learning and adapting to societal requirements, and held its fourth FSC workshop in national context in Germany.
- An NEA workshop sponsored by the RWMC, the CNRA, the CRPPH, the CSNI and the NDC discussed Safe, Efficient, and Cost-effective Decommissioning, in Rome, Italy.

A workshop on Safe, Efficient and Cost-effective Decommissioning was held in Rome in September 2004. Shown right are views of a leaflet largely distributed at the event and to decommissioning correspondents around the world.



strategies, methods for the management of uncertainties, and the role of risk in a safety case.

NEA work on the role of engineered barrier systems (EBS) in a safety case is being organised as a series of workshops jointly held with the EC, the second of which was held in September 2004. The workshop focused on the integration of process issues and addressed which processes are most important for the design and performance of engineered barriers, as well as how their impact could be analysed in a systematic manner.

Decommissioning

A large array of decommissioning issues was addressed at a workshop on Safe, Efficient and Cost-effective Decommissioning, held in Rome in September 2004. The workshop, which was organised by the RWMC together with the CNRA, the CRPPH, the CSNI and the NDC, in co-operation with the IAEA and the EC, and hosted by the Italian organisations SOGIN and APAT, addressed such issues as materials management, decommissioning techniques, the management of transition, costs and funding, safety and regulation. It provided valuable input for planning future work on decommissioning in the NEA committees.

Interest in and experience with different funding schemes for decommissioning have increased. The RWMC addressed this area through a specialised working party, and a task group which will prepare a document on the status of funding mechanisms in different countries.

Regarding the safety case for decommissioning, the release of sites, and the release of buildings and materials, work is ongoing to collect experience and describe the current status. A leaflet on decommissioning was also produced, showing to a wide audience that decommissioning is a technically mature undertaking that "can and has been done".

Understanding the scientific basis

To secure the scientific basis of its work, the RWMC continued to support the development and maintenance of quality-assured databases and models for use in the implementation of repositories. Work continued on the Thermochemical Database (TDB), the Features, Events and Processes Database (FEP), and a reference book on the self-healing features of clay. Final reports were drafted for a catalogue of clay characteristics and the Sorption project (see page 34). And finally, a new initiative for a reference book on natural tracers' profiles in clay (CLAYTRAC) was launched at the end of 2004.

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Radiological Protection

Committee on Radiation Protection and Public Health (CRPPH)

The CRPPH is contributing to the definition of new directions and approaches for the international system of radiological protection in order to achieve a clearer and more streamlined result. The ultimate objective is to achieve a system that will better address regulator and practitioner needs, and will more appropriately position scientific radiological protection considerations within the broader context of social judgement and risk governance.

Emerging challenges

At its March 2004 meeting the CRPPH began a series of discussions on what challenges the future may hold for radiological protection – not only for its own work programme needs, but for the general enlightenment of radiological protection (RP) policy makers, regulators and practitioners. With the input from a topical session during the March 2004 meeting, the brainstorming efforts of a broad group of stakeholders, and the work of two expert groups, the Committee is developing its views on issues that could emerge in two main areas: social, policy and implementation evolution; and scientific studies and developments.

The Emergency Centre of the Association Vinçotte Nuclear (AVN), Belgium.



AVN, Belgium

This work is in essence updating the 1994 CRPPH collective opinion, which documented emerging RP issues, and served as a sort of "road map" for the Committee's programme of work during the ten subsequent years. It is expected that this new review work will be completed in 2006, with the publication of two reports expressing the Committee's views on these challenges. In particular, it is expected that the study on scientific research may highlight areas in which further study could support policy and regulatory needs, and which could usefully be addressed by a joint undertaking under CRPPH auspices.

It may also be noted that CRPPH work on nuclear emergency management, through the NEA Secretariat, supported a December 2004 meeting of the G7 + Mexico Health Ministers on the topic of medical response to radiological and nuclear terrorist attacks.

Development of a new radiological protection framework

The recommendations of the International Commission on Radiological Protection (ICRP) form the framework for virtually all national policy and regulation in this area, and thus it is essential to achieve rational consistency while at the same time ensuring appropriate evolution to address changing scientific knowledge and social norms. To achieve this, the CRPPH continued to collaborate with the ICRP, providing constructive feedback to the Commission's ongoing recommendation development. This collaboration included two key aspects. The first was the Second Asian Regional Workshop, held in Tokyo in July 2004, to discuss the Asian perspective on the evolution of the system of radiological protection. The second was the development of specific, constructive comments to the Commission's latest draft recommendations, by collecting the views of all relevant NEA standing technical committees, and analysing these through a CRPPH expert group. Broadly, the CRPPH suggested that further clarity is needed from the Commission regarding its proposed principles of dose restriction (particularly dose constraints, their relationship with dose limits, and their proposed numerical values), its new view of justification, and its use of a matrix to describe collective dose more fully.

These inputs represent the views of the policy makers, regulators and practitioners who will be responsible for implementing the Commission's recommendations, and are thus greatly appreciated by the ICRP. Input from the CRPPH has consistently been reflected in each subsequent draft recommendation. It is now expected that the final ICRP recommendations will not be released until 2006. The CRPPH plans to continue to play a constructive role in this process.

A new approach to the implementation of RP principles

From the vantage point of a national radiological protection authority or responsible government official, it is important to respond appropriately to all radiological protection issues raised

- The CRPPH began a forward-looking study of emerging issues in radiological protection policy, regulation, implementation and science.
- The Committee continued its constructive dialogue with the ICRP on the latter's new recommendations, providing comments on draft ICRP materials and input through discussions at the Second Asian Regional Workshop.
- The CRPPH finalised a report suggesting a simple, coherent approach to implementing the new ICRP concepts.
- Preparations for the Third International Nuclear Emergency Exercise (INEX 3) were finalised.
- Participants in the Information System on Occupational Exposure (ISOE) agreed to migrate its experience sharing and data exchange processes to the web.

by government, the private sector or the public. With the wide-ranging recommendations still being developed by the ICRP in mind, the CRPPH has devised a practical, simple and coherent approach to this task, elaborating what it calls the "process of regulatory authorisation".

This work focuses on the decisional steps needed to judge whether a given radiation source or exposure situation should be deemed unjustified and thus i) not authorised, ii) authorised with a specified set of regulatory controls, or iii) authorised without regulatory controls. This approach avoids the complications and pitfalls that arise from the use of specific yet not fully understood concepts such as exclusion, exemption, clearance, practices or interventions. It also provides decision makers with a tool to help identify the most appropriate level of stakeholder involvement, which will facilitate the development of sustainable, accepted decisions in radiological decision making.

Nuclear emergency exercises: consequence management

Following the INEX 2 series of exercises, which were completed in 2001, and the INEX 2000 exercise, the CRPPH Expert Group on Nuclear Emergency Matters (EMEX) has summarised a series of urgent response lessons learnt and experience for national response organisations to assess and implement as appropriate within their own contexts. The next phase of a nuclear emergency, consequence management, is now under study. For this, the INEX 3 table-top exercise has been developed based on a large-scale contamination scenario. Exercise preparation, support and assessment documents have been prepared and made available to national exercise co-ordinators. The exercise begins with the contamination in place, but not yet fully characterised. The broad objectives of the exercise focus on agricultural countermeasures and food restrictions; decision making on soft/light countermeasures, such as travel, trade and tourism; recovery management; and public information. It is expected that countries will begin to hold the exercise(s) in the latter part of 2005. A summary workshop, early in 2006, will provide the opportunity to assess the results and to share experiences and lessons learnt.

Occupational exposure at nuclear power plants

Occupational exposures at nuclear power plants continue to be an important issue for the members of the CRPPH. The sharing



A. Gomin, CEA, France

Occupational exposure management is a central concern in the work of the CRPPH.

of lessons and experience, as well as the exchange and analysis of occupational exposure data continues to be addressed by the NEA joint project: the Information System on Occupational Exposure (ISOE). In support of CRPPH collaboration with the ICRP on the development of new recommendations, the ISOE participated in the work of the CRPPH expert group analysing draft ICRP recommendations, and has developed a report on good industry practice regarding various aspects of optimisation of protection. The latter work presents the implications that might result from the implementation of new ICRP draft principles. Further details on the ISOE are provided on page 34.

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Nuclear Science

Nuclear Science Committee (NSC)

The aim of the NEA nuclear science programme is to help member countries identify, pool, develop and disseminate basic scientific and technical knowledge used to ensure safe and reliable operation of current nuclear systems, as well as to develop next-generation technologies. The main areas covered are reactor physics, fuel behaviour, fuel cycle physics and chemistry, criticality safety and radiation shielding.

The NEA nuclear science programme is to a large extent devoted to international comparison exercises or benchmark studies for the validation of computation methods and data used to predict the behaviour and performance of different nuclear systems. In addition, the nuclear science programme sponsors specialist meetings and workshops and co-ordinates the preparation of state-of-the-art reports as necessary.

Reactor physics

The NEA has an ongoing programme of international comparison exercises to model reactor stability and transient events, as well as to study different reactor physics parameters for high-temperature reactors. Among the reactor stability benchmarks could be mentioned a study on a reactivity transient simulation in a VVER-1000 reactor and a study of a boiling water reactor (BWR) full-size bundle test based on experimental data from Japan. First results from a benchmark study of a plutonium-fuelled high-temperature reactor are being analysed and specifications for a pebble bed modular reactor (PBMR) core physics modelling exercise are being developed.

The NEA programme also covers scientific studies related to the burning of weapons-grade plutonium in reactors. Both fuel behaviour and reactor physics issues are being addressed in the ongoing studies. Results from an international comparison exercise of a three-dimensional mixed-oxide (MOX) fuelled reactor core, based on experimental data from the Belgian VENUS-2 reactor, was published in 2004.

Another current issue in reactor physics calculations is the ability of modern deterministic transport codes to model three-dimensional reactor core problems without using spatial homogenisation. The NEA has organised an international benchmark on this issue and the report will be published in early 2005.

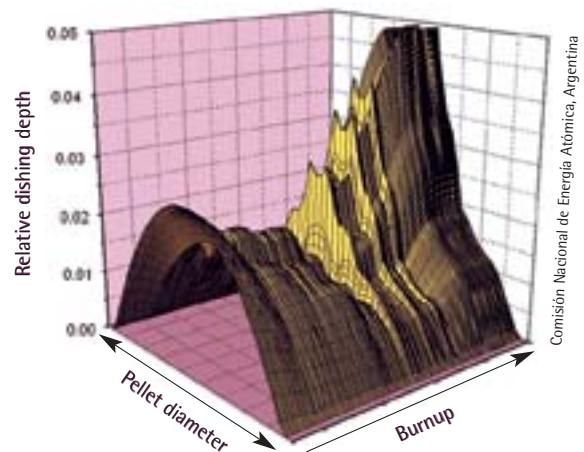
The International Reactor Physics Benchmark Experiments (IRPhE) project to evaluate and preserve well-documented integral nuclear data, measured at different reactors or mock-up experiments, continues. Four new evaluations were completed in 2004 and seven additional evaluations are ready for an independent peer review before publication.

The NEA also published a series of reports from the EC-sponsored CRISSUE-S project, which aims at evaluating fundamental technical issues related to the interaction between thermal-hydraulics and neutron kinetics in light water reactors (LWRs).

Fuel behaviour

A new edition of the NEA International Fuel Performance Experiments (IFPE) database was released in 2004. The database contains measured fuel behaviour data such as fuel temperatures, fission gas release, fuel swelling, clad deformation and mechanical interactions. The data are mainly used for model development and code validation. Some data sets were, for example, recently utilised in the IAEA-coordinated exercise on Fuel Modelling at Extended Burn-up (FUMEX). The IFPE database was also extensively discussed at a seminar on pellet-clad interaction in water-cooled reactors held in March 2004.

Dishing shape evolution of a fuel pellet during irradiation.



Fuel cycle physics and chemistry

The NEA recently launched a study with the objective to assemble and organise information to obtain a better understanding of the issues involved in the transition from current fuel cycles to long-term sustainable fuel cycles, and to assess specific needs related to that transition.

The treatment of spent nuclear fuel is presently performed by the industry using different aqueous chemical processes. Alternative dry processes, using pyrochemical methods, are beginning to receive greater attention, and in response to this interest the NEA published a status report in 2004 on *Pyrochemical Separations in Nuclear Applications*.

- A seminar to discuss pellet-clad interaction in water reactors was organised in March 2004.
- A report was published on the effects of a beam interruption in an accelerator-driven, mixed-oxide (MOX) fuelled, lead-bismuth-cooled reactor.
- A status report on pyrochemical separations in nuclear applications was published.
- A workshop on utilisation and reliability of high power proton accelerators in an accelerator-driven system was organised in May 2004.
- The need for integral critical experiments with low-moderated MOX fuels was discussed at a workshop in April 2004.
- A workshop on shielding of accelerators, targets and irradiation facilities (SATIF) was organised in May 2004.

Scientific issues in partitioning and transmutation

In relation to partitioning, a report on current national programmes in member countries and a study to evaluate critical performance parameters for chemical processes used in different fuel cycle scenarios are being prepared. The latter study is being performed in close co-operation with the Nuclear Development Committee activity on the impact of advanced fuel cycle options on waste management policies.

Regarding transmutation, the NEA has conducted a series of benchmarks studying the effect of accelerator beam interruptions in an accelerator-driven reactor system. A report on such a beam interruption in an accelerator-driven mixed-oxide (MOX) fuelled lead-bismuth-cooled reactor was published in 2004. Another benchmark, based on the MUSE-4 experiment performed at CEA Cadarache, France was completed, and the report will be published in early 2005.

Nuclear criticality safety

The NEA science programme in the nuclear criticality safety area deals with issues relevant to the fabrication, transportation and storage of fuel and to other operations related to the fuel cycle. The 2004 edition of the *International Handbook of Evaluated Criticality Safety Benchmark Experiments* contains 379 evaluations representing 3 331 critical configurations. The handbook is mainly used by criticality safety analysts to perform necessary validations of their calculation techniques and tools.

A workshop to review the need for integral critical experiments with low-moderated, mixed-oxide (MOX) fuel was organised in April 2004. The recommendations from the workshop were to encourage the release of unpublished, relevant experimental data and to define a framework for the selection of new experimental programmes. A small ad hoc group was formed to develop such a framework and to make recommendations on suitable experiments. Two proposed experiments, one from France and one from Russia, were finally recommended and further investigations will be undertaken to define a framework for these experiments.

Radiation shielding and reactor dosimetry

The Shielding Integral Benchmark Database (SINBAD) has been updated with 12 new experiments and a new edition was released in February 2004. The database was presented at the

10th International Conference on Radiation Shielding held in May 2004. In connection with this conference, the NEA organised a workshop on Shielding of Accelerators, Targets and Irradiation Facilities (SATIF).

The Radiation Damage Facility at the Fermi National Accelerator Laboratory, United States.



FNAL, United States

A reactor dosimetry benchmark, based on experimental data, was launched in March 2004. This benchmark aims at comparing the capability of current computation methods to perform 3-dimensional dosimetry calculations of a MOX-fuelled reactor.



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Data Bank

The Data Bank operates as an international centre of reference for its member countries respect to basic nuclear tools, such as computer codes and nuclear data, used for the analysis and prediction of phenomena in the nuclear field. It provides a direct service to its users by developing, improving and validating these tools and making them available as requested.

The Data Bank computer program and nuclear data services celebrated its 40th anniversary in 2004. During these 40 years, 67 000 copies of computer program packages were distributed to some 600 establishments, and scientists in member countries have enjoyed free access to a very large collection of bibliographic, experimental and evaluated nuclear data.

Computer program services

During 2004, 1 846 computer program packages were distributed upon request. The major topics of interest in 2004 were programs and associated data libraries for radiation transport and reactor physics. About 20% of the dispatches of computer programs and integral data sets were sent upon request to non-OECD establishments, in accordance with a co-operative agreement with the International Atomic Energy Agency (IAEA).

In addition to the computer program services, the Data Bank is also involved in the development of a graphical user interface that will guide the user to solve radiation transport problems, and in the development of tools for the analysis and estimation of sensitivities and uncertainties in calculations, or their propagation through complex computational schemes, used for example in the field of neutronics and thermal-hydraulics.

Two editions of nuclear program abstracts on CD-ROM were issued in May and September 2004, and five electronic newsletters were sent out to liaison officers and subscribers during the year. Users of the computer program services have provided feedback on their use of the codes and this information has been transmitted to the computer program developers.

Computer program training courses

The Data Bank organised three tutorial courses in conjunction with the International Conference on Radiation Shielding in May 2004. The subjects covered were:

- Big Challenges in Monte Carlo: from Physics to Biology,
- An Introductory Course in Proton Cancer Therapy,
- Radiation Shielding for Diagnostic Radiology and Radiation Therapy.

In addition, the Data Bank arranged a training course on PENELOPE-2003 (an electron-photon transport code) in Barcelona, Spain in October 2004.

Preservation of information from integral experiments

Under the scientific guidance of the NEA Nuclear Science Committee, the Data Bank collects and distributes well-documented information and data from integral experiments in the areas of reactor physics, radiation shielding, fuel behaviour and thermal-hydraulics. Major emphasis was devoted to establishing electronic archives of data and reports from high-temperature reactor experimental campaigns. During 2004, the Data Bank distributed 3 472 sets of integral data, the most popular being the fuel behaviour database (60% of the total distribution), followed by an almost even popularity among the three other categories.

Nuclear data services

The compilation, exchange and dissemination of bibliographic, experimental and evaluated nuclear data are performed within an international framework comprising a small number of nuclear data centres of which the Data Bank is a major one. In 2004, the Data Bank contributed data from about 200 new experiments to the international EXFOR database containing measured data. The nuclear data services are to a very large extent provided through direct online access to the different databases. The Data Bank registered close to 30 000 accesses to these databases in 2004.

A new version of the JANIS nuclear data display program (JANIS-2.1), designed to facilitate the visualisation and manipulation of nuclear data, was released in August 2004. The latest version includes the possibility to access centralised stored data (available on the NEA server) through Java servlet technology. The program is distributed only on DVD to permit inclusion of



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- A preliminary, new version of the Joint Evaluated Fission and Fusion (JEFF) data file underwent extensive testing in 2004, with the goal of releasing the file in mid-2005.

all of the main databases on one single medium for local access. The software can also be downloaded directly from the NEA website. See www.nea.fr/janis/ for further information.

The JEFF project

The third version of the Joint Evaluated Fission and Fusion (JEFF-3.0) nuclear data library was released in 2002 and has since undergone extensive processing and validation, highlighting files that are in need of revisions. In parallel, evaluation work is progressing with the aim of providing new or revised evaluations for inclusion in the next release of the library (JEFF-3.1). A preliminary version of JEFF-3.1 was issued within the JEFF community in November 2004. It is planned to release the final JEFF-3.1 library to the public in mid-2005. This library will include general purpose data as well as special purpose files on activation, radioactive decay and fission yield data.

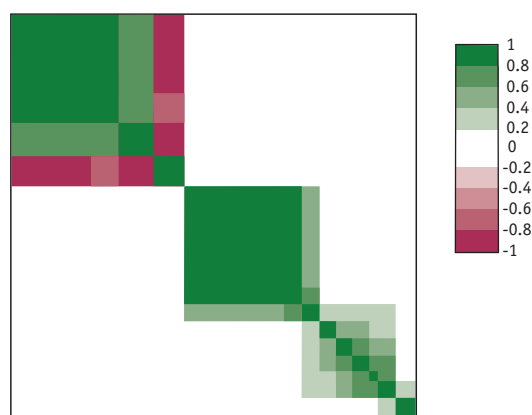


International nuclear data evaluation co-operation

Activities in the area of nuclear data evaluation co-operation promote the exchange of information on nuclear data evaluations, associated measurements, nuclear model calculations and related topics, and provide a framework for co-operative activities between the participating nuclear data evaluation projects. Two reports, entitled *Activation Cross-sections and Assessment of Neutron Cross-sections for the Bulk of Fission*

Products, are being prepared for publication in early 2005. Issues to be discussed in the near future comprise improvements to minor actinide data, evaluation and processing of uncertainty (covariance) data, and a review of photon production data. Work to establish a better-structured high priority request list for nuclear data continues, and a new test database was created in 2004.

Fission cross-section uncertainty correlations as a function of energy for ²⁴¹Pu



The Thermochemical Database (TDB) Project

The Data Bank is developing a database of recommended chemical thermodynamic data for the safety assessment of radio-active waste repositories. This work is performed under the scientific guidance of the NEA Radioactive Waste Management Committee. The details of this programme can be found in the section "Joint Projects and Other Co-operative Projects" (page 35).



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Nuclear Law Committee (NLC)

The NLC promotes the harmonisation of nuclear legislation governing the peaceful uses of nuclear energy in member countries and in selected non-member countries. It supports the modernisation and strengthening of national and international nuclear liability regimes. Under the supervision of the NLC, the NEA also compiles, analyses and disseminates information on nuclear law through a regular publications programme and organises the International School of Nuclear Law educational programme.

The Contracting Parties to the Paris Convention and to the Brussels Supplementary Convention adopted and signed protocols to amend those conventions at a diplomatic conference held on 12 February 2004 at OECD headquarters. They also adopted a Recommendation on the Application of the Reciprocity Principle to Nuclear Damage Compensation Funds, and an Explanatory Report on the revision of the two conventions. The revised Paris Convention will require nuclear operators to make more money available to compensate more victims for more types of damage than ever before. The revised Brussels Supplementary Convention will ensure that where compensation amounts under the revised Paris Convention are insufficient, a significant amount of additional funding will be provided. In total, the compensation to be made available to victims of a nuclear accident under the revised Paris-Brussels regime will be €1.5 billion, compared to the current total of 300 million Special Drawing Rights (approximately €350 million).

In connection with the diplomatic conference, the NEA co-organised with the Ministry of Foreign Affairs and the *Commissariat à l'énergie atomique* of France, as well as with the International Nuclear Law Association, a colloquium to highlight the major features of the revised conventions. Speakers addressed such important issues as the significant increase in liability and compensation amounts, the expansion of the geographic scope of application of the conventions, the new detailed definition of nuclear damage, and improvements to the regime covering the transport of radioactive substances.

The Nuclear Law Committee undertook a detailed study of existing regimes covering liability, financial security and compensation for damage caused by radioactive sources. The study was carried out using a questionnaire designed to collect information on national legislation governing civil liability for damage caused by radioactive sources, including equipment containing radioactive sources, as well as on current policies and practices of insurers and other financial guarantors in providing financial security in respect of that liability. The issue is particularly relevant since neither the IAEA Code of Conduct on the Safety and Security of Radioactive Sources nor the Council Directive (Euratom) on the Control of High Activity Sealed Sources and Orphan Sources address liability and compensation for damage caused by radioactive sources, and neither the Paris nor the Vienna Convention apply to radioisotopes outside a nuclear installation that have been prepared for use in industrial, commercial, agricultural, medical, scientific or educational

applications. The Committee will continue its study to determine whether particular legislative requirements or practices should be adopted and harmonised amongst member countries.

NEA Legal Affairs, working in consultation with members of the Nuclear Law Committee, undertook major planning activities for the 2nd International Workshop on Nuclear Damage Indemnification to take place in Bratislava in May 2005. This workshop is designed to test the effectiveness of nuclear third party liability and compensation mechanisms that would be activated if a nuclear accident were to occur in a Vienna Convention/Joint Protocol country, and is expected to help participants assess the current state of nuclear emergency preparedness and response in their own and neighbouring countries.

Information on nuclear law

Issues No. 73 and 74 of the *Nuclear Law Bulletin* were published in June and December 2004, along with their respective Supplements reproducing nuclear legislation adopted in Croatia and Iceland. This periodical provides up-to-date information on developments in legislation, regulations, case law and institutional structures in the field of nuclear law at the national and international levels. The Bulletin has proved to be an invaluable tool for those in government, regulatory, academic, industry and international circles that work closely with nuclear law. Back issues of the Bulletin and other nuclear law information resources are available on the NEA website at www.nea.fr/html/law/.

The 2002/2003 update of the analytical study of nuclear legislation in OECD countries was published in 2004. This study comprises a chapter on the institutional framework and legislation and regulations governing nuclear energy in each OECD country. Country chapters are revised in rotation, and the 2002/2003 update contains replacement chapters for Belgium, Canada, the Czech Republic, France, Germany, Ireland, Mexico, Poland, Portugal, Sweden, Switzerland and the United Kingdom.



- The Protocols to Amend the Paris Convention on Nuclear Third Party Liability and the Brussels Convention Supplementary to the Paris Convention were adopted and signed at a diplomatic conference convened at OECD headquarters on 12 February 2004.
- The Nuclear Law Committee undertook a detailed study of member countries' legislative regimes covering liability and compensation for damage caused by radioactive sources, including existing compensation policies and practices of insurers and other financial guarantors.
- Extensive planning was carried out for the organisation of an international workshop on the indemnification of nuclear damage following a nuclear incident, to be held in Bratislava in May 2005.
- The fourth session of the International School of Nuclear Law was organised at the University of Montpellier 1.
- An International Seminar on Nuclear Law and Environmental Law was organised in Cluj-Napoca, Romania.

Educational programme

The fourth session of the International School of Nuclear Law (ISNL) was held at the University of Montpellier 1, France, in August-September 2004. The ISNL is jointly managed by the NEA and the University of Montpellier 1. Its objective is to provide high-quality education in nuclear law to law students and legal professionals through a two-week intensive course. A total of 57 participants from more than 30 countries attended the 2004 programme, which was held entirely in English.



The University Diploma (*Diplôme d'Université* – D.U.) in International Nuclear Law, established in 2003, attracted an even higher number of candidates in 2004 than in the previous year. ISNL participants may apply for this diploma which is delivered upon successful completion of written examinations and satisfactory performance during the course. The University has also organised official recognition of the Diploma through ECTS credits (European Credit Transfer and Accumulation System). This system, introduced in 1989 within the framework of Erasmus and now part of the Socrates programme, facilitates the recognition of study periods spent in European universities.

Further information on the 2005 session, scheduled to take place from 22 August to 2 September 2005 is available on the NEA website at www.nea.fr/html/law/isnl/index.html. Applications can be submitted online.

An International Seminar on Nuclear Law and Environmental Law was organised in Cluj-Napoca (Romania) from 5 to 9 July 2004. This seminar was the first activity carried out under



Maria Durisova, Bohunice NPP, Slovak Republic

Participants at the International Seminar on Nuclear Law and Environmental Law in Cluj-Napoca, Romania.

the ISNL partnership system and enjoyed close co-operation between the University of Babeş-Bolyai, the NEA, the Romanian nuclear authorities, the French section of the International Nuclear Law Association and the Law and Insurance Branch of the French Nuclear Energy Society. Up for discussion were a series of questions covering environmental protection in the context of nuclear activities; the safety of nuclear installations and radiation protection; legal and political aspects of radioactive waste management; management of nuclear accidents and radiological emergencies; liability and indemnification of nuclear damage; nuclear security and public participation and information. Over 120 participants attended this seminar which was conducted entirely in French.

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NUCLEAR SAFETY

The Halden Reactor Project

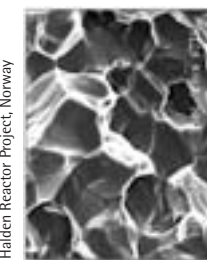
The Halden Reactor Project has been in operation for 46 years and is the largest NEA project. It brings together an important international technical network in the areas of nuclear fuel reliability, integrity of reactor internals, plant control/monitoring and human factors. The programme is primarily based on experiments, product development and analyses, which are carried out at the Halden establishment in Norway, and is supported by approximately 100 organisations in 20 countries.

The 2004 programme of work in the fuel area included the realisation of the first in-pile loss-of-coolant accident (LOCA) test aimed at assessing high burn-up fuel behaviour in accident conditions. The first test was a trial with fresh fuel and was successfully completed. It will be followed up with tests using high burn-up fuel, which will be carried out in 2005. Properties of UO_2 , gadolinia and MOX fuels in a variety of conditions relevant to operation and licensing were investigated. Corrosion and creep behaviour of various alloys were studied. A test on PWR crud deposition and control produced valuable results for the understanding and remedy of axial offset anomalies. Finally,



Examples of large (top) and negligible (bottom) crud deposition along a PWR fuel rod after testing in the Halden test reactor.

tests to investigate the cracking behaviour of reactor internals material in BWRs and PWRs continued, with the aim of characterising the effect of hydrogen addition to the water coolant. The programme on human factors focused on tests and data analyses carried out in the Halden man-machine laboratory. The human factor work also encompasses new designs and evaluations of human-system interfaces and control rooms. This involves *inter alia* the use of the Halden Virtual Reality Facility.



Close-up (500x) of PWR internals material (from the Chooz A reactor in France) after being tested for cracking behaviour at Halden.

A number of international workshops were also organised at Halden, notably on fuel code benchmarking, online monitoring and cable ageing. The project continued its summer school programme, which is supported by the NEA Nuclear Safety Division. This is in follow-up to a recommendation of the Halden Board to actively pursue the transfer of nuclear knowledge to the younger generation.

The Halden Reactor Project operates by way of three-year renewable mandates; the current mandate runs until the end of 2005. Consultations with member country representatives have started in preparation for the 2006-2008 programme period. The Halden Project signatory organisations confirmed their intention to continue the Halden Project Agreement for the 2006-2008 period during a meeting held at NEA headquarters in December 2004.

The Cabri Water Loop Project

The Cabri Water Loop Project is investigating the ability of high burn-up fuel to withstand the sharp power peaks that can occur in power reactors due to rapid reactivity insertion in the core (RIA accidents). It involves substantial facility modifications and upgrades and consists of 12 experiments to be performed with fuel retrieved from power reactors and refabricated to suitable length. The project began in 2000 and will run for eight years. The experimental work is being carried out at the Institute for Radiological Protection and Nuclear Safety (IRSN) in Cadarache, France, where the Cabri reactor is located. Programme execution also involves laboratories in participating organisations for fuel preparation, post-irradiation examinations and test channel instrumentation. Organisations in 12 countries, including regulators, industry and research organisations, participate in the project.

Post-irradiation examinations of the two tests that have been carried out so far were undertaken in 2004. They involved destructive examinations and investigated in particular the effect of hydrogen on cladding properties. The planning of future tests continued, with the aim of developing a consistent set of objectives and identifying suitable fuel specimens. Considerable progress was made on the refurbishment of the Cabri test facility and the preparation of the water loop installation.

Two meetings of the Technical Advisory Group (TAG) took place in 2004, during which the programme results and the plans for future activities were reviewed. Related analyses were also presented and discussed in a Cabri seminar held in conjunction with a TAG meeting. The TAG also addressed technical issues related to the water loop design. Two meetings of the project Steering Committee were held in 2004. Among other items, recommendations were expressed in favour of the possible accession of Japan to the project.

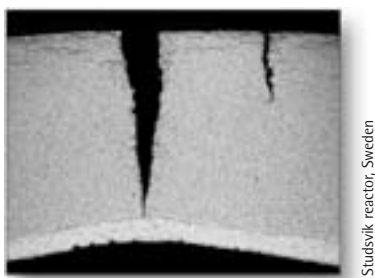
The SCIP Project

The Studsvik Cladding Integrity Project (SCIP) started in July 2004 and aims to utilise the hot cell facilities and expertise available at the Swedish Studsvik establishment in order to assess material properties and to determine conditions that can lead to fuel failures. The project has the following general objectives:

- To improve the general understanding of cladding integrity at high burn-up.
- To study both BWR and PWR/VVER fuel cladding integrity.
- To complement two large international projects (Cabri and ALPS), which focus on fuel behaviour in design basis accidents (notably RIA), where some of the mechanisms are similar to those that may occur during normal operational transients or anticipated transients.
- To achieve results of general applicability (i.e. not restricted to a particular fuel design, fabrication specification or operating condition), so that they can consequently be used in solving a wider spectrum of problems and be applied to different cases.
- To achieve experimental efficiency through the judicious use of a combination of experimental and theoretical techniques and approaches.

Although the primary concern of this project is the integrity of LWR cladding during in-reactor service, a number of closely related areas may also be addressed, of relevance to water reactors in general. In addition, some of the results will be able to be used in relation to cladding behaviour of discharged fuel during handling, transportation and storage.

Organisations from ten member countries participate in the project. As recommended by the CSNI, comprehensive industry participation was sought in the project establishment phase. The first meeting of the project steering bodies was held with NEA support in November 2004.



Studsvik reactor, Sweden

Cracks in BWR liner cladding material which was irradiated in the Studsvik R2 reactor to assess material properties under high burn-up conditions.

The MASCA Project

The first phase of the MASCA Project investigated the consequences of a severe accident involving core melt. It started in

mid-2000 and was completed in July 2003. The second phase of the project started thereafter, upon request of the member countries and recommendation of the CSNI, and will last for three years. The programme is supported by organisations in 17 countries, and is based on experiments that are mainly carried out at the Kurchatov Institute and that make use of a variety of facilities in which corium compositions prototypical of power reactors can be tested.

The tests in the first phase of the programme were primarily associated with scaling effects and coupling between thermal-hydraulic and chemical behaviour of the melt. A workshop sponsored by the French IRSN and supported by the NEA was held in 2004. It aimed to review the results of the first phase of the programme and to provide input to the current programme.

The tests of the second phase seek to provide experimental information on the phase equilibrium for the different corium mixture compositions that can occur in water reactors. This determines the configuration of materials in the case of stratified pools, and thus the thermal loads on the vessel. In order to enhance the application of MASCA results to reactor cases, the influence of an oxidising atmosphere and the impact of non-uniform temperatures (presence of crusts or solid debris) will be addressed in addition to scaling effects. The programme is also intended to generate data on relevant physical properties of mixtures and alloys that are important for the development of qualified mechanistic models.

Two meetings of the project steering bodies, supported by the NEA, were held in 2004. During these meetings, the results obtained so far and the plans for future tests were reviewed.

The MCCI Project

The Melt Coolability and Concrete Interaction (MCCI) Project is managed by the US Nuclear Regulatory Commission (NRC), carried out at the Argonne National Laboratory (USA), and has participants from 13 countries. It was started early in 2002 and will continue for four years. It addresses ex-vessel phenomena, which occur in the hypothetical case that the molten core is not retained inside the reactor vessel and is spread in the reactor cavity where it can interact with the concrete structure.

The MCCI Project is to provide experimental data of relevance to the type of severe accident mentioned above and to resolve two important accident management issues. The first one concerns the verification that the molten debris that has spread on the base of the containment can be stabilised and cooled by water flooding from the top. The second issue concerns the two-dimensional, long-term interaction of the molten mass with the concrete structure of the containment, as the kinetics of such interaction is essential for assessing the consequences of a severe accident. To achieve these basic objectives, supporting experiments and analyses are being performed, with

a view to providing an understanding of the phenomena of interest, and to producing a consistent interpretation of the results relevant to accident management.

Two Programme Review Group meetings and two Management Board meetings were held in 2004. The experiments on water ingress mechanisms were completed. They show that cooling of the melt by water is reduced at increasing concrete content, i.e. cooling by water flooding is more effective in the early phase of the melt-concrete interaction. The effect of concrete type, i.e. siliceous and limestone types (used respectively in Europe and the United States), has also been addressed. Material properties such as porosity and permeability are also derived from these tests. After a first melt-concrete interaction test, which produced unexpected results (i.e. a strong asymmetry in concrete ablation), a new test was carried out in 2004. An analytical exercise was organised among participants as a blind prediction of the test results. The test was successful and the analytical exercise very valuable in order to understand code capabilities and shortcomings. As concerns the test parameters, the second test was carried out at 30% lower power than the first test, and involved limestone concrete (siliceous concrete was used in the first test). The strength of the solid upper crust, a parameter that is of great interest for modelling and understanding MCCI at plant scale, was also determined during these experiments.



US DOE, USA

MCCI Project: cross-sections of two water-ingress test sections, obtained after test completion. The tests were run for two compositions containing 8% (left) and 25% (right) concrete respectively in the melt. One can note that the 8% case has more extensive cracking than the 25% case, indicating that the water ingress would be more effective for low concrete content in the melt.

Two meetings of the project steering bodies took place in 2004, both supported by the NEA. On these occasions the scope of a possible extension of the project was discussed.

The SETH Project

The SETH Project is supported by 14 NEA member countries. It began in 2001 and is to run for four years. It consists of thermal-hydraulic experiments in support of accident management, which are carried out at facilities identified by the CSNI as those requiring international collaboration to sponsor their continued operation. The tests carried out at Framatome's *Primär Kreislauf* (PKL) in Germany, which were completed in 2003, investigated boron dilution accidents that can arise from a small-break, loss-of-coolant accident (LOCA) during mid-loop operation (shut-

down conditions) in PWRs. The final report of the PKL tests was completed in 2004.

The experiments to be carried out at the Paul Scherrer Institute (PSI) PANDA facility in Switzerland are to provide data on containment three-dimensional gas flow and distribution issues that are important for code prediction capability improvements, accident management and design of mitigating measures. After an extensive preparation phase, the experimental series started in the second half of 2004 and will continue throughout 2005.

An analytical exercise addressing code predictability took place in 2004, by means of blind computerised fluid dynamics (CFD) code predictions of the first PANDA test. To this end, a workshop supported by the NEA was organised in conjunction with a SETH Programme Review Group meeting. Two meetings of the project steering bodies took place in 2004, both supported by the NEA. Considering that, due to their complexity, there has been a delay in the PANDA experiments, the Project Board decided to extend the time frame of the programme by up to 12 months.

The PKL Project

This project started in 2004 and consists of experiments carried out in the *Primär Kreislauf* (PKL) thermal-hydraulic facility, which is operated by Framatome ANP in its establishment at Erlangen, Germany. Organisations from 14 countries participate in the project.

The PKL experiments focus on the following PWR issues that are currently receiving great attention within the international reactor safety community:

- boron dilution events after small-break, loss-of-coolant accidents (LOCAs);
- loss of residual heat removal during mid-loop operation with a closed reactor coolant system in context with boron dilution;
- loss of residual heat removal during mid-loop operation with an open reactor coolant system;
- an additional test to be defined in agreement with the project partners according to the state of open issues such as:
 - boron precipitation during large-break LOCAs, or
 - boron dilution after steam generator tube rupture.

Two tests were carried out in 2004. Their preparation and the first test outcome were extensively discussed in the two meetings of the project steering bodies that took place in 2004. These meetings were supported by the NEA.

The PSB-VVER Project

The objective of the PSB-VVER Project is to provide experimental data of relevance to the validation of safety codes in the field of VVER-1000 thermal-hydraulics. The project, in which seven countries participate, started in 2003 and will be completed at the end of 2006. It consists of five PSB-VVER experiments addressing:

- scaling effects;
- natural circulation;
- small, cold leg break LOCAs;

- primary to secondary leaks;
- 100% double-ended, cold leg break (indicative, actual size to be agreed upon).

Extensive pre- and post-test analyses are to accompany the experimental programme throughout the experimental series. The possibility of setting up sets of international standard problems – either limited to project participants or with broader attendance – will also be considered in light of the resources that this effort requires.



EREC, Russia

The PSB-VVER test facility in Russia.

Three project tests have been successfully carried out and reported upon so far. The test matrix for the remaining part of the programme was discussed and revised by members. The fourth test will investigate accidental conditions involving a primary to secondary leak (steam generator header rupture) and will be carried out in the first half of 2005. A blind test exercise where the fourth test's outcome will be predicted by calculations before its execution is being organised. Two meetings of the project's Programme Review Group were held in 2004 with NEA support.

The ICDE Project

The International Common-cause Data Exchange (ICDE) Project collects and analyses operating data related to "common-cause" failures (CCF), which have the potential to affect several systems, including safety systems. The project has been in operation since 1998, and a new agreement covering the period 2002–2005 came into force in 2002. Eleven countries participate.

The ICDE Project comprises complete, partial and incipient CCF events, called "ICDE events". The project covers the key components of the main safety systems, such as centrifugal pumps, diesel generators, motor-operated valves, power-operated relief valves, safety relief valves, check valves, batteries, reactor protection system circuit breakers, control rod drives and level measurements in the primary coolant system.

These components have been selected because probabilistic safety assessments have identified them as major risk contributors in the case of common-cause failures. Qualitative insights from the analysis of the data will help reduce the number of

CCF events that are risk contributors. In the long term, the project will provide a broad basis that will enable the quantification of CCF events.

The FIRE Project

The FIRE Project started in 2002 and will run for three years, with the main purpose of encouraging multilateral co-operation in the collection and analysis of data relating to fire events in nuclear environments. The objectives are to:

- define the format for, and collect fire event experience (by international exchange) in, a quality-assured and consistent database;
- collect and analyse fire events data over the long term so as to better understand such events, their causes and their prevention;
- generate qualitative insights into the root causes of fire events that can then be used to derive approaches or mechanisms for their prevention or for mitigating their consequences;
- establish a mechanism for the efficient feedback of experience gained in connection with fire events, including the development of defences against their occurrence, such as indicators for risk-based inspections; and to record event attributes to enable quantification of fire frequencies and risk analysis.

Studying the consequences of an electrical cabinet fire (PICSEL programme, Cadarache, France).



IFSN/DPAM/ISEREA, Cadarache, France

After having established the project quality guidelines and the quality-assurance procedure, data acquisition has proceeded according to plans. A meeting of the project steering body was held in 2004. Nine countries participate in the project, whose membership is expected to grow in future.

The OPDE Project

The Piping Failure Data Exchange (OPDE) Project started in 2002, currently has 12 participating countries, and will run for three years. Its goals are to:

- collect and analyse piping failure event data to promote a better understanding of underlying causes, impact on operations and safety, and prevention;
- generate qualitative insights into the root causes of piping failure events;

- establish a mechanism for efficient feedback of experience gained in connection with piping failure phenomena, including the development of defence against their occurrence;
- collect information on piping reliability attributes and factors of influence to facilitate estimation of piping failure frequencies.

The OPDE Project is envisaged to include all possible events of interest with regard to piping failures. It will cover piping components of the main safety systems (e.g. ASME Code Classes 1, 2 and 3). It will also cover non-safety piping systems that, if leaking, could lead to common-cause initiating events such as internal flooding of vital plant areas. Specific items may be added or deleted upon decision of the Project Review Group. Steam generator tubes are excluded from the OPDE project scope.

RADIOLOGICAL PROTECTION

The Information System on Occupational Exposure (ISOE)

Since its creation in 1992, the Information System on Occupational Exposure (ISOE) has been facilitating the exchange of data, lessons and experience in occupational radiological protection at nuclear power plants. Jointly sponsored by the IAEA, the ISOE programme includes 462 reactor units (403 operating and 59 in cold-shutdown or some stage of decommissioning) operated by 68 utilities in 29 countries. ISOE databases cover 92% of the total number of power reactors (441) in commercial operation throughout the world. In addition, the regulatory authorities of 25 countries participate actively in ISOE. Utilities and authorities continue to join the ISOE programme, notably the new units that have recently come on line in Korea and Japan, as well as new participants from Pakistan and the Ukraine.

The database and information exchange mechanism used initially was the floppy disk, which then evolved to the CD. With the increasing use and flexibility of the web, it was recommended in 2003 that the ISOE programme should migrate its data exchange/assessment processes, as well as its information and experience sharing to the web. As a result of a pilot study during 2004, and assessment by the ISOE Working Group on Data Assessment, it was agreed that the ISOE databases should be transferred to a web-compatible database system (such as Oracle), and that data entry and analysis should be performed online. This would also create a natural network for the online exchange of information and experience. Several approaches will be investigated during 2005. The databases will also, however, be maintained on CD for those without access to the web.

In substantive terms, the ISOE programme finalised in 2004 a report on good practice in occupational radiological protection, focusing on various practical aspects of optimisation. The areas addressed in the report include: optimisation of public protection; optimisation of worker protection; empowerment of the workforce; the use of tools in optimisation; the equality of old-plant ALARA versus new-plant ALARA; optimisation of

decommissioning; and international aspects of optimisation. In addition to documenting good practice in these key areas, the report also serves as a reference point for the development of new ICRP recommendations. In order to highlight radiological protection principles that are effective in application, the optimisation processes and approaches that currently work well in nuclear power plants are put in the context of the current ICRP recommendations, as well as the newly developing context of the future recommendations.

RADIOACTIVE WASTE MANAGEMENT

The Sorption Project

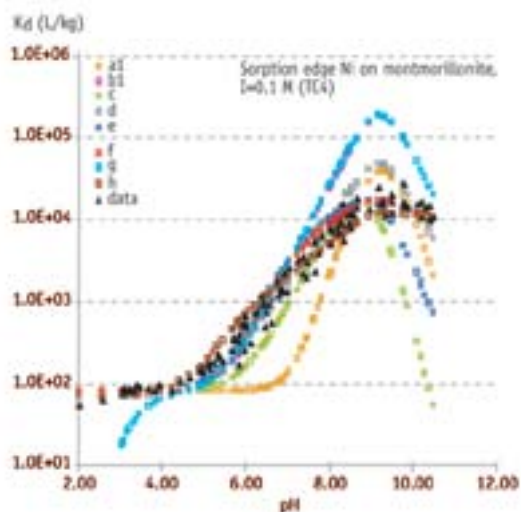
The NEA Sorption II Project was launched in October 2000 with the objective of demonstrating the applicability of different chemical thermodynamic modelling approaches to support safety assessments of geological repositories. To enable an evaluation of the respective merits and limitations of different thermodynamic sorption models, the project was implemented in the form of a comparative modelling exercise based on selected datasets for radionuclide sorption by both simple and complex materials. These were organised into seven test cases that were prepared and distributed to participating organisations. A Technical Direction Team (TDT) evaluated the existing database, developed test cases for sorption modelling, and carried out the subsequent analysis and interpretation of modelling outcomes. Eighteen funding organisations from thirteen different countries joined phase II of the Sorption Project, and in total, twenty modelling teams participated in the exercise, making it possible to base the conclusions of the project on a broad range of experience and expertise.

Using additional information gained from a workshop held in October 2002 in Spain, the TDT further interpreted and synthesised the project outcomes and delivered a draft of the final project report. In analysing the modelling outcomes, model fits as well as predictions were quantitatively compared with the respective experimental data. Particular attention was paid to elucidating the effects of certain model components and of decisions implicit in the development of preferred models on model performance.

The Sorption II Management Board agreed to publish the findings of the project as an open NEA report addressing an audience of radioactive waste management organisations and regulators, as well as modellers and experimentalists who are involved in performance assessment. The NEA report, which will be published early in 2005, summarises the main results and interpretations of test cases with examples of graphical comparisons of experimentally determined and model-derived K_d values. It reflects a view of the current capabilities of thermodynamic sorption modelling and how these could be developed in the future. The report identifies the strengths and drawbacks of various typical approaches and stresses the importance of the quality of data and specific estimates used in modelling.

As a final step for phase II of the Sorption Project, it is planned to organise an international workshop to discuss project results with a wide array of experts in the field.

Graphical comparisons of K_d values as part of the Sorption Project



The Co-operative Programme on Decommissioning (CPD)

The Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD) is a joint research project operating under Article 5 of the NEA Statute since its inception in 1985. The concept of exchanging information, experience and possibly personnel among a number of decommissioning projects, and carrying out other forms of co-operation as appropriate, obtained strong support from all OECD countries having one or more large decommissioning projects either under way or in the planning process.



Winfrith, United Kingdom



The Winfrith fuel fabrication facility during operation, and then during demolition of the decontaminated building shell, United Kingdom.

An in-depth review of its mode of operation and its 18-year-old Agreement resulted in a consolidation of the Co-operative Agreement and the Amending Protocol regulating the financial aspects of the programme into a single document. The new Agreement came into force on 1st January 2004, again for a

period of five years. It more clearly defines the scope of the information exchange actions that participants would undertake within the bounds of the Agreement. It also made changes to the way the Agreement is managed, and to the tasks and financing modus of the programme's secretary (the CPD Programme Co-ordinator).

Currently, 22 organisations from 12 countries participate in the CPD, providing experience from a total of 41 decommissioning projects, which include 26 reactors and 15 other fuel cycle facilities, along with information from some invited non-OECD projects. Altogether 47 decommissioning projects have benefited from the information exchange framework provided by the CPD since its inception in 1985.

Cross-membership of some of the programme's Management Board in the RWMC Working Party on Decommissioning and Dismantling (WPDD) ensures that insight gained at the CPD can be fed into the work of the NEA standing technical committees. CPD members also contributed to the NEA workshop on Safe, Efficient and Cost-effective Decommissioning held in Rome, Italy, in September 2004.

The new Agreement continues to include biannual meetings of the Technical Advisory Group (TAG), during which the site of one of the participating projects is visited, and good and less positive examples of decommissioning experience are openly exchanged for the benefit of all. In 2004, TAG meetings were held in Daejeon, South Korea, and in Aachen, Germany. The CPD also started to prepare a brochure on the CPD, its history and work items, as well as a list with information on the participating projects, to encourage additional decommissioning projects from member countries to join the co-operative programme.

The Thermochemical Database (TDB) Project

The Thermochemical Database (TDB) Project aims to meet the specialised modelling requirements for safety assessments of radioactive waste disposal sites. Chemical thermodynamic data are collected and critically evaluated by expert review teams and the results are published in a series of books edited by the Data Bank.

Reviews of inorganic chemical thermodynamic data of selenium and nickel have been concluded and will be published in early 2005. Reviews of inorganic data of zirconium, as well as selected organic compounds and complexes of uranium, neptunium, plutonium, americium, selenium, nickel, technetium and zirconium, are currently undergoing peer review.

New reviews on inorganic data for thorium and tin have been started, together with the preparation of scientific guidelines to deal with the chemical thermodynamics of solid solutions. In view of the large amount of information available for the inorganic chemistry of iron, it has been decided to further explore the available literature with a goal to arrive at a better definition of the deliverables compatible with the project's time constraints. Accordingly, the TDB Management Board decided to lower the priority of the review of molybdenum, and to postpone a decision on its undertaking until early in 2005 when the decision on the iron review is expected to be taken.

NEA mission

- To assist its Member countries in collecting and disseminating nuclear data information and to help them improve their nuclear data infrastructure, thereby contributing to the safety, efficiency and cost-effectiveness of nuclear energy.
- To assist its Member countries in the development of nuclear energy and to help them improve their nuclear data infrastructure, thereby contributing to the safety, efficiency and cost-effectiveness of nuclear energy.

Data Bank mission

- To provide a central point of access to nuclear data information and to help them improve their nuclear data infrastructure, thereby contributing to the safety, efficiency and cost-effectiveness of nuclear energy.

NEA Member Countries



NEA Nuclear Data Services

Nuclear data are fundamental for all applications involving radioactive materials and nuclear fuels.

Why use?

The properties of nuclear materials are essential for the design, operation, and safety of nuclear reactors, and for the development of nuclear energy.

The volume of data is growing

There is a large variety of nuclear data and of end users of these data.

There is a large variety of nuclear data and of end users of these data.

Need for an easy access to nuclear data

Evolution of nuclear data services of the NEA



Web technology offers the means for unifying the following two approaches:

Web-based services

Access via data centres



General Information

Information and Communications

Nuclear energy decision making and stakeholder participation need to be based on understanding. The NEA seeks to provide member governments and other interested parties with a large array of information resulting from the Agency's activities, thereby enhancing awareness and understanding of the scientific, technical and economic aspects of the nuclear option.

The NEA is an intergovernmental agency specialised in studying the scientific, technical and economic aspects of nuclear energy. Its activities cover the full range of the fuel cycle and consider future technological developments. It has no commercial interests in the nuclear industry and is not a lobby group. As such, it strives to provide high-quality, factual information in a timely manner to those with "a need to know" for their professional activities, as well as to those with an interest in learning about nuclear energy's multiple aspects.

One of the activities undertaken in 2004 to help enhance understanding of nuclear energy was the organisation of a nuclear power plant tour for the ambassadors and energy advisors of OECD member countries working in Paris. The visit was to the Nogent nuclear power plant, which has two 1 310 MWe pressurised water reactors, and included detailed explanations of nuclear power plant operation as well as a visit to the reactor building. Similar activities and information seminars are expected to be organised in the future.



Visitors to the Nogent nuclear power plant in France.

Relations with the press

Eight press communiqués were issued during the year as part of efforts to keep journalists informed of important developments in the Agency's activities and results from its programme of work. A press briefing was organised in August in conjunction with the 19th World Energy Congress held in Sydney, Australia, during which Luis Echávarri, NEA Director-General, chaired a session entitled "Nuclear Energy: Inevitable or Irrelevant?"



Mr. Luis Echávarri, NEA Director-General, communicating to international audiences on nuclear energy issues.

Several articles were published in the specialised press by various members of the NEA Secretariat. Articles of note by the NEA Director-General included "International Perspectives on the Future of Nuclear Energy" (*World Energy Review*) and "World Energy Congress in Sydney: Energy, the End of the Taboos?" (in French in the *Moniteur officiel du commerce international*).

The recently created "Press Room", housed within the Agency's website at www.nea.fr/html/general/press/, also continues to provide the press with a selection of facts and analyses, along with useful links to more detailed information sources.

Publications

The Agency produced 80 publications in 2004, a significant increase over the 70 publications produced in 2003 and the 64 published in 2002. Of these titles, 34 were put on sale and 46 were distributed free of charge. The list of these publications is provided on page 42. Best sellers included *Uranium 2003: Resources, Production and Demand* and *Nuclear Energy Data*. In addition to standard distribution of free publications (some 50 000 copies), several hundred individual requests were received. Over 8 000 reports were shipped to information and publications stands around the world.

Two issues of *NEA News* were published in English and French. They provided feature articles on the latest developments in the nuclear energy field, as well as updates on NEA work, news briefs, and information about NEA publications and forthcoming events. Sample articles and back issues are available on the NEA website at www.nea.fr/html/pub.

- The Agency produced 80 publications in 2004, of which 34 were put on sale and 46 were distributed free of charge.
- A nuclear power plant tour and information session was organised for OECD ambassadors and energy advisors.
- NEA information and publications stands were organised at 15 international conferences.
- The NEA co-sponsored 21 international conferences during 2004.

Internet-based communication

The NEA website remains an important part of the Agency's information programme and has proved effective in raising the profile of the Agency's work. Visits to the NEA website increased during 2004, growing 13% over 2003. The most accessed report in the course of 2004 was *Chernobyl: Assessment of Radiological and Health Impacts - 2002 Update* (downloaded over 13 000 times), followed by *Nuclear Electricity Generation: What Are the External Costs?* and *Research and Development Needs for Current and Future Nuclear Energy Systems*.

The "Delegates' area" on the NEA website continues to provide an important service for many NEA committees and working groups. This section of the website provides authorised users with OECD official documents, information on forthcoming NEA meetings and contact details for other committee members. Over 5 000 official documents are available in the Delegates' area, 449 of which were added during the course of 2004. Much heavier use was made of this service in 2004 than was the case in previous years.

Individual subscriptions to the Agency's monthly electronic bulletin continued to grow during 2004, topping 6 500 subscribers by year end. Distributed free of charge, the bulletin includes monthly updates on important NEA activities and newly released reports. Subscription requests can be made at www.nea.fr/html/signon.html.



NEA visibility in international fora

The NEA Secretariat ensured high-quality, expert presence in a wide range of international conferences and seminars. Senior staff were invited to make a number of important keynote

speeches. Particularly noteworthy were the NEA Director-General's interventions at the 19th World Energy Congress in Sydney and the November 2003 European Nuclear Assembly in Brussels. The opening address of the OECD Secretary-General at the November 2004 meeting of the American Nuclear Society (ANS) on "Nuclear in the 21st Century - Going Forward Together", merits special mention.

NEA information and publications stands were organised at 15 international conferences in 2004. These included stands at:

- Energy Choices for Europe (March 2004, Brussels, Belgium);
- Safe, Efficient and Cost-effective Decommissioning (September 2004, Rome, Italy);
- the 19th World Energy Congress (September 2004, Sydney, Australia);
- the International Conference on Nuclear Knowledge Management (September 2004, Saclay, France);
- the ANS Winter Meeting (November 2004, Washington DC, USA);
- COP 10 (December 2004, Buenos Aires, Argentina).

The NEA also co-sponsored 21 international conferences. Its role and presence were especially distinctive at the DisTec 2004 International Conference on Radioactive Waste Disposal (April 2004, Berlin, Germany), the International Symposium on Disposal of Low Activity Radioactive Waste (December 2004, Cordoba, Spain) and the International Conference on Nuclear Knowledge Management (September 2004, Saclay, France).

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Nuclear Energy and Civil Society

Stakeholder participation in radioactive waste management

"Stakeholder involvement" is a key concept in modern approaches to governance that has received considerable attention within the NEA programme of work, in particular in the area of radioactive waste management and the disposal of long-lived waste. Stakeholder involvement rests upon providing information, and may include consultation as well as active participation. In finalising the first phase of its work (2000-2004), the NEA Forum on Stakeholder Confidence (FSC) prepared a report on *Learning and Adapting to Societal Requirements for Radioactive Waste Management*, presenting a synthesis of key FSC findings and drawing specifically on the experience gained in three workshops held in national context in Belgium, Canada and Finland. Three overarching principles have been found to be essential elements of any decision making seeking broad societal support:

- Decision making should be performed through iterative processes, providing flexibility to adapt to contextual changes, e.g. by implementing a stepwise approach that provides sufficient time for developing a competent and fair discourse.
- Social learning should be facilitated, e.g. by promoting interactions between various stakeholders and experts.
- Public involvement in decision-making processes should be facilitated, e.g. by promoting constructive and high-quality communication between individuals with different knowledge, beliefs, interests, values and worldviews.

Within those principles, a hierarchy of objectives should be considered. The waste management programme should be founded first upon recognition by the national government that the status quo is no longer acceptable, and that an important issue needs to be resolved. The link between current waste management policy and the future of nuclear energy should be openly addressed. Identification of a safe and licensable site and a safe and licensable waste management concept that enjoy host community support should then follow. Next, siting efforts should allow for consideration of local and regional development schemes that take into account the needs and views of the affected communities. Finally, radioactive waste management facilities should be designed and implemented in ways that reflect the values and interests of local communities. According to the latter, safety, participation and local develop-

ment are the main pillars of trust. Reviewers have also pointed out that most of these findings are of relevance to all public policy-making processes, not only to radioactive waste management.

In long-term radioactive waste management, consideration is also increasingly being given to concepts such as "stepwise decision making" and "adaptive staging". The key feature of these concepts is development by steps or stages that are reversible, within the limits of practicability. This is designed to provide reassurance that decisions can be reversed if experience shows them to have adverse or unwanted effects.

Despite its early identification within the radioactive waste management community as an important means for reaching solutions and decisions in which there is broad-based confidence, the bases for and application of stepwise decision making, has not yet been widely reviewed. The FSC undertook this task, and documented key findings as well as extensive references to the literature in an FSC report on *Stepwise Approach to Decision Making for Long-term Radioactive Waste Management*. Some of the outstanding issues identified are that:

- Progress can no longer be expected to be linear when an iterative approach is used (this will pose challenges to traditional organisational structures).
- Criteria will be needed for balancing the social sustainability and the efficiency of a process made more lengthy and uncertain by added decision checkpoints.
- The concrete arrangements for sketching out and agreeing on decision phases, for selecting and involving stakeholders in a participative process, and for adapting institutions to meet long-term requirements, will require careful reflection and tuning in each national context.
- A democratic society must seek to accommodate conflicting values and fairness principles.

Institutions and governments are aware of these challenges and examples have been given of a proactive stance, e.g. the re-styling of the role of the regulators and the search for, and implementation of, new forms of dialogue. The FSC report confirms that radioactive waste management is more than finding a technical answer to a technical problem. Continued monitoring of stepwise experience will provide important guidance.

The FSC workshops held in national context have proven to be successful instruments for sharing national experience in interacting with stakeholders. In 2004, the FSC organised its fourth workshop in this series in Germany, following previous events in Finland, Canada and Belgium. Extensive discussions with stakeholders on all levels of interaction gave insight into the specific challenges of the German process, which are characterised by historic interactions perceived as traumatic by some stakeholders, as well as by the proposal of a new approach regarding repository siting criteria and procedures. In this context, the workshop provided a "testing ground" for the



Technical visit during the FSC workshop in Germany.

FSC

government, stakeholders and industry to probe the various viewpoints and probable positions in the discussions to come. It has been shown that in spite of different agendas, various stakeholders from civil society act unanimously regarding process issues, and towards what is perceived as "fact-setting" unilateral actions.

Stakeholder involvement in radiological protection

Since the late 1990s the CRPPH has studied stakeholder involvement in radiological protection decision making, having held three workshops on the subject in Villigen, Switzerland (1998, 2001, 2003). It has been concluded that, while broad stakeholder involvement is not essential to most decisions in radiological protection, it is important for some situations, such as the release of sites from radiological control. The involvement of stakeholders in decision-making processes can improve the quality and sustainability of decisions, and through stakeholder interaction with radiological protection specialists can improve the relevance of scientific input to the decision at hand.

During 2004, the CRPPH worked to consolidate and diffuse the conclusions of its Villigen workshops, publishing the proceedings of the third workshop, as well as a policy-level summary of its findings and a detailed report on the case studies used as a basis for discussions.

The case studies used, however, all dealt with situations in Europe or North America, and thus with stakeholders having European and North-American social and cultural backgrounds. With nuclear power significantly expanding in Asia, and stakeholder questions becoming more common, the Asian members of the CRPPH have begun to consider how the experience from the Villigen workshops could be assessed in the context of Asian cultures, particularly Japanese and Korean. Thus, in 2004 the CRPPH organised the Second Asian Regional Workshop on the Evolution of the System of Radiological Protection, and as in the case of the first Asian regional workshop, included a session on the Committee's stakeholder involvement experience.

Nuclear regulators and the public

Building, measuring and improving public confidence has become a priority for nuclear regulators worldwide. The NEA Committee on Nuclear Regulatory Activities (CNRA) established a working group on public communication of regulatory matters to share information, practices and experiences, and to discuss new developments and techniques in the area of nuclear regulatory communication with the public. This group organised a workshop in Ottawa, Canada, in May to share practices and experience, and to identify important issues.

The workshop addressed how to plan and implement public confidence building activities; how to measure and assess public confidence in the nuclear regulator; and how the results of measuring public confidence impacted the regulator. The workshop used as case studies specific examples where some loss of confidence both in the industry and the regulator had occurred. These cases were related to the Davis Besse issue in the USA, the TEPCO problems in Japan and the Paks incident in Hungary.

The workshop concluded that re-establishing lost confidence is a long and demanding task. Maximum transparency, and intense and proactive communication are needed. It is also important to understand correctly what sort of public the regulator is addressing. A general observation from the presentations and discussions was that cultural differences between the countries are large, and similar means for communication are not effective in all countries. It was also agreed that in some countries the regulators can achieve public confidence more easily than in others. An important factor in this respect is the general public trust in the government and its representatives. Nevertheless, a number of common principles were identified that can be recommended to all regulators:

- Give high priority to building and maintaining public confidence.
- Confidence among all stakeholders is a necessary prerequisite for successful nuclear regulation.
- Use available means to make the regulator well-known. It is convenient to be proactive with the public whenever information needs arise.
- The regulator should make experts available to answer the questions. An adequate number of experts and managers who are prepared for public communication are needed in the regulatory organisation to ensure prompt and accurate responses to communication needs at any time.
- Periodically measure regulator confidence among stakeholders.
- Stay clear of energy policy and keep an adequate distance from the licensees when communicating with the general public and news media.

Society and nuclear energy policy

The second phase of the NDC project on society and nuclear energy was completed with an analysis of case histories related to communication on the risks and benefits of nuclear energy. The report will be made freely available on the NEA website early in 2005. Readers will find a wide array of information and analysis covering generic and country-specific aspects of the issue. Countries addressed in the case histories include Belgium, Canada, Finland, Hungary, Japan, Spain and the United States.

NEA Publications Produced in 2004

General Interest

Annual Report 2003

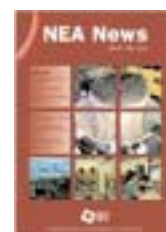
ISBN 92-64-02066-7 – Free: paper or web versions.

NEA News – 2004, No. 22.1 and No. 22.2

ISSN 1605-9581 – Yearly subscription: € 49, US\$ 56, £ 31, ¥ 6 600.

The Strategic Plan of the Nuclear Energy Agency – 2005-2009

ISBN 92-64-02081-0 – Free: paper or web versions.



Nuclear Development and the Fuel Cycle

Government and Nuclear Energy

ISBN 92-64-01538-8 – Price: € 21, US\$ 26, £ 15, ¥ 2 700.

Nuclear Competence Building

ISBN 92-64-10850-5 – Price: € 24, US\$ 29, £ 17, ¥ 3 100.

Nuclear Competence Building

Summary Report

ISBN 92-64-02073-X – Free: paper or web versions.

Nuclear Energy Data – 2004

ISBN 92-64-01632-5 – Price: € 21, US\$ 26, £ 15, ¥ 2 700.

Uranium 2003: Resources, Production and Demand

A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency

ISBN 92-64-01673-2 – Price: € 85, US\$ 106, £ 59, ¥ 10 900.



Nuclear Safety and Regulation

Collective Statement Concerning Nuclear Safety Research

Capabilities and Expertise in Support of Efficient and Effective Regulation of Nuclear Power Plants

ISBN 92-64-02169-8 – Free: paper or web versions.

CSNI Technical Opinion Papers No. 4

Human Reliability Analysis in Probabilistic Safety Assessment for Nuclear Power Plants

ISBN 92-64-02157-4 – Free: paper or web versions.

CSNI Technical Opinion Papers No. 5

Managing and Regulating Organisational Change in Nuclear Installations

ISBN 92-64-02069-1 – Free: paper or web versions.

CSNI Technical Opinion Papers No. 6

PSA-based Event Analysis

ISBN 92-64-02091-8 – Free: paper or web versions.

Debris Impact on Emergency Coolant Recirculation

Workshop Proceedings, Albuquerque, NM, USA, 25-27 February 2004

ISBN 92-64-00666-4 – Price: € 90, US\$ 113, £ 62, ¥ 11 500.



Direct Indicators of Nuclear Regulatory Efficiency and Effectiveness

Pilot Project Results

ISBN 92-64-02061-6 – Free: paper or web versions.

Nuclear Regulatory Challenges Related to Human Performance

ISBN 92-64-02089-6 – Free: paper or web versions.



Radioactive Waste Management

Dealing with Interests, Values and Knowledge in Managing Risk

Workshop Proceedings, Brussels, Belgium, 17-21 November 2003

ISBN 92-64-00731-8 – Price: € 40, US\$ 52, £ 27, ¥ 5 400.

Decommissioning of Nuclear Power Facilities – It Can and Has Been Done

NEA no. 05728 (leaflet) – Free: paper or web versions.

Engineered Barrier Systems (EBS): Design Requirements and Constraints

Workshop Proceedings, Turku, Finland, 26-29 August 2003

ISBN 92-64-02068-3 – Free: paper or web versions.

Geological Disposal: Building Confidence Using Multiple Lines of Evidence

First AMIGO Workshop Proceedings, Yverdon-les-Bains, Switzerland, 3-5 June 2003

ISBN 92-64-01592-2 – Price: € 50, US\$ 63, £ 35, ¥ 6 400.

Handling of Timescales in Assessing Post-closure Safety (The)

Lessons Learnt from the April 2002 Workshop in Paris, France

ISBN 92-64-02161-2 – Free: paper or web versions.

Learning and Adapting to Societal Requirements for Radioactive Waste Management

Key Findings and Experience of the Forum on Stakeholder Confidence

ISBN 92-64-02080-2 – Free: paper or web versions.

Post-closure Safety Case for Geological Repositories

Nature and Purpose

ISBN 92-64-02075-6 – Free: paper or web versions.

Regulatory Control of Radioactive Waste Management (The)

Overview of 15 NEA Member Countries

ISBN 92-64-10650-2 – Price: € 50, US\$ 63, £ 35, ¥ 6 400.

Safety of Disposal of Spent Fuel, HLW and Long-lived ILW in Switzerland

An International Peer Review of the Post-closure Radiological Safety Assessment for Disposal in the Opalinus Clay of the Zürcher Weinland

ISBN 92-64-02063-2 – Free: paper or web versions.

Stakeholder Involvement Techniques

A Short Guide and Annotated Bibliography

ISBN 92-64-02087-X – Free: paper or web versions.

Stepwise Approach to Decision Making for Long-term Radioactive Waste Management

Experience, Issues and Guiding Principles

ISBN 92-64-02077-2 – Free: paper or web versions.



Strategy Selection for the Decommissioning of Nuclear Facilities

Seminar Proceedings, Tarragona, Spain, 1-4 September 2003
ISBN 92-64-01671-6 – Price: € 60, US\$ 75, £ 42, ¥ 7 700.

Radiological Protection

Evolution of the System of Radiological Protection

Asian Regional Conference, Tokyo, Japan, 24-25 October 2002
ISBN 92-64-02163-9 – Free: paper or web versions.

Future Policy for Radiological Protection (The)

A Stakeholder Dialogue on the Implications of the ICRP Proposals
Summary Report, Lanzarote, Spain, 2-4 April 2003
ISBN 92-64-02165-5 – Free: paper or web versions.

Occupational Exposures at Nuclear Power Plants

Twelfth Annual Report on the ISOE programme, 2002
ISBN 92-64-02164-7 – Free: paper or web versions.

Stakeholder Participation in Radiological Decision Making: Processes and Implications

Case Studies for the Third Villigen Workshop, Villigen, Switzerland, 21-23 October 2003
ISBN 92-64-02065-9 – Free: paper or web versions.

Stakeholder Participation in Radiological Decision Making: Processes and Implications

Summary Report of the 3rd Villigen (Switzerland) Workshop, October 2003
ISBN 92-64-02079-9 – Free: paper or web versions.

Stakeholder Participation in Radiological Decision Making: Processes and Implications

Third Villigen Workshop, Villigen, Switzerland, 21-23 October 2003
ISBN 92-64-10825-4 – Price: € 24, US\$ 29, £ 17, ¥ 3 000.



Nuclear Science and the Data Bank

Basic Studies in the Field of High-temperature Engineering

Third Information Exchange Meeting, Ibaraki-ken, Japan, 11-12 September 2003
ISBN 92-64-01601-5 – Price: € 65, US\$ 81, £ 45, ¥ 8 300.

Benchmark on Beam Interruptions in an Accelerator-driven System

Final Report on Phase II Calculations
ISBN 92-64-02072-1 – Free: paper or web versions.

Benchmark on the Three-dimensional VENUS-2 MOX Core Measurements

Final Report
ISBN 92-64-02160-4 – Free: paper or web versions.

Chemical Thermodynamics of Americium

Reprint of the 1995 Review
ISBN 92-64-02168-X – Available on the web.

Chemical Thermodynamics of Uranium

Reprint of the 1992 Review
ISBN 92-64-02167-1 – Available on the web.

Computing Radiation Dosimetry – CRD 2002

Workshop Proceedings, Sacavém, Portugal, 22-23 June 2002
ISBN 92-64-10823-8 – Price: € 65, US\$ 81, £ 45, ¥ 8 300.



JANIS – Version 2.1 (A Java-based Nuclear Data Display Program) - DVD

NEA no. 03728 – Available on request.

Need for Integral Critical Experiments with Low-moderated MOX Fuels (The)

Workshop Proceedings, Paris, France, 14-15 April 2004

ISBN 92-64-02078-0 – Free: paper or web versions.

Neutronics/Thermal-hydraulics Coupling in LWR Technology, Vol. 1

CRISSE-S – WP1: Data Requirements and Databases Needed for Transient Simulations and Qualification – 5th EURATOM Framework Programme (1998-2002)

ISBN 92-64-02083-7 – Free: paper or web versions.

Neutronics/Thermal-hydraulics Coupling in LWR Technology, Vol. 2

CRISSE-S – WP2: State-of-the-art Report – 5th EURATOM Framework Programme (1998-2002)

ISBN 92-64-02084-5 – Free: paper or web versions.

Neutronics/Thermal-hydraulics Coupling in LWR Technology, Vol. 3

CRISSE-S – WP3: Achievements and Recommendations Report – 5th EURATOM Framework Programme (1998-2002)

ISBN 92-64-02085-3 – Free: paper or web versions.

Nuclear Production of Hydrogen

Second Information Exchange Meeting, Argonne, Illinois, USA, 2-3 October 2003

ISBN 92-64-10770-3 – Price: € 65, US\$ 81, £ 45, ¥ 8 300.

Pyrochemical Separations in Nuclear Applications

A Status Report

ISBN 92-64-02071-3 – Free: paper or web versions.

Shielding Aspects of Accelerators, Targets and Irradiation Facilities – SATIF 6

Workshop Proceedings, Stanford, California, USA, 10-12 April 2002

ISBN 92-64-01733-X – Price: € 95, US\$ 119, £ 66, ¥ 12 200.



Nuclear Law

Nuclear Law Bulletin No. 73 (June 2004) and No. 74 (December 2004)

ISSN: 0304-341X – Price: € 90, US\$ 103, £ 58, ¥ 12 200 (Yearly subscription).

Nuclear Legislation in Central and Eastern Europe and the NIS

2003 Overview

ISBN 92-64-01542-6 – Price: € 48, US\$ 60, £ 33, ¥ 6 100.

Nuclear Legislation: Analytical Study – 2002 and 2003 Updates

Regulatory and Institutional Framework for Nuclear Activities

ISBN 92-64-01814-X – Price: € 60, US\$ 75, £ 42, ¥ 7 700.

Supplement to Nuclear Law Bulletin No. 73 (June 2004)

Croatia – Act on Nuclear Safety (promulgated on 21 October 2003)

ISBN 92-64-01710-0 – Price: € 21, US\$ 26, £ 15, ¥ 2 700.

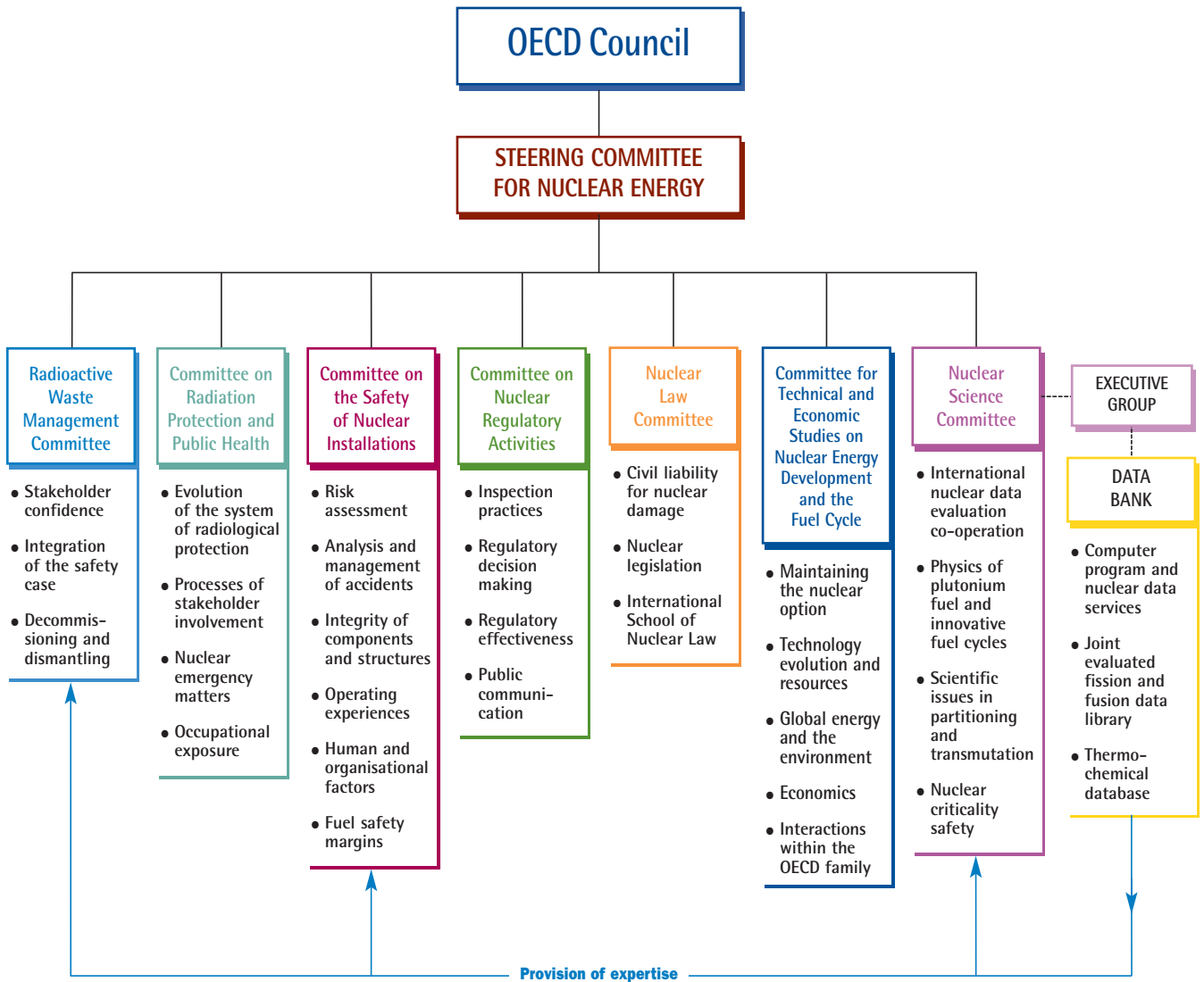
Supplement to Nuclear Law Bulletin No. 74 (December 2004)

Iceland – Act on Radiation Protection (8 April 2002)

ISBN 92-64-00769-5 – Price: € 21, US\$ 26, £ 15, ¥ 2 700.



Organisation Charts of the NEA



The Nuclear Energy Agency (NEA) is a semi-autonomous body of the Organisation for Economic Co-operation and Development. OECD member countries wishing to participate in the activities of the Agency must make a formal request to join. Of the 30 OECD member countries, 28 are members of the NEA:

Australia	France	Japan	Slovak Republic
Austria	Germany	Luxembourg	Spain
Belgium	Greece	Mexico	Sweden
Canada	Hungary	Netherlands	Switzerland
Czech Republic	Iceland	Norway	Turkey
Denmark	Ireland	Portugal	United Kingdom
Finland	Italy	Republic of Korea	United States

The NEA is governed by **the Steering Committee for Nuclear Energy**. This committee is primarily made up of senior officials from national atomic energy authorities and associated ministries. It oversees and shapes the work of the Agency to ensure its responsiveness to member countries' needs, notably in establishing the biennial programmes of work and budgets. It approves the mandates of the seven standing technical committees.

The current members of the **Bureau of the Steering Committee** for Nuclear Energy are:

Mr. William MAGWOOD (United States), Chairman

Mr. Jussi MANNINEN (Finland), Vice-Chairman

Dr. Walter SANDTNER (Germany), Vice-Chairman

Mr. Kenji SEYAMA (Japan), Vice-Chairman

Mr. Philippe THIÉBAUD (France), Vice-Chairman

The standing technical committees are primarily composed of member country experts and technical specialists. These committees constitute a unique feature and important strength of the NEA, providing flexibility for adapting to new issues and helping to achieve consensus rapidly. Their main areas of work are listed in the chart.

The Steering Committee for Nuclear Energy and the Agency's seven standing technical committees are serviced by **the NEA Secretariat**, composed in 2004 of 72 professional and support staff from 18 countries. Professional staff are often specialists from national administrations and research institutes, bringing their experience to the Agency for two to five years on average.

NEA Secretariat Structure in 2004



Director-General
Luis Echávarri



**Deputy
Director-General**
Gail Marcus



**Safety and
Regulation**
Kazuo Shimomura
Deputy Director



**Science and
Development**
Thierry Dujardin
Deputy Director



**Central Secretariat,
External Relations,
Public Affairs**
Karen Daifuku
Head



**Legal
Affairs**
Patrick Reyners
Head



**Management
Support Unit**
John Hembury
Head



**Radiation
Protection and
Radioactive Waste
Management**
Hans Riotte
Head of Division



**Nuclear
Safety**
Javier Reig
Head of Division



**Nuclear
Development**
Peter Wilmer
Head of Division



**Nuclear
Science
and
Data Bank**
Claes Nordborg
Head of Section

*Through to May 2004. Post to be held
by Stan Godelier from January 2005.*

Main Workshops and Seminars Held in 2004

February

- 02-04 Management of Uncertainty in Safety Cases and the Role of Risk, Stockholm, Sweden
- 11 Colloquium on the Revision of the Paris Convention and the Brussels Supplementary Convention, Paris, France

March

- 09-11 Pellet-Clad Interaction in Water Reactors, Aix-en-Provence, France

April

- 26-29 International Workshop on Inspection Activities related to Risk-informed Inspection, Inspection Aspects of Plants Near or at End-of-Life, and Inspection of Performance of Licensee Organisations, Budapest, Hungary

May

- 16-19 Utilisation and Reliability of High Power Proton Accelerators, Daejeon, Korea
- 17-18 Shielding Aspects of Accelerators, Targets and Irradiation Facilities, Lisbon, Portugal
- 18-21 Workshop on Building, Measuring and Improving Public Confidence in the Nuclear Regulator, Ottawa, Canada

June

- 17-18 Ensuring a Sound Technical Basis for Safe Nuclear Power Plant Operation – Regulatory Information Forum (RIF 2004), Paris, France

July

- 05-09 International Seminar on Nuclear Law and Environmental Law, Cluj-Napoca, Romania
- 28-29 Second Asian Regional Conference on the Evolution of the System of Radiological Protection, Tokyo, Japan

September

- 06-10 Safe, Efficient and Cost-effective Decommissioning, Rome, Italy
- 14-17 Engineered Barrier Systems (EBS) Workshop on Process Issues, Las Vegas, NV, USA

October

- 04-05 Workshop on PSA for Non-reactor Nuclear Facilities, Issy-les-Moulineaux, France
- 06-08 Workshop of the NEA Forum on Stakeholder Confidence (FSC): The Forming of a New Approach in Germany, Hitzacker and Hamburg, Germany

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of 30 democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

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This work is published on the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the Organisation or of the governments of its member countries.

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full member. NEA membership today consists of 28 OECD member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, the Republic of Korea, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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