



NEA
Annual
Report
2003

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

45 years of international service

7 standing technical committees

15 international joint projects funded by participants

72 professional and support staff

583 national experts participating in NEA committees

4 000 experts participating annually, on average, in policy and technical meetings organised at OECD headquarters

€ 9.6 million budget for the NEA in 2003, supplemented by voluntary contributions

€ 2.7 million budget for the Data Bank in 2003, supplemented by voluntary contributions

70 publications produced in 2003

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.



Table of Contents

I. 2003 in Perspective	
from the Director-General of the NEA	4
II. Trends in Nuclear Power	6
III. Technical Programmes	10
Nuclear Development and the Fuel Cycle	10
Nuclear Safety and Regulation	12
Radiological Protection	16
Radioactive Waste Management	18
Nuclear Science	20
Data Bank	22
Legal Affairs	24
Joint Projects and Other Co-operative Projects	26
IV. General Information	32
Information Programme	32
Nuclear Energy and Civil Society	34
NEA Publications Produced in 2003	36
Main Workshops and Seminars Held in 2003	41
Organisation Charts of the NEA	42

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.



2003 in Perspective



Mr. Luis Echávarri
Director-General of the NEA

We are in a changing environment, one that is strongly affected by world events. In 2003, the war in Iraq and the blackouts in North America and Europe brought energy supply questions more starkly to the front of people's minds. What has been the impact on the energy sector? Many ask: is nuclear energy making a comeback? Based on the energy policy of our member countries, the answer is not clear-cut, as a full range of scenarios exists spanning from no nuclear energy or gradual nuclear phase-out, to nuclear expansion and growth. Regardless of the specific scenarios in place, the Nuclear Energy Agency continues to have an important role to play in helping its members maintain sound bases for the safe and economical use of nuclear energy, as governments struggle to find effective solutions to ensure security of energy supply as well as address climate change considerations.

The Agency was very active and productive in 2003, as the reader will discover in the pages that follow. These achievements are the result of much hard work; our member countries and their experts deserve a great deal of the credit. Our results mirror the ambitious programme of work endorsed by our member countries, bringing added value to all of them in areas such as nuclear safety and regulation, energy policy, radioactive waste management, radiological protection, nuclear science, nuclear law, knowledge preservation and nuclear data.

The Nuclear Energy Agency conducts its activities based on a programme of work developed through member country inputs in accordance with the Agency's five-year Strategic Plan, the programmes of work of its seven standing technical committees, joint project support and voluntary contributions. Some of the highlights for 2003 were:

Safety of nuclear installations

- Heads of the nuclear regulatory agencies of OECD countries met in June 2003 with high-level government officials and executives from the nuclear industry to discuss ways of measuring, assessing and communicating nuclear regulatory effectiveness and efficiency.
- A workshop organised with the International Atomic Energy Agency held in June 2003 focused on nuclear safety management and safety culture.

Energy policy and legislation

- The reference book, *Nuclear Energy Today*, was published in order to provide policy makers and interested members of the public with factual information of relevance to decision making in this field.
- A report on *Government and Nuclear Energy* was completed for publication early in 2004.
- The path was cleared for the signing in 2004 of the protocols to amend the Paris Convention on Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention.

Radioactive waste management, decommissioning and radiological protection

- The NEA co-sponsored a major international meeting on political and technical progress in the development of geological repositories for the disposal of high-level waste.
- The NEA conducted international peer reviews of certain aspects of the radioactive waste management research programmes of Belgium and France.
- Two major reports were issued in 2003 addressing the decommissioning of nuclear power plants.
- Current work in the area of radiological protection includes collaboration on a new system of protection being developed by the International Commission on Radiological Protection (ICRP). This also addresses new approaches to the protection of fauna and flora.

The future of nuclear power

- Under a special programme, the NEA has contributed to the Generation IV International Forum, which is exploring new reactor types and related research and development.

These are only a few examples of the many activities performed in depth at the NEA. This annual report provides details and shows the scope of the work that the Agency performs with and for its member countries. As so widely acknowledged, international co-operation on nuclear energy is becoming ever more necessary, and I am particularly pleased that the Agency can provide an effective environment to foster quality work in this area.



Trends in Nuclear Power

Nuclear energy development

As of 31 December 2003, 351 reactors were in operation in OECD countries constituting about 84% of the world's nuclear electricity generating capacity and about 23% of the total electricity supply in the OECD area (see Table). During 2003, one reactor (960 MWe net) was started up in Korea and six reactors were shut down (988 MWe net), while two units in Canada were returned to service after extensive periods of lay-up. Six units were under construction in OECD countries with a net capacity of about 6.4 GWe. During 2003, 17 units in Japan were temporarily shut down for inspections after quality assurance issues were discovered. By the end of 2003 six of these units had been returned to service and the rest are expected to return on line during 2004.

Japan and Korea remain committed to strong growth in nuclear energy. At the same time, France remains strongly committed to the use of nuclear energy. During 2003, France conducted a debate on energy policy, following which recommendations were made to construct an advanced reactor in France. Finland committed to building a new nuclear power plant in 2002, and at the end of 2003 a contract was awarded to construct a European pressurised reactor (EPR), to be operational by 2009. In the United States, two electric utilities filed applications for early site permits for construction of new nuclear power plants, a result of a Government programme intended to encourage deployment of advanced reactors. Also in the United States, extensions of operating lives and increases in generating capacity are trends that will maintain

and increase installed capacity over time, even in the absence of new construction. US regulatory authorities expect to receive 46 applications for power uprates by 2005, equivalent to about 1.6 GWe of net capacity. Additional capacity is also expected to be added if plans to restart the Browns Ferry-1 plant (shut down since 1985) by May 2007 are realised.

Other OECD member countries have recently been showing renewed interest in nuclear energy due to its potential role in ensuring stable energy supply, increasing diversification and reducing external dependence on oil and gas, as well as alleviating the risk of climate change. The European Commission recently confirmed the role of nuclear energy as Europe strives to meet its greenhouse gas emission targets. In 2003, voters in Switzerland rejected two motions that would have led to a phase-out of nuclear energy. In the United Kingdom, although government policy is neutral regarding future nuclear power plants, market conditions are forcing the early closure of older plants and may be discouraging new construction.

On the other hand, the Belgian, German and Swedish governments remain committed to pursuing nuclear phase-out policies. In all countries that have chosen to relinquish the use of nuclear power, the implementation of alternative energy sources remains an issue in the face of increasing electricity demand, and difficult decisions remain on how to implement a phase-out of a nearly carbon-free source of energy while still meeting carbon reduction goals.

Electricity market deregulation has progressed in many member countries, accelerating consolidations of power plant ownership and mergers in the industry at the international level. The European Union (EU) reached an agreement on full deregulation of domestic electricity markets within several years. At the same time, market liberalisation has pushed many utilities to enhance economic effectiveness through increased availability factors, lifetime extensions and capacity uprating. The latter two have proven to be cost-effective and often the cheapest way to increase electricity generation in liberalised markets.

In the longer term, two international endeavours are seeking to develop a fourth generation of nuclear energy systems that will respond to society's future needs. In particular, the Generation IV International Forum (GIF) and the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) are working to advance nuclear technology for future use. The December 2002 "Technology Roadmap for Generation IV Nuclear Energy Systems" proposes international R&D

2003 Nuclear Data Summary (as of 31 December 2003)

Country	Operational reactors	Installed capacity (GWe net)	2002 uranium requirements (tonnes U)	Nuclear share of electricity production
Belgium	7	5.8	845	41.5
Canada	22 (a)	11.6	1 650	12.5
Czech Republic	6	3.8	730	55.5
Finland	4	2.7	538	25.5
France	59	63.6	8 570	77.6
Germany	18	20.6	3 200	30.2
Hungary	4	1.8	373	37.1
Japan	52	43.9	8 154 (b)	25.8
Mexico	2	1.4	156	5.9
Netherlands	1	0.5	63	4.0
Republic of Korea	18	14.9	3 348 (b)	39.9
Slovak Republic	6	2.5	500	56.7
Spain	9	7.5	1 530	23.6
Sweden	11	9.4	1 600	49.2
Switzerland	5	3.2	550 (b)	39.4
United Kingdom	31	12.3	1 980	23.9
United States	104	98.8	22 701 (b)	19.9
Total	359	304.1	56 488	23.2

(a) Five units, shut down since 1997, remain connected to the grid, with possible restarts under evaluation.

(b) Provisional data.

programmes to demonstrate the viability and performance of six systems identified by the project members as promising in terms of: sustainability; safety and reliability; economics; and proliferation resistance and physical protection. The anticipated schedule, based upon the assumption of increased international collaboration in the field, would bring Generation IV nuclear energy systems to the market by the 2030 time frame.

Uranium production

In 2002 (the last year for which data is available), uranium was mined in just four OECD countries; however, two of those countries, Canada and Australia, accounted for over 51% of world production. Production in the OECD area amounted to 20114 tonnes of uranium (tU) in 2002 and is expected to decrease to 18112 tU in 2003, in part because of events in Canada where the Cluff Lake mine definitively closed at the end of 2002 and operations were suspended at the McArthur River mine from April 2003 through July 2003 due to flooding in a portion of the mine.

At the end of 2002, world uranium production (36 042 tU) provided about 54% of world reactor requirements (66 815 tU), with the remainder being met by secondary sources including civilian and military stockpiles, uranium reprocessing and re-enrichment of depleted uranium.

As currently projected, uranium production capabilities including existing, committed, planned and prospective production centres supported by known conventional resources recoverable at a cost of <USD 80/kgU through 2020 cannot satisfy projected future world uranium requirements in either the low or high demand cases. Thus, secondary sources will remain necessary to ensure adequate supplies in the near term. However, secondary sources are expected to decline in importance, particularly after 2020, and reactor requirements will have to be increasingly met by the expansion of existing production capacity, together with the development of additional production centres or the introduction of alternative fuel cycles. Because of the long lead times necessary to discover new resources and bring them into production (typically in the order of 10 to 20 years or more), there is potential for the development of uranium supply shortfalls and significant upward pressure on uranium prices as secondary sources are exhausted.

Enrichment

Several significant developments relating to uranium enrichment took place in OECD member countries in 2003. An emerging trend is that future

enrichment activities will utilise centrifuge technology. In the United States, the US Enrichment Corporation (USEC) ceased pursuit of the laser-based SILEX technology and France concluded its research into the laser-based SILVA technology with no announced plans for near-term deployment. Two separate efforts are under way to create a commercial centrifuge enrichment capability in the United States. One, sponsored by USEC, will use advanced centrifuge technology adapted from prior US Government research and a second initiative, under Louisiana Energy Services (LES), is based on Urenco centrifuge technology. USEC is planning on a demonstration facility of up to 240 machines to begin operation in 2005. LES plans to have an initial operational capability in service by 2006 with full capacity by 2011. In France, AREVA took steps to acquire centrifuge technology through the purchase of a 50% equity stake in Urenco's technology arm for use in eventual replacement of its gaseous diffusion plant in Tricastin. In 2003, Urenco also announced that it is expanding its centrifuge enrichment capacity by over 10%.

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

In 2003, several significant events took place that are worth noting. The most important one took place at the Paks nuclear power plant in Hungary, where severe damage was caused to thirty fuel elements during a fuel cleaning procedure in April. A reactor vessel penetration degradation at South Texas (US); a spurious safety injection that led to repeated cycling of a relief valve at Dampierre-3 (France) and thermal sleeve failures at Barseback-2 were also reported. The nuclear power plants generally performed as designed during the 2003 grid blackout events in North America and Europe.

Human-related safety issues that were revealed as a consequence of these events included: deficient operator knowledge, inadequate learning processes from prior events and problems with procedures. Safety-culture and organisational matters such as the use of contractors, a lack of clear responsibility or authority, and complacency



AREVA, Cameco, France

At the end of 2002, world uranium production provided about 54% of world reactor requirements, with the remainder being met by secondary sources.

were also noted as possible contributors. 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 joint research projects to this effect.

Radiological protection

The evolution of the system of radiological protection continues to be a central theme of discussions in this field and activities to reach consensus have accelerated. The International Commission on Radiological Protection (ICRP) widely distributed and requested comments on two framework documents describing its proposed conceptual views on the general system of radiological protection, and on the radiological protection of non-human species. The views of radiological protection policy makers, regulators and practitioners have begun to converge, although further discussions and investigation will be necessary before full understanding of the implications of the ICRP's recommendations can be achieved. It is clear, however, that stakeholders would like the new recommendations to maintain several practically useful concepts that the ICRP had at first proposed to eliminate, namely dose limits, collective dose and ALARA. The open and active effort by the ICRP to collect stakeholder input has been very much appreciated, and stakeholders are eagerly awaiting the ICRP's presentation of draft recommendations at the International Radiological Protection Association Congress in May 2004 in Madrid, Spain.

The state of radiological protection infrastructures remains a subject of interest. Issues range from the number of students, professors and qualified professionals in the field, to the condition of research institutions and facilities. Defining government funding policy, even in support of its own infrastructure needs, is increasingly difficult in a deregulated market.

Finally, in an era of potential vulnerability to terrorist attacks that could involve radiological dispersion devices, governments are seeking to ensure that existing urgent-response structures and processes are able to quickly and appropriately address such situations. Related issues, such as the decision whether to use x-ray screening devices as part of public security reinforcement efforts, have also arisen. Ongoing studies of stakeholder participation in radiological protection decision making suggest that affected populations may well wish to be involved in government deliberations of pre- and post-incident protective actions.

Radioactive waste management

In 2003, countries with major programmes in geological disposal proceeded on schedule. The Finnish and Swedish programmes as well as the Yucca Mountain project in the US advanced their work on sites that had been designated, or would accept in principle, to become repositories. In France, a new disposal site for very low-level waste began operation in 2003. The implementation of such a repository specifically designed for this waste category reflects the current very restrictive French policy on clearance of radioactive materials.

In Belgium, France and Switzerland major studies have been released describing the research, development and demonstration activities on the disposal of high-level and long-lived waste in these countries. These studies have been subjected to international peer reviews to help the responsible institutions decide on future work programmes and priorities.

Recent developments in Canada, Germany and Japan point to the importance of, and particular needs associated with, addressing stakeholders' concerns adequately in waste management programmes. In Canada, the new Nuclear Fuel Waste Act requires that the non-profit waste management organisation, which had been established by the waste owners, must consult with the general public; in Germany, new general criteria for site selection have been proposed by a government-established committee, which include both geoscientific and societal aspects; and finally, in Japan, the national implementing agency NUMO officially announced the start of "open solicitation for volunteers for primary investigation areas" for a HLW repository. Less progress was made in Italy and Korea, where recent government proposals for the siting of intermediate waste repositories in these countries faced very strong public resistance and had to be withdrawn.

Most countries with mature programmes for the management of high-level and long-lived waste have independent technical groups to advise governments on the conduct of their waste management programmes. The UK Department for Environment, Food and Rural Affairs (DEFRA) adopted such an approach when it installed a new Committee on Radioactive Waste Management (CoRWM). The CoRWM is expected to give its recommendations by the end of 2005 on how to put the 2001 DEFRA programme "Managing Radioactive Waste Safely" into action.

At a major conference on "Geologic Repositories: Political and Technical Progress", held in December in Stockholm, Sweden, participants from implementing, regulatory and R&D institutions



Ph. Braut, CEA, France

Checking for radioactive contamination is a fundamental part of worker protection in the nuclear industry.

Most NEA member countries are opting for the geological disposal of high-level waste.



AREVA, Studio Clin d'oreil, France

as well as high-level decision makers from NEA member countries and China considered geological disposal as a radioactive waste management endpoint that was technically feasible and acceptable from an ethical and environmental viewpoint, thus providing security and safety in a sustainable manner.

Nuclear science

In the field of nuclear science, attention has focused on issues related to improving the performance and safety margins of current nuclear power plants, and to developing the next generation of reactor systems. As concerns current nuclear power plants, the main scientific challenges relate to nuclear reactor lifetime extension, the employment of higher burn-up fuel cycles and the potential of using partitioning and transmutation techniques to reduce the radiotoxicity and the volume of nuclear waste. Among the future reactor concepts, it is primarily the fast spectrum and/or high-temperature systems that have attracted the most attention.

The development of new, and the behaviour of existing, structural materials are of interest both to current and future reactor systems. The behaviour of these materials after years of irradiation is of importance when considering both lifetime extension of current reactors, as well as the employment of higher burn-up fuel cycles. In addition, there is, especially for new reactor concepts, a strong incentive to study and develop new materials that can resist both very high temperatures and intense irradiation.

Another important area of concern in nuclear science is the fuel cycle, both the front end and the back end. The prospect of using fuels containing higher actinides for transmutation in fast reactors or in accelerator-driven, sub-critical reactors is being examined, and new fuel types, such as nitride fuels, are being studied. There is also a renewed interest in research related to pyrochemical reprocessing of irradiated fuel.

Nuclear data and software

As the availability of experimental facilities declines, the need for good basic tools – such as computer codes and nuclear data used for the analysis and prediction of phenomena in the nuclear field – becomes increasingly important. It has also become evident that sharing these tools helps in the development, improvement and validation of both the computational models and the nuclear data.

The continued increase in computing power and the employment of parallel computing, using a cluster of workstations, has made it possible to simulate progressively more complex physical phenomena, such as the modelling of full reactor cores and of radiation transport in materials. It has also made it feasible to increase the use of Monte Carlo methods, as it is now possible to obtain good accuracies within reasonable computing times.

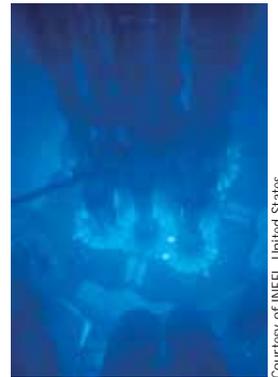
In the nuclear data field, there is still a need to improve the accuracy of the data, especially of the major and minor actinides, to better predict different reactor parameters in existing reactors, with subsequent potential economies. These data are also needed for the modelling of advanced reactor systems, such as actinide burner systems. In addition, specific nuclear data are needed for the transmutation of nuclear waste, and in medical and astrophysics applications. The possibility to theoretically predict nuclear data at intermediate energies is also being pursued through the development of different statistical nuclear model codes.

Nuclear law

Harmonisation of legislation governing the peaceful uses of nuclear energy remains an important issue for most NEA member countries and it could take on even greater significance for those which are, or will become, members of the European Union, particularly in light of the expansion of the Union's legislative jurisdiction into the fields of liability for nuclear damage, nuclear safety and radioactive waste/spent fuel management.

Modernising and strengthening national and international nuclear liability regimes will help ensure that adequate and equitable compensation is available to victims suffering damage as a result of a nuclear incident. The revision of the Paris and Brussels Supplementary Conventions reflects the trend in member countries to increase the amounts of compensation to be made available, to broaden the range of damage that will be compensable and to provide compensation to a much larger number of victims.

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.



View of the advanced test reactor at the Idaho National Engineering and Environmental Laboratory, USA.

Courtesy of INEEL, United States

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

In a period of transition and uncertainties, in which some governments are showing a renewed interest in the nuclear option for economic and policy reasons and others are considering phasing out nuclear energy to avoid perceived risks and long-term liabilities, the NDC has focused its activities on enhancing the broad understanding of nuclear policy issues, analysing the role of governments and assisting member countries in policy making.

A new NEA publication entitled *Nuclear Energy Today*, issued in 2003, aims at informing policy makers about the scientific, technical, economic and social issues related to peaceful applications of nuclear energy in modern societies. The book is based upon studies and analyses carried out by the Agency over several decades in the field of nuclear science and technology, nuclear safety, radiological protection, radioactive waste management, nuclear law, and economic and social aspects of nuclear energy development. It provides authoritative and factual information on the multiple facets of nuclear energy relevant to national policy making and international co-operation in the field.

A report on *Government and Nuclear Energy*, prepared under NDC auspices, was completed at the end of 2003 and will be 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. It is intended to stimulate and inform the debate on nuclear issues at the beginning of the 21st century.

The NEA participated in the in-depth energy policy reviews carried out by the International

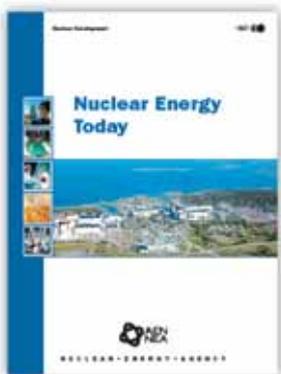
Energy Agency (IEA) on Canada, Finland, Japan and Sweden. In those countries, nuclear energy plays a major role in the supply mix and is especially important as a means to address the climate change threat. The reviews offered opportunities to analyse national policies in the field of energy and electricity market deregulation, and to identify specific challenges facing governments with regard to the role of nuclear energy.

The NEA was involved in Ministerial meetings held in 2003 by the IEA and the OECD, and contributed to the OECD delegation to the Ninth Conference of the Parties to the UNFCCC (COP9, held in Milan, Italy, at the end of November), presenting relevant publications of the Agency. The NEA continues to participate in the horizontal activities of the OECD on sustainable development whenever the topics raised are of relevance to the nuclear energy field.

Economics

A study on *Decommissioning Nuclear Power Plants: Policies, Strategies and Costs*, carried out under the joint auspices of the NDC, the CRPPH and the RWMC, was published in mid-2003 and its main findings and conclusions were presented in several international conferences. The report, based upon data provided by 26 countries, provides an overview of decommissioning cost estimates for a broad range of nuclear power plants; it also provides insights into cost drivers and the influence of national policies and industrial strategies on decommissioning costs.

Work on external costs, initiated in 2002 by a joint IEA/NEA workshop on *Externalities and Energy Policy: The Life Cycle Analysis Approach*, was pursued by a detailed analysis of external costs and benefits of nuclear electricity, based on a large literature review including previous NEA studies. The outcomes of this work were summarised in a booklet for policy makers entitled *Nuclear Electricity Generation: What Are the External Costs?*



- *Nuclear Energy Today* was prepared and published based upon the work of the Agency on scientific, technical, economic and policy issues related to nuclear energy. It provides policy makers and interested members of the public with factual information on a broad range of topics of relevance to decision making in this field.

- An overview of the internalised and external costs of nuclear-generated electricity, containing authoritative information and data, was published as a booklet for policy makers and energy analysts.

- A report on *Government and Nuclear Energy* was completed. It highlights the important role played by

governments in the development of nuclear energy and their challenging responsibilities in the context of electricity market deregulation.

- The Agency continued to provide technical support to the Generation IV International Forum (GIF), notably its Economic Modelling Working Group.

A workshop on "Power Generation Investment in Liberalised Electricity Markets" was organised jointly with the IEA and held in Paris, France on 25-26 March 2003. The presentations covered the views of investors on power generation investments, the impact of liberalisation on technology choices and the role of government policies. Among the main findings from the discussions was that governments have an important role to play in liberalised markets and economies to ensure security of supply and environmental protection. The workshop presentations and papers are posted on the two agencies' websites. The outcomes from the workshop have served as background for future work including the joint NEA/IEA study on projected costs of generating electricity, which began in December 2003.



C. Carotly, EDF, France

Security of electricity supply remains an important issue for NEA member countries.

Technology

The proceedings from the Seventh Information Exchange Meeting on "Actinide and Fission Product Partitioning and Transmutation", held in Jeju, Korea on 14-16 October 2002, were published in 2003. The preparation of the Eighth Meeting, to be held in Las Vegas, Nevada, USA on 9-11 November 2004, was initiated in co-operation with the Nuclear Science Committee.

Work concerning the back end of the fuel cycle continued, focusing on the impact of advanced fuel cycles, including P&T, on the required physical characteristics and costs of repositories for high-level waste disposal. The ad hoc expert group in charge of the study has prepared a preliminary draft report and undertaken economic analyses.

In the framework of the Generation IV International Forum (GIF), the NEA is providing technical support to the Economic Modelling Working Group in charge of economic assessment of Generation IV concepts. Work carried out by the group in 2003 was mainly devoted to reviewing existing economic models and tools and evaluating their adaptation

to Generation IV concepts, their specific technical characteristics and their degree of conceptual development.

Data and resource assessment

In the field of uranium resource assessment, the Joint NEA/IAEA Uranium Group pursued its activities with emphasis on the preparation of the 2003 update of the "Red Book", to be published in 2004. The group met twice in 2003 to review drafts of the publication and to discuss the implementation of a more efficient data collection and analysis method relying on an Internet-accessible database.

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 2003 edition offers, in addition, projections to 2020 and country reports highlighting key events in the nuclear energy field.



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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. A variety of issues have been identified in international operating experience; recurring events figure prominently on the list. Many human and organisational factors including deficient operator knowledge, inadequate learning processes from prior events, problems with procedures, complacency in organisation and unclear definition of responsibility were also identified. Contractor work has also been involved in a number of events. Finally, maintaining adequate levels of exchange of international operating experience has been recognised as an important element in helping to improve nuclear safety. Corrective actions and research activities are ongoing or planned in all of the areas mentioned above.

The CSNI Working Group on Operating Experience (WGOE) has continued its work to bring lessons from NPP operating experience to the nuclear safety community. In 2003, the group issued the second international report on recurring events as well as a technical opinion paper on the same subject intended for a wide audience. The task force on safety impact of so-called minor and non-identified modifications organised a workshop on the safety of nuclear power plant (NPP) modifications jointly with the CSNI Special Expert Group on Human and Organisational Factors (SEGHOF). Furthermore, the activities of the task groups on safety performance indicators and strainer clogging are planning to hold international workshops in the near future; the task group that deals with computerised systems is looking to launch a joint NEA project in 2004.

Human and organisational factors are an important part of nuclear safety.



NEI, United States

Analysis and management of accidents

Most CSNI activities in the area of safety 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, in nuclear power plant safety and design evaluations, of best-estimate codes, 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. Action plans are being implemented in these areas.

Regarding in-vessel behaviour of degraded cores, the ISP-46 (international standard problem) exercise, based on a test at the PHEBUS facility, was completed during the year. The objective was to assess the capability of computer codes to reproduce an integral simulation of the physical processes taking place during a severe accident in a pressurised water reactor.

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 validate codes that calculate thermal-hydraulics inside a reactor containment under accident conditions.

As regards fission product release, transport, deposition and retention, the ISP-46 exercise, mentioned above, and a second follow-up exercise to ISP-41 on iodine behaviour, based on RTF and CAIMAN tests, were completed during the year.

Good progress continues to be made on the SERENA (Steam Explosion Resolution for Nuclear Applications) Co-ordinated Programme, investigating the field of steam explosions resulting from fuel/coolant interactions, with a view to determining by mid-2005 whether current knowledge is sufficient for risk management under reactor conditions, and whether additional, analytical, experimental work is needed.

Safety aspects of improved performance – Integrated assessment of safety margins

In recent years, largely as a result of economic pressures arising from the liberalisation of electricity markets, the nuclear industry has tried to maximise the

- The CSNI and the CNRA completed 30 reports. Particularly noteworthy were those on recurring events, fuel safety criteria and the inspection of research reactors.
- The CSNI and the CNRA organised 11 workshops, notably a workshop on redefining large-break, loss-of-coolant accidents and the Forum on Measuring, Assessing and Communicating Regulatory Effectiveness.
- In 2003 the MASCA Project completed its first phase and its members agreed to continue with MASCA 2. A number of initiatives were assessed in terms of their potential for becoming new NEA joint projects.

outputs of operating plants. This has resulted in changes to the main parameters of the reactor core. Such modifications require an in-depth safety analysis to evaluate the possible safety impact. More generally, the effect of cumulative, small design changes which are not individually tested can produce significant differences from the original design. A comprehensive, integrated assessment is needed in order to evaluate the impact of multiple, synergistic safety margin reductions (related to power uprates, longer operating cycles, fuel design, increased fuel burn-up, etc.), combined with plant ageing and plant life extension. An extensive Action Plan on Integrated Assessment of Safety Margins has been initiated.

Ageing and structural integrity of reactors

The main topics investigated in this area include metal components, concrete structures, seismic behaviour and the ageing of wire systems. One workshop was held and nine reports issued.

Work on concrete containments was completed and an international standard problem on containment capacity was begun based on NUPEC/NRC tests carried out at Sandia National Laboratories. Work on the use and performance of concrete structures in nuclear power plant fuel cycle facilities was initiated through co-operation with other organisations. A review of regulatory aspects and the technical basis for a possible redefinition of loss-of-coolant accidents (LOCA) was also carried out.

In the area of metallic components, several activities were initiated on non-destructive examination and risk-informed inspection, environmental effects on nickel-based alloys, thermal fatigue of reactor components and wire system ageing. A benchmark on the probabilistic approach for reactor pressure vessel integrity was launched.

Activities are continuing in the area of seismic engineering, notably on seismic codes and standards, seismic inputs, and testing facilities to be maintained for the future.

Risk assessment

The main mission of the Working Group on Risk Assessment (WGRisk) continues to be to advance the

understanding and utilisation of probabilistic safety assessment (PSA) in ensuring the continued safety of nuclear installations in member countries. While PSA methodology has matured greatly over the past years, further work is required. WGRisk has been active in several areas, including human reliability, low power and shutdown risk. In order to maintain a current perspective, the working group collaborates and assists other working groups within the CSNI, such as those on operating experience and organisational factors, as well as ensuring close co-ordination with other international organisations.

A technical opinion paper was approved for publication on human reliability analysis in PSA. WGRisk is beginning work on several new tasks, including the use of risk information in the regulatory process, the use of Level 2 PSA information for emergency planning, the development of methodology for the use of OECD databases, and probabilistic safety analysis for non-reactor nuclear facilities.

Fuel safety margins

Among the most important issues to the international nuclear industry is high burn-up fuel performance both during normal operations and under accident conditions, such as loss-of-coolant accidents (LOCA) and reactivity-initiated accidents (RIA). The NEA Special Expert Group on Fuel Safety Margins is seeking, in particular, to systematically assess 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. The survey of ongoing fuel safety research programmes in NEA member countries was completed and published in 2003. It demonstrates a tremendous effort, in both time and money, to improve understanding of materials and component behaviour in a wide range of postulated scenarios. The majority of ongoing activities are addressing such issues as the 17% cladding oxidation criterion in the light of new alloys and new geometries, and energy deposition levels leading to fuel failure by rapid reactivity insertion. In addition, the high burn-up structure at the pellet rim is under intense separate-effects study as this is anticipated to be the root cause of the increased fuel clad loading.



P. Stroppa, CEA, France

Remote manipulation at the Phebus research reactor for the programme on severe accidents (PWR core melt).



Plant improvements being implemented at the Bohunice nuclear power plant in the Slovak Republic.

Human and organisational factors

The Special Expert Group on Human and Organisational Factors (SEGHOF) continued its activities in this area, producing in particular a technical opinion paper about regulatory management of organisational change. The programme of work also included drafting a state-of-the-art report on scientific methods for safety management; a report on events involving MTO (man, technology, organisation) aspects and techniques to study them; preparatory work in the area of maintenance; and continuation of the task on human factors in NPP modifications.

In terms of design modifications, a workshop was organised in Paris jointly with the WGOE in October 2003 with wide participation by utilities, regulators and research bodies. Recent events show that minor modifications may be of high safety significance but sometimes remain unnoticed, e.g. when manufacturers introduce small changes considered as improvements solely in electrical and instrumentation systems. The conclusions of the workshop stated that operability and maintainability issues need to be taken into account early enough in the modification processes, and that careful scrutiny needs to be exercised independently of the size of the modifications.

Safety research capabilities and expertise in support of regulation

The role of research sponsored by nuclear regulatory organisations is to provide those organisations with adequate capability and expertise to assess reactor safety issues, review designs and perform their various other functions, independent from those seeking regulatory approval or promoting nuclear energy. Such capability and expertise is fundamental to

public confidence and contributes to safety by enhancing the efficiency and effectiveness of regulatory programmes. A collective statement on capabilities and expertise in support of efficient and effective regulation of nuclear power plants was approved at the end of the year for publication in 2004. The statement provides information which can be of use to member countries in establishing and maintaining adequate safety research capability and expertise, and is intended to assist NEA member countries in the task of judging and defining what safety research capability and expertise should be maintained in support of regulation.

Good practice and closure criteria for safety research

The method for setting nuclear safety research priorities and the criteria for ranking programmes and projects, including for closure, vary from one country to another. A successful research project requires clearly defined research programme backgrounds, objectives, deliverables and schedules, and progress must be monitored regularly. Setting a well-defined programme basis and monitoring programme performance, including closure considerations, are examples of good practice in conducting research.

In 2003 the CSNI developed a collective statement addressing good practices in conducting nuclear safety research and focusing on closure considerations. The statement also addresses the potential detrimental effects of programme closure, such as potential losses of technical capability, expertise and facilities, etc. This statement is intended to assist NEA member countries and the CSNI in the task of defining, monitoring and judging whether certain safety research programmes should be closed.

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 interface between the public and the regulator, the effectiveness of the regulatory process, the introduction of competition in the electricity market, the maintenance of a high level of safety competence and the development of advanced reactors.

Regulatory effectiveness

Under the aegis of the NEA, heads of nuclear regulatory authorities met in June with high-level government officials and executives from the nuclear

industry to exchange perspectives on measuring, assessing and communicating regulatory effectiveness. The main conclusion of the forum was that regulatory performance indicators are both good and useful in improving a regulator's effectiveness and

efficiency, but there are a number of areas that deserve careful attention. For example, incorrect analysis of these indicators could lead to inaccurate decision making, and misinterpretation could lead to misunderstandings by the stakeholders.

The underlying starting point for this forum was a set of performance indicators recently developed to measure regulators' performance in five key areas: competence; promotion of safety; continuous improvement; internal processes; and stakeholder confidence. The results of a one-year pilot project undertaken by nine NEA member countries provided the basis for the discussions. A main objective of the forum discussions was to seek verification and validation of the selected measures. Participants debated the appropriateness of the indicators chosen, whether others could be applied and what were the most essential measures of a regulator's effectiveness and efficiency. The final publication was approved by the CNRA at the end of 2003 and is scheduled to be issued early in 2004.

Nuclear regulators and the public

Efficiency in decision making by government authorities is increasingly dependent upon public trust. Public communication is one of the keys to the future of nuclear power. In 2003, an NEA working group on public communication of nuclear regulatory organisations discussed such topics as public communication in relation to the April 2003 Paks-2 incident in Hungary; the public impact of the April 2003 HSK (Swiss nuclear safety authority) report on aircraft attacks of nuclear power plants; lessons learnt from the Swiss vote in May 2003 in favour of nuclear power; Swedish public opinion of nuclear power; and follow-up to inspection findings on core internals in Japan. Preparations were also undertaken to organise a workshop on "Building, Measuring and Improving Public Confidence in the Nuclear Regulator", to be held in Ottawa, Canada in May 2004.

Regulatory inspection practices

Inspectors from regulatory bodies meet periodically to exchange information and experience related to regulatory safety inspections, discuss commendable inspection practices and carry out studies. Reports were issued on nuclear regulatory inspection of contracted work and on inspection practices of nuclear research reactors. A seventh international workshop is being planned for 2004 and will cover inspection activities related to risk-informed inspections, inspection of plants at or near end-of-life and inspection of licensee organisation performance.

The working group in this area is currently studying several inspection issues including: inspection of site selection, construction and commissioning; inspection of licensees' capability to assure the nuclear safety aspects of contractors' work; and regulatory inspection practices used to bring about compliance. It is also preparing a compendium of commendable inspection practices.

Licensees' capabilities to ensure nuclear safety

A common concern to both regulators and industry is the ongoing gradual loss of experienced and competent personnel in nuclear technology and the resulting weakening of nuclear field organisations. In some cases NPP vendors have merged with other companies and are no longer offering their earlier designs, while the technical strength of some others has decreased from the time they were actively designing and constructing NPPs. Consequently, some nuclear operating organisations have difficulty finding sufficient external support needed for the maintenance and operation of their facilities. Additionally, suppliers of specific nuclear equipment are disappearing from the market and as a result, the in-depth knowledge on the design features of their equipment is being lost. Similarly, nuclear research institutes and other expert organisations have reduced their nuclear staff and budget.

The gap is partly filled by consultants and specialised companies that offer contracted services to the operators. The expert knowledge of these contractors is often focused on a limited area, and does not include a comprehensive understanding of the NPP safety concept. Furthermore, contractors may not have had much involvement or experience on the specific plant sites where they are working. Therefore they require due guidance and supervision by the operating organisation.

The licensee's ability to maintain control over the nuclear safety aspects of the 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. It would be worthwhile to identify commendable means used by the operators to maintain control over nuclear safety aspects of contracted work and to identify the type of regulatory oversight (e.g. inspections, assessment, etc.) that allows the regulator to have assurance on the adequacy of such controls.



KKB/NOK, Switzerland

Inspection of a residual heat removal pump at the Beznau nuclear power plant in Switzerland.



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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.

Development of a new system of radiological protection

Building on two of its earlier reports (*The Way Forward in Radiological Protection* and *A New Approach to Authorisation in the Field of Radiological Protection*), the CRPPH has been developing its views on how the recommendations and concepts emerging from the International Commission on Radiological Protection (ICRP) could be interpreted and applied in regulation and application. The Committee has begun elaborating a broad, holistic approach to radiological protection that would subject all sources and exposure situations to some level of regulatory control, setting aside from further consideration only a very few situations (i.e. K-40 in the body, cosmic radiation at sea level) that are intrinsically unamenable to control. At the same time the Committee has proposed to use a graded approach appropriate for the level of risk being considered.

The value and innovation of this approach comes primarily from two aspects. First, all sources and exposure situations are treated in the same fashion, using optimisation below a pre-determined dose constraint. This results in a system that is simple, consistent and coherent and avoids the need to explain and justify, as previously necessary, why some regulatory "levels" were not to be passed (limits), and others required no actions until they

were passed (action levels, intervention levels). Second, this approach has tried to avoid the use of terminology that has been deemed confusing in the past, such as practice, intervention, exclusion, exemption and clearance. It is hoped that by addressing all situations in the same conceptual framework, this single approach will be more generally applicable and coherent as well as more easily and transparently applied.

NEA/ICRP fora

In addition to providing the ICRP and the international radiological protection community with its proposed approaches, the CRPPH has developed a mutually fruitful relationship with the ICRP. The 1st NEA/ICRP Forum (Taormina, 2002), and the 2nd NEA/ICRP Forum (Lanzarote, 2003), enabled a privileged exchange of practical and regulatory views on draft conceptual framework material. This process has allowed CRPPH members to better understand the ICRP's proposed approaches, and has allowed the ICRP to interact with key stakeholders to fine-tune its new recommendations and facilitate their application. For example, as a result of the 2nd Forum in Lanzarote, the ICRP is considering keeping the concepts of dose limits, ALARA (as low as reasonably achievable) and collective dose in its new recommendations.

The NEA will continue its work in this area, publishing the proceedings of the Lanzarote workshop as well as a policy-level summary of the workshop's results. In addition, the CRPPH will perform another in-depth assessment of possible implications of the next draft ICRP general recommendations document that is expected to be available following the IRPA-11 Congress in May 2004. Finally, a third NEA/ICRP Forum will be organised following the publication of the new ICRP recommendations and will focus on implementation aspects.



- The possible implications of two key draft ICRP framework documents were analysed, based on input from all NEA standing technical committees.

- The 2nd NEA/ICRP Forum achieved wide-ranging stakeholder consensus on key regulatory concepts that should be kept and clearly articulated in new ICRP recommendations.

- The 3rd "Villigen Workshop" demonstrated the value of, and need for, stakeholder involvement in certain situations to achieve sustainable decisions. Several broadly applicable policy-level implications, lessons and processes were identified.

- An assessment of effluent management was published, describing

current state-of-the-art practice, and identifying and discussing key policy issues.

- The ISOE system continued to expand as well as to consolidate its efforts in order to facilitate data analysis and management, and the exchange of information, experience and lessons learnt.

Stakeholder participation in decision making involving radiation

The NEA has long been exploring the details and implications of stakeholder participation in decision-making processes. The most recent focus of this work was the 3rd "Villigen Workshop", which took place in October 2003 and clearly demonstrated the value of and need for stakeholder involvement to achieve accepted decisions in certain situations. The policy-level implications were seen to have almost universal applicability. The published results of the workshop will help policy makers and regulators to better understand how stakeholder participation can lead to better decisions, the possible implications of such participation, and the processes that can be used to implement stakeholder participation. For a fuller description of NEA work in this area, see the section on "Nuclear Energy and Civil Society" (page 34).

Occupational radiological protection

Through its Information System on Occupational Exposure (ISOE), a co-operative programme supported jointly with the IAEA, the CRPPH has further enhanced its efforts to facilitate data analysis and management, and the exchange of information, experience and lessons in this area. In 2003, various ISOE elements were consolidated, particularly the data input and data analysis software, but also the ALARA communication network. As a result of an in-depth evaluation of the programme and its working procedures, it was decided that ISOE should offer new products, such as an ISOE newsletter and selected web products, and further promote the use of the ALARA communication network.

Nuclear emergency exercises

CRPPH work on international nuclear emergency management exercises (INEX 2, INEX 2000) and on

nuclear emergency management more generally has demonstrated the importance of communication, facilitating national and international improvements. A report summarising policy lessons from the INEX 2000 exercise will be published in 2004.

Building upon this background, work during 2003 turned to the study of later nuclear emergency phases and the preparation of the INEX 3 exercise programme, which will focus on the more generic aspects of dealing with widespread contamination. This will include agricultural countermeasures, as well as so-called "soft" countermeasures dealing with travel, trade and tourism issues. INEX 3 will be a table-top exercise, using a contamination "footprint" as the basis for a decision-making scenario, and will be held in the 2005-2006 time frame. Lessons and experience from these studies are also of relevance to other situations, such as terrorist attacks with radiological materials.

Management of large-scale systemic risks

NEA experience in radiological protection, risk assessment and nuclear emergency management made an important contribution to two OECD reports addressing risk from a broad cross-cutting perspective. The reports were issued under the titles of *Emerging Risks in the 21st Century* and *Lessons Learned from Large-scale Disasters*.



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Occupational radiological protection at the Civaux nuclear power plant in France.



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Radioactive Waste Management

Radioactive Waste Management Committee (RWMC)

The RWMC is helping member countries to find long-term, sustainable solutions for radioactive waste management and is currently focusing its efforts on improving both technical and societal confidence in geological disposal. In addition to long-lived radioactive waste, materials from decommissioning are of specific concern for the RWMC.

Waste management policy and governance issues

Work in the area of radioactive waste has focused on the management of long-lived waste and decommissioning, with emphasis on institutional, regulatory and technical aspects. A very important conference on "Geologic Repositories: Political and Technical Progress", was held in December in Stockholm, Sweden, and hosted by the Swedish implementing organisation SKB. The NEA co-sponsored and helped organise this event, which followed the model of the "Denver conference" convened by the United States Department of Energy in 1999. Participants from implementing, regulatory and R&D institutions as well as high-level decision makers from NEA member countries and China reviewed national perspectives and addressed policy and decision making in this field.

A safety case that commands an adequate level of confidence and can usefully support decision making in the stepwise process can play a key role in demonstrating long-term safety. While the need for such a safety case is generally acknowledged, the detailed concept needs further clarification. The RWMC is preparing a short document to facilitate a common understanding of what a safety case is and to help explain the purpose and structure of a safety case to external audiences. This work as well as other RWMC experience also provides the basis for the draft of a new safety standard on geological repositories, which will be published as a joint IAEA/NEA Safety Requirements document.

To understand the very different and sometimes complex institutional arrangements set up by member countries for radioactive waste management, the RWMC Regulators' Forum compiled relevant country information and prepared a synoptic overview. The corresponding publication is due to be released in the beginning of 2004.

International peer reviews

On request from member countries, the NEA organises peer reviews of national waste management

programmes in relation to geological disposal. In this context, a review of a comprehensive study by the Belgian implementer ONDRAF/NIRAS was delivered to the Belgian authorities. The peer review covered the research, development and demonstration activities of the Belgian programme for disposal in clay as described in the SAFIR-2 study. It was instrumental in identifying remaining uncertainties and specific needs of the R&D programme and was designed to help the Belgian government and the institutions involved in waste management to decide on the future work programme and its priorities.

In 2003, the NEA also organised an international peer review of the French "Dossier 2001 Argile", which was produced by the French National Agency for Radioactive Waste Management (Andra) to describe the research, development and demonstration activities on the disposal of high-level and long-lived waste in argillaceous formations. The study represents a milestone in the process of studies and research work leading up to support a parliamentary decision on the French waste management programme in 2006. The international team presented its views on whether the French R&D programme as described in the "Dossier 2001 Argile" was consistent with other international disposal programmes and international practices.

Another international peer review has begun on a report prepared by Nagra, the Swiss organisation for nuclear waste, presenting the safety aspects of a repository project in the Opalinus Clay in Switzerland. The NEA peer review will be used by the Swiss regulator as an input to its own review of the Nagra study. Preliminary findings have already been presented to the Swiss authorities and the final report is scheduled to be delivered in February 2004.

Integration of sciences

Through its Integration Group for the Safety Case (IGSC) the RWMC further supported the development of geological disposal with two new projects: the EBS project, co-sponsored with the EC, and the AMIGO project.



NEA, United States

Long-term, sustainable solutions for radioactive waste management need to be found and implemented.

- The RWMC co-sponsored and helped organise a highly visible conference on geological disposal in Sweden. The conference was held as a follow-up to the 1999 "Denver conference" and took stock of recent developments in this area.

The engineered barrier systems (EBS) initiative is a series of workshops intended to improve understanding of how to achieve the integration needed for successful design, construction, testing, modelling and performance assessment of EBS's, and to clarify the role that an EBS can play in the overall safety case for a repository. A first EBS workshop was organised in Finland, in August 2003, to promote common understanding of design requirements and methodologies to develop detailed design specifications. The next workshop is planned to be held in the United States in September 2004. Future workshops will deal with process issues, the role of performance assessment, and design confirmation and demonstration.

The AMIGO project (Approaches and Methods for Integrating Geologic Information in the Safety Case) aims to understand the state of the art in the collection and integration of all types of geologic information (e.g. geophysical, hydrogeological, geochemical, structural) in performance assessment (PA) models and the overall safety case. A first workshop was held in Switzerland in June 2003 to address the interface between geosphere and site characterisation, and performance assessment. A second workshop is planned to be held in Canada in 2005.

To ensure the long-term safety of geological repositories, it is important to assess the stability of geosphere conditions throughout time and vis-à-vis external and internal perturbations. These issues were addressed by a workshop on "Stability and Buffering Capacity of the Geosphere for Long-term Isolation of Radioactive Waste" that took place in Germany in December 2003, and focused on the specific case of argillaceous media.

Decommissioning

The detailed issues associated with decommissioning strategy selection were addressed at a workshop hosted jointly by the Spanish regulator and implementing agency. This workshop attracted a large array of specialists from 15 countries, including several mayors from municipalities with decommissioning projects. It revealed the parameters

- Under RWMC auspices important studies by Andra (France) and Nagra (Switzerland) were reviewed, representing major milestones in their respective national programmes.

- A workshop analysing national practices in selecting decommissioning strategies for obsolete nuclear

power plants was held in Tarragona, Spain.

- The Forum on Stakeholder Confidence (FSC) organised a workshop in Brussels to meet with local partnerships and learn about their interaction in the Belgian radioactive waste management programme.

considered for decommissioning strategy selection, from the regulator, implementer and stakeholder viewpoints. The RWMC also collected experience in its decommissioning groups to prepare a report on the status, approaches and challenges in decommissioning, which is meant to inform the interested public and to support specialists and policy makers in their work. Other ongoing work includes the safety case for decommissioning and the impact of regulations on the release of materials and sites on the decommissioning process.

Stakeholder involvement

The NEA Forum on Stakeholder Confidence (FSC) published an international survey compiling national experience in *Public Information, Consultation and Involvement in Radioactive Waste Management* and held its third national workshop in Belgium. The workshop investigated "Dealing with Interests, Values and Knowledge in Managing Risk" in the Belgian context of Local Partnerships. As in previous cases, this workshop had direct interaction with local stakeholders and reviewed lessons learnt.

Modern societal demands in terms of risk governance and the widespread adoption of stepwise decision-making processes encourage a new set of behaviours and a new understanding of how regulators may best serve the public interest. The FSC therefore analysed the regulator's evolving role and image in radioactive waste management and published its findings in this area.

Understanding the scientific basis

To secure the scientific basis of its work, the NEA continued to support the development and sharing of quality-assured databases and models – for example the Thermochemical Database, the Catalogue of Clay Characteristics, a general features, events and processes (FEP) database, and the co-operative project on sorption modelling – as well as the preparation of a reference book on the self-healing features of clays.



Energiewerke Nord GmbH, Germany

A decommissioned reactor vessel being transported to interim storage.



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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, criticality safety, partitioning and transmutation of nuclear waste and radiation shielding.

The NEA nuclear science programme includes studies of relevance to both current nuclear reactors and to more advanced and innovative reactor systems. Examples in the first category are reactor stability and transient studies, employing the most advanced calculation methods to simulate different phenomena in existing reactors, and studies on nuclear fuel behaviour, under normal and off-normal operating conditions. Work related to advanced and innovative reactor systems includes physics benchmarks for high-temperature reactors and for nuclear waste transmutations systems; workshops and information exchange meetings have been organised in such areas as high-temperature engineering and nuclear production of hydrogen.

Power Engineering Company (NUPEC) in Japan, is being started.

A number of physics benchmarks related to the utilisation of MOX fuels in reactors are under way. These investigations refer to the analysis of several critical configurations based on data from, for example, the Swedish KRITZ and the Belgian VENUS experimental reactors. The benchmark programme also includes a study of a high-temperature reactor (HTR) fuelled with reactor-grade plutonium.

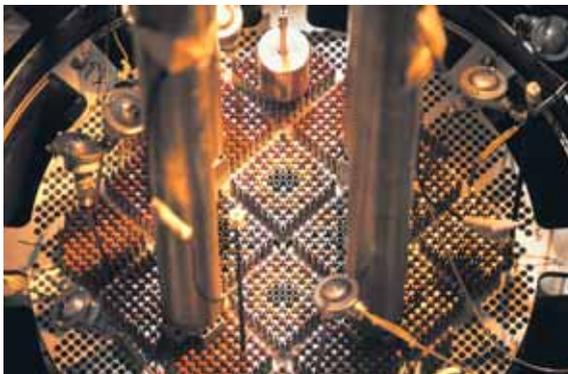
Fuel cycle physics

The NEA science programme covers many activities related to the behaviour of nuclear fuel in a reactor. A modelling exercise has been conducted with the aim of predicting fuel temperature and rod pressure in irradiated, solid and hollow MOX fuel pellets. The predictions will be compared to experimental data released by the Halden reactor in Norway and the results will be published in 2004.

The NEA and the IAEA are co-operating on an exercise to model nuclear fuel at extended burn-up (FUMEX-II). The NEA contribution to this exercise is to provide the required experimental data from its International Fuel Performance Experiments Database (IFPE), which contains a large number of fuel behaviour data, both from commercial irradiations as well as from experiments performed at material test reactors.

The increased interest in high burn-up fuels has prompted the NEA to establish an expert group which will write a comprehensive report on the potential benefits of very high burn-up fuel cycles (60-100 GWd/t), covering both scientific/technical aspects and economic aspects. The study is restricted to identifying problem areas and is not aimed at solving the identified problems.

A report on *Plutonium Management in the Medium Term* was published. The report reviews the technical options available for plutonium management in the medium and longer term, and is intended to serve as a reference source for researchers as well as utilities.



P. Stroppa, CEA, France

Close-up of fuel pins at the Eole research reactor in France.

Reactor physics

The NEA has an ongoing programme to model different reactor stability and transient events. A series of benchmark studies on the consequences of a main steam line break in a PWR has been completed and the last volume was published in 2003. Two other benchmark studies, one on the effect of a turbine trip on a BWR and one on a coolant transient in a VVER-1000 reactor, are being pursued. A new benchmark, based on unique data from a BWR full-size fuel bundle test, provided by the Nuclear



- The scientific and technical feasibility of using nuclear power to produce hydrogen was discussed at a workshop in October 2003.
- A study of the consequences of a main steam line break in a pressurised water reactor (PWR) was published.
- A study was launched on the potential scientific/technical and economic benefits of very high burn-up fuel cycles.
- A report on the capability of modern computer programs to simulate highly heterogeneous reactor cores loaded with MOX fuel was published.

Scientific issues in partitioning and transmutation

Different techniques to reduce the radiotoxicity of nuclear waste are being studied, ranging from chemical separation methods to accelerator-driven reactor systems (ADS) for the partitioning and transmutation of high-level waste from irradiated fuel. The chemical partitioning part of this work comprises the writing of a state-of-the-art report on national programmes in dry and aqueous reprocessing of spent fuel, and another more detailed report on dry reprocessing. The reports will be published in the first half of 2004. The major issues on current technology of fuel development for transmutation are also being evaluated and the report, suggesting necessary R&D, will be published in 2004.

A set of guidelines for improving the reliability of high power proton accelerators is being developed in the field of waste transmutation with ADS. Two benchmark exercises, related to the physics and safety of ADS, are also being pursued. One of the benchmarks studies the consequences on the reactor of a loss of the accelerator beam; the other benchmark examines the capability of current calculation methods and programs to model a small, fast neutron reactor coupled to a deuteron accelerator. The underlying experimental data originate from the MUSE-4 experiment in Cadarache, France.

Nuclear criticality safety

The International Criticality Safety Benchmark Evaluation Project (ICSBEP) issued a new edition of its handbook in autumn 2003. The publication contains 3 070 critical and sub-critical experimental configurations, of which 189 were added in 2003. The comprehensive overview of the project was published in two special issues (September and October 2003) of the journal *Nuclear Science and Engineering*.

Two reports on the use of burn-up credit in nuclear fuel cycle operations were published. They relate to mixed-uranium and plutonium-oxide (MOX) fuels, irradiated in PWRs. One of the publications reports on the calculation of infinite PWR



P. Stroppa, CEA, France

Installation of a fission chamber at the Minerve research reactor in France.

fuel pin reactivity for fresh and irradiated MOX fuels with various MOX compositions, burn-ups and cooling times, whereas the other publication deals with an investigation of the spatial and spectral effects during the irradiation of the MOX fuel.

Radiation shielding

A new version of the International Database for Integral Shielding Experiments (SINBAD) was issued in October 2003. The CD-ROM publication contains 33 reactor, 21 fusion neutronics and 5 accelerator shielding experiments. The database is jointly maintained by the NEA and the Radiation Safety Information Computational Center (RSICC) in the United States.

Homogenisation techniques tend to introduce large uncertainties when using deterministic transport calculation methods for calculating whole reactor cores. A benchmark exercise using a MOX fuel assembly was conducted to test the capability of modern computer programs to simulate highly heterogeneous reactor cores, without using homogenisation techniques. The report of the exercise was published in 2003 and will be of particular interest to reactor physicists and computer program developers.



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Data Bank

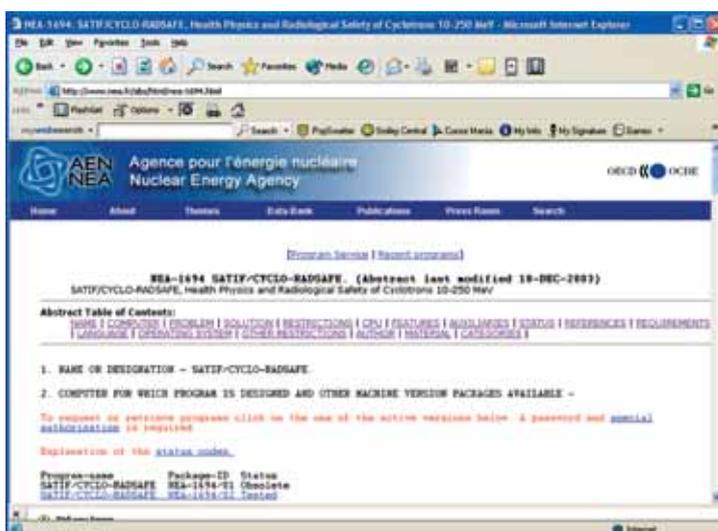
The Data Bank operates as an international centre of reference for its member countries with respect to basic nuclear tools, such as computer codes and nuclear data, used for the analysis and prediction of phenomena in the nuclear field. It provides a direct service to its users by developing, improving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

Computer program services

Demand for Data Bank computer program services remained high in 2003. More than 1 900 programs were distributed upon request, a figure that is comparable to previous years. The Data Bank also tested and added 82 new programs or new versions of programs to the collection, which contains in total more than 2 000 programs, covering all application areas of nuclear energy. The application areas that attracted most interest in 2003 were radiation physics and shielding, reactor safety analysis and static reactor analysis.

In 2003, the Data Bank issued one edition of the complete collection of nuclear program abstracts on CD-ROM. Four electronic newsletters were sent out via e-mail to liaison officers and subscribers.

A workshop on "Common Tools and Interfaces for Deterministic Radiation Transport, Monte Carlo and Hybrid Codes" was organised in September 2003 at NEA headquarters. It covered recently developed tools for modelling 3-dimensional problems, including automated mesh generation and visualisation of the results, to facilitate interpretation and documentation of these results. Methods for 3-dimensional sensitivity and uncertainty analysis were also covered.



Computer program training courses

The following training courses were organised in 2003:

- KENO/SCALE Training Courses 2003; 23-27 June 2003, Paris, France (14 participants).
- PENELOPE-2003 (electron-photon transport) Training Course/Tutorial; 7-10 July 2003, Paris, France (24 participants).
- MCNP5 Introductory Training Course; 15-19 September 2003, Issy-les-Moulineaux, France (17 participants).
- MCNPX Training Course, Intermediate Level; 6-10 October 2003, Stuttgart, Germany (16 participants).

Preservation of information from integral experiments

The Data Bank is, under the guidance of the NEA Nuclear Science Committee, collecting information from integral experiments to be used, for example, in benchmark testing of computer programs and nuclear data. The areas in which integral information is collected includes reactor physics, nuclear fuel behaviour, radiation shielding and reactor safety.

These integral data sets are highly sought-after among Data Bank customers. More than 2 500 such sets were distributed in 2003, with fuel behaviour data being the most popular category (50%), followed by radiation shielding and safety data (20% each), and reactor physics data (10%). The figure for the reactor physics data is only partially representative as the project started in June 2003 and the data preparation is in progress. New editions of both the fuel behaviour and the radiation shielding databases were issued on CD-ROM in October 2003.

Nuclear data services

The compilation of experimental data for the international EXFOR database continued in 2003 according to plans. The Data Bank contributed 114 neutron-induced and 165 charged-particle-

■ Demand for Data Bank computer program and nuclear data services remained high in 2003, with more than 1 900 programs distributed upon request.

■ A new version of JANIS software to display nuclear data was issued.

■ An update on the *Chemical Thermodynamics of Uranium, Neptunium, Plutonium, Americium and Technetium* was published.

induced experiments to the database. The Data Bank recently assumed responsibility for the annual publication of the CINDA database of bibliographic references and the CINDA 2003 volume will be distributed together with the new version of the JANIS data display software.

The above-mentioned EXFOR and CINDA databases, as well as a database containing evaluated nuclear data, are directly accessible to customers through the Data Bank's web pages. In 2003, the Data Bank registered more than 20 000 accesses to these databases, with the EXFOR database being the most popular (55%), followed by the database for evaluated data (40%) and the CINDA bibliographic database (5%).

The first version of the Java-based nuclear data display program JANIS was released in October 2001 and has since been distributed to more than 700 users. Important feedback has been accumulated and a new version of the software has been developed. A number of improvements and extensions have been incorporated: the development of an internal Java-based database for storage of the data and the inclusion of the CINDA bibliographic data are the most significant.



The JEFF project

Following the release of the JEFF-3.0 General Purpose Library of evaluated nuclear data in April 2002, work in 2003 focused on the testing and benchmarking of the data. The first benchmark results show that the JEFF-3.0 library performs better than the former versions. One of the main

validation efforts is aiming at solving the problem of reactivity under-prediction for LWR lattices, an international study carried out in the International Nuclear Data Evaluation Co-operation framework.

Work on the JEFF-3.0 special purpose libraries on radioactive decay and fission yield data has begun, with the goal of releasing already-tested libraries at the end of 2004 or in the beginning of 2005.

International Nuclear Data Evaluation Co-operation

International Nuclear Data Evaluation Co-operation is a worldwide co-operative effort to improve the quality and completeness of evaluated nuclear data available for use in science and technology and to promote the efficient use of available resources through international collaboration. It initiates joint efforts to help solve outstanding and common nuclear data issues. A report on the status of fission neutron spectra of ^{235}U was published in 2003. The report recommends that a new, accurate measurement of the spectrum be undertaken to help solve noted discrepancies.

The Co-operation also maintains a High Priority Request List (HPRL) for nuclear data. The list is being reorganised in order to better highlight the very high priority requests and to improve the documentation and justification of the requests. The group responsible for the list will periodically review it and interact with both requesters and providers of data to maintain the list up-to-date.

The Thermochemical Database (TDB) Project

The Data Bank is working, together with the NEA Radioactive Waste Management Committee, to develop a database of recommended chemical thermodynamic data for the safety assessment of radioactive waste repositories. The details of this programme can be found in the section "Joint Projects and Other Co-operative Projects" (page 26).



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Legal Affairs

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.

Nuclear legislation and nuclear liability regimes

The Nuclear Law Committee studied detailed information collected via a questionnaire on the ability of nuclear operators to obtain insurance coverage or other financial security for third party liability and material damage resulting from nuclear incidents caused by terrorist acts. It is expected that this information will lead to a better appreciation of the nuclear insurance market as it currently exists in member countries and will, in particular, assist Paris Convention States to meet the new financial security requirements under the revised Convention. While in most countries nuclear operators are able to obtain the required amount of financial security, there are a few countries in which insurance coverage is limited or even unavailable. The Committee will thus continue to seek information, notably on excluded risks and other forms of financial security, in the hope of finding ways to overcome difficulties in this area.

The Nuclear Law Committee continued to closely follow developments in the evolution of a European Community Directive on Environmental Liability, particularly since nuclear operators in member countries that are both EU Members and Paris Convention States could be liable for damage caused by activities falling within the scope of both the Directive and the Convention. Since such a result would conflict with Article 6(c)(ii) of the Convention, those member countries concerned strongly supported the retention of a nuclear damage exclusion clause in the Directive, thereby preventing its application to activities falling within the scope of the Paris Convention.

The Committee also closely monitored the evolution of a European Commission Proposal for a Regulation on Non-contractual Obligations (Rome II), which is designed to extend the harmonisation of private international law in relation to civil and commercial obligations. In particular, member countries are concerned with the potential conflict between the Regulation and those provisions of the Paris Convention which determine the

law to be applied by the court having jurisdiction in respect of nuclear damage claims. Once again, those member countries concerned strongly supported the retention of a proposed nuclear damage exclusion clause in the Regulation itself as the most effective means of avoiding such a conflict.

All outstanding issues relating to the signing of the Protocols to Amend the Paris and Brussels Supplementary Conventions were resolved, including finalisation of the texts in six official languages, definitive adoption of the instruments by their Contracting Parties at the NEA Steering Committee level, conclusion of actions necessary to enable European Community Member States to sign the Protocol to Amend the Paris Convention and preparation of required documentation for the OECD Council.

In addition, the NEA provided significant legal and administrative support to the negotiations between a considerable number of its member countries and the Russian Federation in connection with the adoption of a Framework Agreement and accompanying liability and indemnification Protocol on the Multilateral Nuclear Environmental Programme in the Russian Federation. The signing of both instruments in May will enable nuclear assistance projects in the areas of radioactive waste and spent fuel management and reactor safety improvement to be implemented in Russia. The OECD Secretary-General is co-depository of both instruments.

Information on nuclear law

Issues No. 71 and 72 of the *Nuclear Law Bulletin* were published in June and December 2003, along with their respective Supplements reproducing new nuclear legislation adopted in Bulgaria and Switzerland. This periodical, issued twice per year, provides up-to-date information on recent 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 over the past thirty

- The Nuclear Law Committee studied detailed information on nuclear operators' ability to obtain insurance or other financial security for third party liability and material damage resulting from nuclear incidents caused by terrorist acts.
- The extent and implications of potential conflicts between European Community legislation and member

country obligations under the existing international nuclear liability conventions was examined in detail.

- All remaining issues relative to the signing of the Protocols to Amend the Paris and Brussels Supplementary Conventions were finally resolved.
- The NEA supported the conclusion of negotiations and the signing of the

Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR) Framework Agreement and Protocol.

- The third session of the International School of Nuclear Law was organised at the University of Montpellier 1 and a University Diploma in International Nuclear Law was established.

years 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/.

A new edition of the overview of Nuclear Legislation in Central and Eastern European Countries (CEEC) and the New Independent States (NIS) was finalised in 2003 and will be published in early 2004. This study was first published in 1997 and was updated in 2000 in light of the proliferation of legislative and regulatory texts governing nuclear energy in this geographical region and the interest generated by this phenomenon. Over the past three years, numerous other texts have been promulgated and new international conventions have entered into force in the CEEC and the NIS. It thus appeared timely to produce a fully revised edition of this overview, while also enlarging its scope to now cover eleven CEEC and twelve NIS.

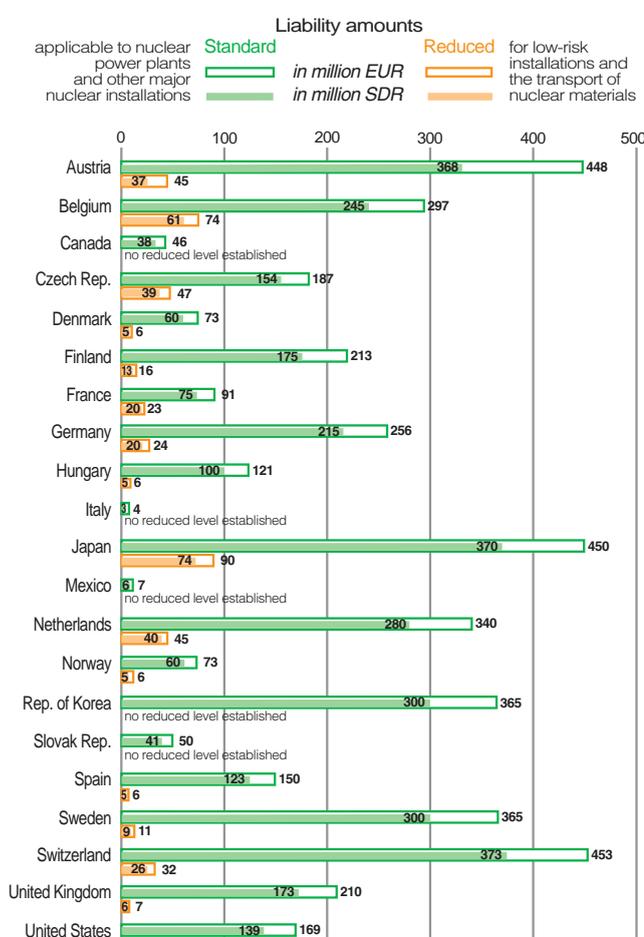
International School of Nuclear Law

The third session of the International School of Nuclear Law (ISNL) was held at the University of Montpellier 1, France, in August-September 2003. The ISNL is jointly managed by the NEA and the University of Montpellier 1 on the basis of close co-operation between these institutions.

The objective of the ISNL is to provide a high-quality course of education on the various aspects of this discipline both to law students and legal professionals. A total of 53 participants from more than 30 countries attended the 2003 programme. The programme consisted of ten days of classes, held in English over a two-week period, and explored the principal topics of international nuclear law.

Shortly before the 2003 session, the governing board of the University of Montpellier 1 authorised the establishment of a University Diploma (*Diplôme d'Université - D.U.*) in International Nuclear Law. Participants in the ISNL programme are entitled to apply for this diploma which is delivered upon

Operator liability amounts under national legislation



This bar graph reflects national legislative requirements with respect to operator liability amounts for third party nuclear damage in all NEA countries, with the exception of Australia, Greece, Iceland, Ireland, Luxembourg, Portugal and Turkey, which have not enacted specific legislation for this purpose. For Austria, Germany, Japan and Switzerland, where the liability amount is unlimited, the bars indicate the amounts of compulsory financial security for the operator. For the United States, this figure represents individual insurance coverage of each operator only.

successful completion of written examinations and satisfactory performance during the course. Over half of all participants applied for the University Diploma after the 2003 session. Plans are currently under way to explore the possibility of arranging the validation of university credits by other universities for participation in this course.

Further information on the 2004 session, scheduled to take place from 23 August to 3 September 2004, and application forms are available on the NEA website at www.nea.fr/html/law/isnl/index.html.



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Joint Projects and Other Co-operative Projects

NUCLEAR DEVELOPMENT

The International Advisory Group (IAG) for the Jules Horowitz Reactor (JHR)

The International Advisory Group (IAG) for the Jules Horowitz Reactor (JHR), established under NDC auspices, met for the first time in November 2003. The objectives of the IAG are to support the establishment of the JHR as an international R&D infrastructure (mainly for material testing but also for other research purposes) for the nuclear industry, and to assist in JHR project monitoring from an international perspective. The second meeting of the IAG is scheduled to take place in September 2004.

The Halden Project operates by way of three-year renewable mandates; the current mandate runs from 2003 to 2005. Unfortunately, a few small, non-penetrating cracks were detected in a segment of the primary reactor piping during a scheduled reactor inspection that took place in June 2003. The investigations and the activities oriented towards the repair work and the recovery of reactor operation started promptly. By the end of the year, the repair was practically completed, including the post-repair inspections. The reactor is expected to return to power in February 2004.

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 technology and know-how to the younger generation.

NUCLEAR SAFETY

The Halden Reactor Project

The Halden Reactor Project has been in operation for more than 40 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 developments and analyses carried out at the Halden establishment in Norway, and is supported by approximately 100 organisations in 20 countries.

The 2003 programme of work in the fuel area continued to focus on high burn-up fuel properties. Experiments addressed the performance of UO₂, gadolinia and MOX fuels in a variety of conditions relevant to operation and licensing. Various cladding alloys were also tested, especially as related to corrosion and creep behaviour. The work included a first in-pile test in preparation of an important loss-of-coolant accident (LOCA) series with high burn-up fuel that will start in 2004. A new test aimed to investigate the cracking behaviour of reactor internals material in BWRs was started in 2003. At the same time, preparations were made for a new PWR test. 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, amongst others, the use of the Halden Virtual Reality Facility.

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 *Institut de radioprotection et de sûreté nucléaire* (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.

Two tests have been carried out so far. They involved fuel with very high burn-up (~70 MWd/kg) and having two types of modern cladding materials. They were subjected to energy injection beyond what is expected for power reactor cases. The fuel examinations after both tests confirmed that the fuel did not fail.

Two meetings of the Technical Advisory Group (TAG) took place in 2003, during which the outcome of the experimental work carried out so far and related analyses were presented and discussed. The TAG also addressed technical issues related to the water loop design and to the tests that will be performed in the future. One meeting of the project Steering Committee was also held in 2003.



P. Stroppa, CEA, France

View of the core at the Cabri research reactor in France.

This focused on the review of the test matrix and of the criteria for selecting the test rods.

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 recommendation of the member countries and the CSNI. It 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.

The tests of the second phase aim to provide experimental information on the phase equilibrium for different corium mixture compositions that can occur in water reactors. This determines the configuration of materials in case of stratified pools and thus the thermal loads on the vessel. In order to enhance the application of MASCA results for 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.

During 2003 there were two meetings of the project steering bodies. In addition, extensive technical discussions and communications with project members took place in connection with the establishment of the Agreement for the new phase of the project. A MASCA seminar will be held in 2004 aiming to review and discuss the results obtained so far.

The MCCI Project

The Melt Coolability and Concrete Interaction (MCCI) Project is managed by the USNRC, 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 2003. The experiments on water ingress mechanisms continued, showing how cooling of the melt by water is affected by the concrete-melt composition. 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. A melt-concrete interaction test was carried out at the end of 2003. It included a device to determine the strength of the solid upper crust, a parameter that is of great interest for modelling and understanding MCCI at plant scale. The evaluation of the results of this test will be performed in 2004. Discussions have taken place in the project steering bodies about test interpretation and on the best way to support the analytical work accompanying the experiments. The USNRC, the ANL and the French CEA have carried out most of the analyses so far.

The SETH Project

The SETH Project is supported by 14 NEA member countries. It started 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,



The RASPLAV cylindrical wall facility during preparations for the MASCA experimental programme.

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 (shutdown conditions) in PWRs. The final report of the PKL tests will be 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. They were prepared during 2003, especially as regards the sophisticated test instrumentation. The experimental series will start in mid-2004 and will continue throughout 2005.

An analytical exercise addressing code predictability – mostly related to the PKL experiments – took place in 2003 by means of a workshop that was convened in Barcelona, Spain. A similar exercise is intended to be carried out for the PANDA tests, involving in particular users of clad failure detection (CFD) codes.

The PKL-2 Project

During 2003, Framatome ANP prepared a proposal for a new test series to be carried out in the PKL facility, which was to constitute the basis of the PKL-2 project. The draft proposal was circulated among potential participants and subsequently revised according to the input received. Discussions on the establishment of this new project were successfully completed towards the end of 2003.

The PKL experiments will 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;
- 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.

The project will start in 2004 and will last three years.

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.

The first two tests of the project were successfully carried out and reported upon in 2003. The test matrix for the remaining part of the programme was discussed and revised by members. Preparations were made also in relation to a blind test exercise where a test would be predicted by calculations before its execution. Two meetings of the project's Programme Review Group were held in 2003 with support of the OECD/NEA.

The Bubbler Condenser Project

The Bubbler Condenser Project was undertaken in December 2001 to resolve remaining issues on bubbler-condenser performance under accident conditions. The experimental part of the project was completed in 2002; the data interpretation and the project's final report were completed in 2003.

The bubbler condenser is a system for VVER 440/213 reactors which is devised to reduce the pressure build-up in the reactor building during a loss-of-coolant accident. The project provided answers on remaining safety research issues by means of in-depth analyses of previous experimental results and of three new experiments carried out at the Electrogorsk Research Center (EREC) in Russia. Regulatory bodies and utilities from the



View of the PKL facility in Germany.

Framatome, France

Czech Republic, Hungary and the Slovak Republic, as well as experts from France, Germany and the United States participated in the project and supported the experimental work with pre- and post-test analyses. The European Union also participated in the project. Czech, Hungarian and Slovak utilities provided the financing for the test programme.

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 is envisaged to include all possible events of interest, comprising 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, reactor protection system circuit breakers, batteries and transmitters.

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 would 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 defenses against their occurrence, such as indicators for risk-based inspections; and to record event attributes to enable quantification of fire frequencies and risk analysis.

The quality coding guidelines and the quality assurance procedure were established in 2003. Thereafter, data acquisition was started.

At present, the project participants are the Czech Republic, Finland, France, Germany, Japan, Spain, Sweden, Switzerland and the United States. Several more are expected to join in the near 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. As an example, raw water systems such as non-essential service water could be a significant flood source given a pipe break. Specific items may be added or deleted upon the unanimous decision of the Project Review Group. Steam generator tubes are excluded from the OPDE project scope.

The project has successfully completed the trial phase and is currently finalising the review of the data already in the database. A first release of the database was distributed to project members in 2003.



Almaraz NPP, Spain

Piping failure can affect both operations and safety in a nuclear power plant. In-service inspection programmes are in place to detect degradation at an early stage.

RADIOLOGICAL PROTECTION

The Information System on Occupational Exposure (ISOE)

Since its start in the early 1990s, ISOE has become a unique worldwide programme to discuss, promote and co-ordinate international co-operative undertakings for the radiological protection of workers at nuclear power plants; a forum for discussing occupational exposure management issues; and the repository of the world's largest database on occupational exposure from nuclear power plants. This joint NEA/IAEA programme is the only one in the field of occupational exposure that enjoys active participation of radiation protection experts from both utilities and national regulatory authorities. This programme supplies data to the European Commission and to UNSCEAR.

At the end of 2003, data in the ISOE programme had grown to include 407 operating commercial nuclear reactors and 59 commercial nuclear reactors in cold-shutdown or some stage of decommissioning, representing 68 utilities in 29 countries. Regulatory authorities from 26 countries participate in ISOE. In 2003, elements of the ISOE system were further consolidated, particularly the data input and data analysis software of the ISOE database on occupational exposure, and the ALARA communication network. To further enhance the use of the system, ISOE performed an evaluation of the programme and reviewed its working procedures. As a result of this evaluation, ISOE decided to offer new ISOE products, such as an ISOE newsletter and selected ISOE products on the web, and to further promote the use of the ALARA communication network. An international ALARA workshop was held in Orlando, Florida, USA to exchange operational dose reduction experience. Finally, ISOE re-approved its Terms and Conditions as valid until the end of 2007.



Electronic dosimetry is part of the radiation dose management system in place in Saclay, France.

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 allow 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 will carry out the subsequent analysis and interpretation of modelling outcomes. In total, 20 modelling teams are participating in the exercise, making it possible to base 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 draft Sorption II 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. Its intended audience is radioactive waste management organisations and regulators, as well as modellers and experimentalists who are involved in performance assessment. As final steps for phase II of the Sorption Project it is foreseen to externally review the draft report and to organise an international workshop to discuss project results.

The Thermochemical Database (TDB) Project

The Thermochemical Database (TDB) Project is designed to help meet the specialised modelling

requirements for safety assessments of radioactive waste disposal sites. As part of the project, chemical thermodynamic data are collected and critically evaluated by review teams of experts. The review teams publish their results in:

- books in the TDB Chemical Thermodynamics Series (five volumes already published, four more in preparation) that serve as extensive reference material, documenting the sources and procedures followed in order to select the recommended data and therefore meeting high standards of transparency and traceability;
- electronic files containing the selected thermochemical data, available from the NEA Data Bank.

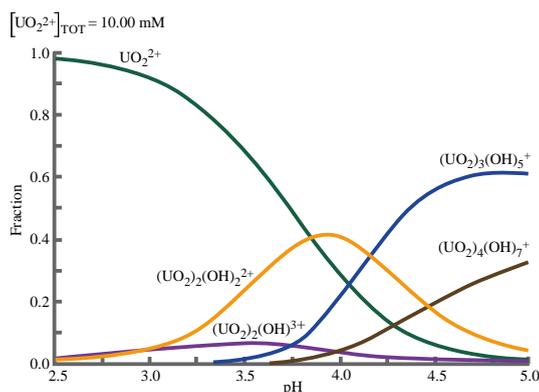
A book in the TDB series entitled *Update on the Chemical Thermodynamics of Uranium, Neptunium, Plutonium, Americium and Technetium* was published in 2003 and is available from Elsevier Science Publisher. Reviews of chemical thermodynamic data for inorganic compounds and complexes of selenium, nickel and zirconium, and of selected organic compounds and complexes of uranium, neptunium, plutonium, americium, selenium, nickel, technetium and zirconium are being finalised.

A new phase of the project was started in 2003 with an exploratory stage, comprising the collection and review of bibliographic references on the inorganic complexes and compounds of thorium, iron, tin and molybdenum. The complete review of these elements will begin in 2004.

The Co-operative Programme on Decommissioning

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. Half way through its fourth 5-year Agreement, the CPD is refocusing its efforts on the exchange of decommissioning experience among its participating projects. This exchange continues to include biannual meetings of the Technical Advisory Group, during which the site of one of the participating projects is visited, and good and bad examples of decommissioning experience are openly exchanged for the benefit of all.

The 42 projects currently in the CPD include the decommissioning of 29 reactors, 9 reprocessing plants, 3 fuel material plants, and 1 isotope handling facility. As a result of the wide variation in the



Examples of a TDB publication on CD-ROM and a graph on speciation in the U(VI) hydroxide system at zero ionic strength.

type of facility being decommissioned and in the environment under which the activity is undertaken, and in order to assist in the comparison of information and experience the focus of the programme has been divided into seven broad areas: inventories, cutting techniques, remote operation, decontamination, melting, and the interfaces between decommissioning and radioactive waste management and radiation protection.

In 2003 the CPD finalised an in-depth review of its 18-year-old Agreement resulting in a consolidation of the Co-operative Agreement and the Amending Protocol regulating the financial aspects of the programme into a single document. This new Agreement, which came into force on 1st January 2004, more clearly defines the scope of the information exchange actions that participants would undertake within the bounds of the Agreement. In addition to this work, the CPD finalised an internal report summarising its first fifteen years of experience. CPD members also contributed to an NEA workshop on decommissioning and participated in the NDC Expert Group on Decommissioning Strategies and Costs. The Technical Advisory Group, through which the Programme's technical and scientific exchanges take place, met twice in 2003.

View of a dismantled reactor vessel in Germany.



Energiewerke Nord GmbH, Germany

Information Programme

Nuclear energy decision making and stakeholder participation need to be based on understanding. The NEA Information Programme 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. It has no commercial interests in the nuclear industry and is not a lobby group. 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. NEA activities cover the full range of the fuel cycle and consider future technological developments. All of these activities are reflected in the Agency's publications and information programme.

Publications

The Agency produced 70 publications in 2003, of which 23 were on sale and 47 were distributed free of charge. The list of these publications is provided on page 36. Best sellers included *Nuclear Energy Today*; *Nuclear Energy Data*; and *Indemnification of Damage in the Event of a Nuclear Accident*. In addition to standard distribution of free publications (some 52 000 copies), over 500 individual requests were received involving the shipment of more than 1 400 reports.



Particular efforts were dedicated to producing *Nuclear Energy Today*, which aims to inform policy makers about the scientific, technical, economic and social issues related to peaceful applications of nuclear energy. The book is based upon studies and analyses carried out by the Agency over several decades in the field of nuclear science and technology, nuclear safety, radiological protection, radioactive waste management, nuclear law, and economic and social aspects of nuclear energy

development. It provides authoritative and factual information on the multiple facets of nuclear energy relevant to national policy making and international co-operation in the field.

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.

Internet-based communication

The NEA website constitutes an important part of the Agency's information programme and is an effective tool for making the Agency's work and the corresponding results widely known. Most visitors come to the site to browse or download reports or to research a specific subject.

The "NEA Press Room" was launched in 2003 primarily to meet the needs of journalists and the staff of policy makers. In addition to the Agency's press releases, this dedicated area of the website includes background information on key nuclear energy issues, which can also be of interest to students and the general public.

A survey of the NEA website was carried out between April and June 2003. Among the main findings (based on responses from users in 43 countries) were that:

- 98% of users were either satisfied or very satisfied with www.nea.fr;
- 0% of users found it difficult to find what they were looking for on the site (87% found it to be easy or very easy);
- 96% of users found NEA publications sufficiently specialised (3% found them too specialised and 1% insufficiently specialised).

The full results of the survey are available upon request addressed to nea@nea.fr. The Agency welcomes additional comments and feedback from website visitors.

■ The Agency produced 70 publications in 2003, of which 23 were on sale and 47 were distributed free of charge.

■ A "Press Room" was added to the NEA website.

■ NEA information and publications stands were organised at six international conferences.

■ The NEA co-sponsored 20 international conferences during 2003.

Visits to the NEA website increased considerably during 2003, growing 22% over 2002. All standard website indicators were also up in comparison with 2002: page views up 172%; downloads up 53%; and visit length up 27%. The most accessed report during 2003 was *Chernobyl: Assessment of Radiological and Health Impacts – 2002 Update of Chernobyl: Ten Years On* (downloaded over 14 000 times), followed by *Nuclear Energy in a Sustainable Development Perspective* and *Society and Nuclear Energy: Towards a Better Understanding*.

The "Delegates' area" on the NEA website continues to provide an important tool 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 4 300 official documents are available in the Delegates' area, 300 of which were added during the year.

Individual subscriptions to the Agency's monthly electronic bulletin continued to grow during 2003, topping 6 200 subscribers by year end (an increase of 700 subscriptions from 2002). The bulletin is distributed free of charge and includes monthly updates on important NEA activities and newly released reports. Subscription requests can be made at www.nea.fr/html/signon.html.

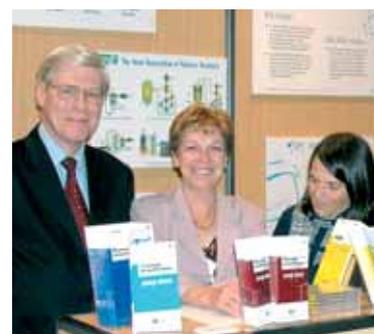
In October the Agency launched a "rich site summary" (RSS) feed to inform users of updates to the NEA website as they are made. The RSS service is a list of headlines with a short description and a link to the updated page or new report on the website. Viewed with software which automatically checks the feed for any updates, the new service has enjoyed an encouraging uptake to date. The contents of each edition of the Agency's monthly electronic bulletin are included in the NEA RSS feed, as well as information about new publications and reports as they are released.

NEA visibility in international fora

NEA information and publications stands were organised at six international conferences in 2003:



NEA information and publications stands at the IEA Ministerial Meeting and Energy Technology Fair. Above: Loyola de Palacio (EC) and Luis Echávarri; right: Jacques de la Ferté, Solange Quarneau and Evelyne Bertel.



- the International Energy Agency (IEA) Ministerial Meeting and Energy Technology Fair (April 2003, Paris, France);
- "Supercomputing in Nuclear Applications" SNA 2003 (September 2003, Paris, France).
- the 7th International Conference on Nuclear Criticality Safety (October 2003, Tokai-mura, Japan);
- the ANS Winter Meeting and Global 2003 (November 2003, New Orleans, LA, USA);
- "Decommissioning Challenges: An Industrial Reality?" (November 2003, Avignon, France);
- the Ninth Conference of the Parties to the UN Framework Convention on Climate Change, COP9 (December 2003, Milan, Italy).

The NEA also co-sponsored 20 international conferences. It was particularly implicated in the international conference on "Geologic Repositories: Political and Technical Progress" held on 8-10 December in Stockholm, Sweden. The conference aimed to further strengthen international co-operation for the safe, secure and environmentally sound disposal of radioactive materials.



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Nuclear Energy and Civil Society



NEI, United States

Understanding and dialogue are key elements in building trust.

Nuclear energy is among those industrial activities that are particularly challenged to show transparency and accountability in decision making. Care must be taken to address citizens' concerns over its potential implications, particularly for public health and safety, including in respect of future generations. The NEA began studying specific aspects of the issue of nuclear energy and civil society two decades ago, and more recently several of the Agency's standing technical committees have launched activities that aim to analyse national and local experience and to communicate lessons learnt. NEA activities currently under way are briefly described below.

Society and nuclear energy policy

The NEA Expert Group on Society and Nuclear Energy began work on a study intended to provide policy makers with findings, guidance and recommendations on communication and consultation with civil society in connection with nuclear energy policy decisions. The Group intends to map the processes used or intended to be used in member countries, and to analyse consultation and communication experience. Preliminary findings will be discussed at a workshop to be organised in 2004.

Nuclear regulators and the public

Regulatory bodies, in fulfilling their responsibilities to inform the public about their role in contributing to nuclear safety, face increasing communication needs. At the same time, good governance and efficiency in decision making by government authorities are increasingly dependent upon mutual trust and confidence between those authorities and the public. It was in this context that the NEA Working Group on Public Communication of Nuclear Regulatory Organisations was established in June 2001.

In 2003, the working group discussed such topics as public communication in relation to the April 2003 Paks-2 incident in Hungary; the public impact of the April 2003 HSK (Swiss nuclear safety

authority) report on aircraft attacks of nuclear power plants; lessons learnt from the Swiss vote in May 2003 in favour of nuclear power; Swedish public opinion of nuclear power; and follow-up to inspection findings on core internals in Japan. Preparations were also undertaken to organise a workshop on "Building, Measuring and Improving Public Confidence in the Nuclear Regulator", to be held in Ottawa, Canada in May 2004.

Stakeholder participation in decision making involving radiation

The NEA Committee on Radiation Protection and Public Health (CRPPH) has explored in detail the implications of stakeholder involvement in decision-making processes for several years and held important workshops in this area in 1998, 2001 and 2003. Specific case studies have been analysed to extract commonalities of stakeholder involvement process aspects that, to some extent, transcend geographic and cultural frontiers.

The CRPPH organised the 1st Villigen Workshop in January 1998 on "Societal Aspects of Decision Making in Complex Radiological Situations", which reached the broad conclusion that radiological protection must adapt to meet the needs of society, and not the reverse. To deepen the understanding of this important subject, the CRPPH launched further studies that resulted in the organisation of the 2nd Villigen Workshop, held in January 2001, on "Better Integration of Radiation Protection in Modern Society". This workshop concluded that although broad stakeholder participation was not needed to reach agreement in the vast majority of regulatory decisions, it can be the best and sometimes only way to achieve agreement in certain blocked situations. In addition, the workshop showed that it is important to develop a common understanding of stakeholder roles and responsibilities, to distinguish clearly between scientific knowledge and social judgement, and to foster an atmosphere of mutual learning.

These analyses were used as fundamental input to the 3rd Villigen Workshop on "Stakeholder Participation in Decision Making Involving Radiation: Exploring Processes and Implications", which took place in October 2003. Although the results of this workshop are still preliminary, case studies appear to show that focusing on the sustainability of a decision is a key aspect. This means that it is essential to clearly understand the concerns of stakeholders, and to identify the common values of all parties to create a "natural decisional framework"

in which an agreed solution can be identified. This requires, however, that decisions strike a balance between national policy and local stakeholder needs. It is also essential that, early in the process, stakeholders clearly understand how their input will be taken into account in the final decision, and who is, in fact, mandated to “make a decision”. The NEA will perform a thorough analysis of the results of this workshop and publish the results in 2004.

Given the growing importance of stakeholder interactions in risk governance, the roles of the radiological protection professional as scientist, regulator and decision maker, would seem to merit further study. Stakeholder aspects also form an essential element in the evolution of the system of radiological protection. This work will therefore also serve as NEA input to the discussions of the International Commission on Radiological Protection (ICRP) on new recommendations for the system of radiological protection.

Stakeholder participation in radioactive waste management

Issues of public perception and confidence have been most critical in gaining approval for the development of repositories for long-lived radioactive waste at specific sites, which raises the question of how best to achieve confidence regarding the ethical, economic, political and technical aspects of a waste management strategy, and disposal in particular. The “public”, however, is not a homogeneous group, and its various components and the concerns they have need to be better identified and understood. The NEA Forum on Stakeholder Confidence (FSC) facilitates the sharing of experience in addressing the societal dimensions of radioactive waste management.

The FSC workshops held in national context have proven to be successful instruments for sharing national experience in interacting with stakeholders. Last year, the FSC organised its third workshop of this series in Belgium, following previous experiences in Finland and Canada. The workshop examined how to deal with different interests, values and knowledge in managing risk. It centered on innovative “local partnerships” established between the national RWM agency ONDRAF/NIRAS and four local communities that are developing integrated concepts for the safe, long-term management of low-level waste. As customary for FSC workshops in national context, the FSC delegates also had the opportunity to visit each partnership and interact with the local stakeholders.

Under the aegis of the FSC, a survey on *Public Information, Consultation and Involvement in Radioactive Waste Management* was prepared which benchmarks stakeholder involvement practices by radioactive waste management institutions and gives an international overview of approaches and experiences in this area. The analysis of this material gave insights into generic elements for credibility and effective means of communicating; it also showed that perceptions, values and interests are the most important factors influencing stakeholders’ attitude. An important aspect is that stakeholders should be afforded opportunities to interact as early as possible in the process. The process by which proposals are brought forward must also be trusted, and decisions made with sensitivity to local concerns. The report provides a valuable baseline of detailed information on stakeholder dialogue, consultation and information practices. Important developments or events are taking place quickly, however, and the information communicated in this survey represents a snapshot within an evolving picture.

The survey also showed that the regulatory and licensing bodies have a very important role to play in all phases of a high-level waste (HLW) programme. The success of public outreach programmes hinges, in large measure, on the extent to which regulators effectively make their presence and role known, and communicate their independence – showing the capacity to make their own evaluations and the integrity to put forward their requirements.

The FSC analysed the regulator’s evolving role and image in radioactive waste management and provided a summary of the lessons learnt by regulatory authorities in carrying out their mission. It noted that amongst all the institutional actors in the field, it is perhaps the regulatory authorities that have restyled their roles most significantly, beginning to overturn the traditional worldwide approach according to which regulators should not be too intensely involved, if at all, since that might bring their independence into question. Today’s experience shows, however, that the regulators can play an active role with involvement in the community processes while maintaining independence for later licensing actions. Ideally, and subject to any legal constraints, the regulators should be “guarantors” of safety and the “peoples’ expert”, acting as an accessible resource for stakeholders. To be fully effective in carrying out their mission, regulators need not only to be independent, competent and reliable; they must also strive to obtain the confidence and trust of stakeholders and the public at large.



NEA Publications Produced in 2003

General interest

Annual Report 2002

ISBN 92-64-02129-9 – Available on the web.

Catalogue of Publications 2003-2004

Free: paper or web versions.

NEA News – 2003, No. 21.1 and No. 21.2

ISSN 1605-9581 – 2003 subscription: € 43, US\$ 43, £ 27, ¥ 5 020.

Nuclear Energy Today

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

Nuclear development

Actinide and Fission Product Partitioning and Transmutation

Seventh Information Exchange Meeting, Jeju, Republic of Korea, 14-16 October 2002

ISBN 92-64-02125-6 – Free: paper or web versions.

Decommissioning Nuclear Power Plants

Policies, Strategies and Costs

ISBN 92-64-10431-3 – Price: € 40, US\$ 46, £ 27, ¥ 5 100.

Nuclear Electricity Generation: What Are the External Costs?

ISBN 92-64-02153-1 – Free: paper or web versions.

Nuclear Energy Data – 2003

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

Nuclear safety

Collective Statement Concerning Nuclear Safety Research

Good Practice and Closure Criteria

ISBN 92-64-02149-3 – Free: paper or web versions.

CSNI Technical Opinion Papers No. 3 – Recurring Events

ISBN 92-64-02155-8 – Free: paper or web versions.

Regulator and Industry Co-operation on Nuclear Safety Research

Challenges and Opportunities

ISBN 92-64-02126-4 – Free: paper or web versions.

Nuclear regulation

Nuclear Regulatory Review of Licensee Self-assessment (LSA)

ISBN 92-64-02132-9 – Free: paper or web versions.

Regulatory Challenges of Decommissioning Nuclear Reactors (The)

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

Radiological protection

Effluent Release Options from Nuclear Installations

Technical Background and Regulatory Aspects

ISBN 92-64-02146-9 – Free: paper or web versions.

Future Policy for Radiological Protection (The)

Workshop Proceedings, Lanzarote, Spain, 2-4 April 2003

ISBN 92-64-10570-0 – Price: € 27, US\$ 31, £ 19, ¥ 3 700.

New Approach to Authorisation in the Field of Radiological Protection (A)

The Road Test Report

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

Occupational Exposure Management at Nuclear Power Plants

Third ISOE European Workshop, Portoroz, Slovenia, 17-19 April 2002

ISBN 92-64-02135-3 – Free: paper or web versions.

Possible Implications of Draft ICRP Recommendations

ISBN 92-64-02131-0 – Free: paper or web versions.

Radiological Protection of the Environment

Summary Report of the Issues

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

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

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

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

Short-term Countermeasures in Case of a Nuclear or Radiological Emergency

ISBN 92-64-02140-X – Free: paper or web versions.

Radioactive waste management

Engineered Barrier Systems and the Safety of Deep Geological Repositories

State-of-the-art Report

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

Engineered Barrier Systems (EBS) in the Context of the Entire Safety Case

Workshop Proceedings, Oxford, UK, 25-27 September 2002

ISBN 92-64-10354-6 – Price: € 45, US\$ 52, £ 30, ¥ 5 700.

Features, Events and Processes Evaluation Catalogue for Argillaceous Media

ISBN 92-64-02148-5 – Free: paper or web versions.

French R&D Programme on Deep Geological Disposal of Radioactive Waste (The)

An International Peer Review of the "Dossier 2001 Argile"

ISBN 92-64-02136-1 – Free: paper or web versions.

Public Confidence in the Management of Radioactive Waste: The Canadian Context

Workshop Proceedings, Ottawa, Canada, 14-18 October 2002

ISBN 92-64-10396-1 – Price: € 45, US\$ 52, £ 30, ¥ 5 700.

Public Information, Consultation and Involvement in Radioactive Waste Management

An International Overview of Approaches and Experiences

ISBN 92-64-02128-0 – Bilingual – Free: paper or web versions.

Regulator's Evolving Role and Image in Radioactive Waste Management (The)

Lessons Learnt Within the NEA Forum on Stakeholder Confidence

ISBN 92-64-02142-6 – Free: paper or web versions.

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

An International Peer Review

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

Nuclear law

Indemnification of Damage in the Event of a Nuclear Accident

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

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

Nuclear Law Bulletin No. 71, Volume 2003/1 + Supplement to No. 71: Bulgaria

Nuclear Law Bulletin No. 72, Volume 2003/2 + Supplement to No. 72: Switzerland

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

Nuclear science

Benchmark on Beam Interruptions in an Accelerator-driven System

Final Report on Phase I Calculations

ISBN 92-64-02138-8 – Free: paper or web versions.

Benchmark on Deterministic Transport Calculations Without Spatial Homogenisation

A 2-D/3-D MOX Fuel Assembly Benchmark

ISBN 92-64-02139-6 – Free on request (paper version includes a CD-ROM).

Burn-up Credit Criticality Benchmark

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

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

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

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

Complete Collection of Published Reports as of May 2003 (CD-ROM)

Free on request.

International Evaluation Co-operation

Volume 9: Fission Neutron Spectra of Uranium-235

ISBN 92-64-02134-5 – Free: paper or web versions.

International Nuclear Data Evaluation Co-operation

Complete Collection of Published Reports as of October 2003 (CD-ROM)

Free on request.

Physics of Plutonium Recycling

Volume VII: BWR MOX Benchmark – Specification and Results

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

Plutonium Management in the Medium Term

A Review by the OECD/NEA Working Party on the Physics of Plutonium Fuels and Innovative Fuel Cycles (WPPR)

ISBN 92-64-02151-5 – Free: paper or web versions.

Pressurised Water Reactor Main Steam Line Break (MSLB) Benchmark

Volume IV: Results of Phase III on Coupled Core-plant Transient Modelling

ISBN 92-64-02152-3 – Free: paper or web versions.

Research and Development Needs for Current and Future Nuclear Systems

ISBN 92-64-02159-0 – Free: paper or web versions.

Update on the Chemical Thermodynamics of Uranium, Neptunium, Plutonium, Americium and Technetium

A Critical Review by the OECD/NEA Thermochemical Database Project

ISBN 0-444-51401-5 – Co-edition with Elsevier (paper copy includes a CD-ROM) – Price: € 260, £ 173.50.

Utilisation and Reliability of High Power Proton Accelerators

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

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

Data Bank

CINDA 2003

The Index to Literature and Computer Files on Microscopic Neutron Data

ISBN 92-64-02144-2 – Free: paper or web versions.

PENELOPE 2003 - A Code System for Monte Carlo Simulation of Electron and Photon Transport

Workshop Proceedings, Issy-les-Moulineaux, France, 7-10 June 2003

ISBN 92-64-02145-0 – Free: paper or web versions.



Cogema, France

Recent discussions on the future system of radiological protection have been giving greater attention to environmental considerations.

Main Workshops and Seminars Held in 2003

April

02-04 The Future Policy for Radiological Protection: A Stakeholder Dialogue on the Implications of the ICRP Proposals – Lanzarote, Spain.

June

17-18 Measuring, Assessing and Communicating Regulatory Effectiveness – Paris, France.

23-24 Redefining the Large-break LOCA: Technical Basis and its Implications – Zurich, Switzerland.

August

26-29 Engineered Barrier Systems (EBS) Workshop on Design Requirements and Constraints – Turku, Finland.

September

02-03 SETH Workshop on Code Analysis – Barcelona, Spain.

02-04 International Seminar on Strategy Selection for the Decommissioning of Nuclear Facilities – Tarragona, Spain.

September

11-12 Information Exchange Meeting on Basic Studies in the Field of High-temperature Engineering – Oarai, Japan.

25-26 Workshop on Common Tools for Deterministic Transport, Monte Carlo and Hybrid Codes – Issy-les-Moulineaux, France.

October

02-03 Information Exchange Meeting on Nuclear Production of Hydrogen – Argonne National Laboratory, Illinois, United States.

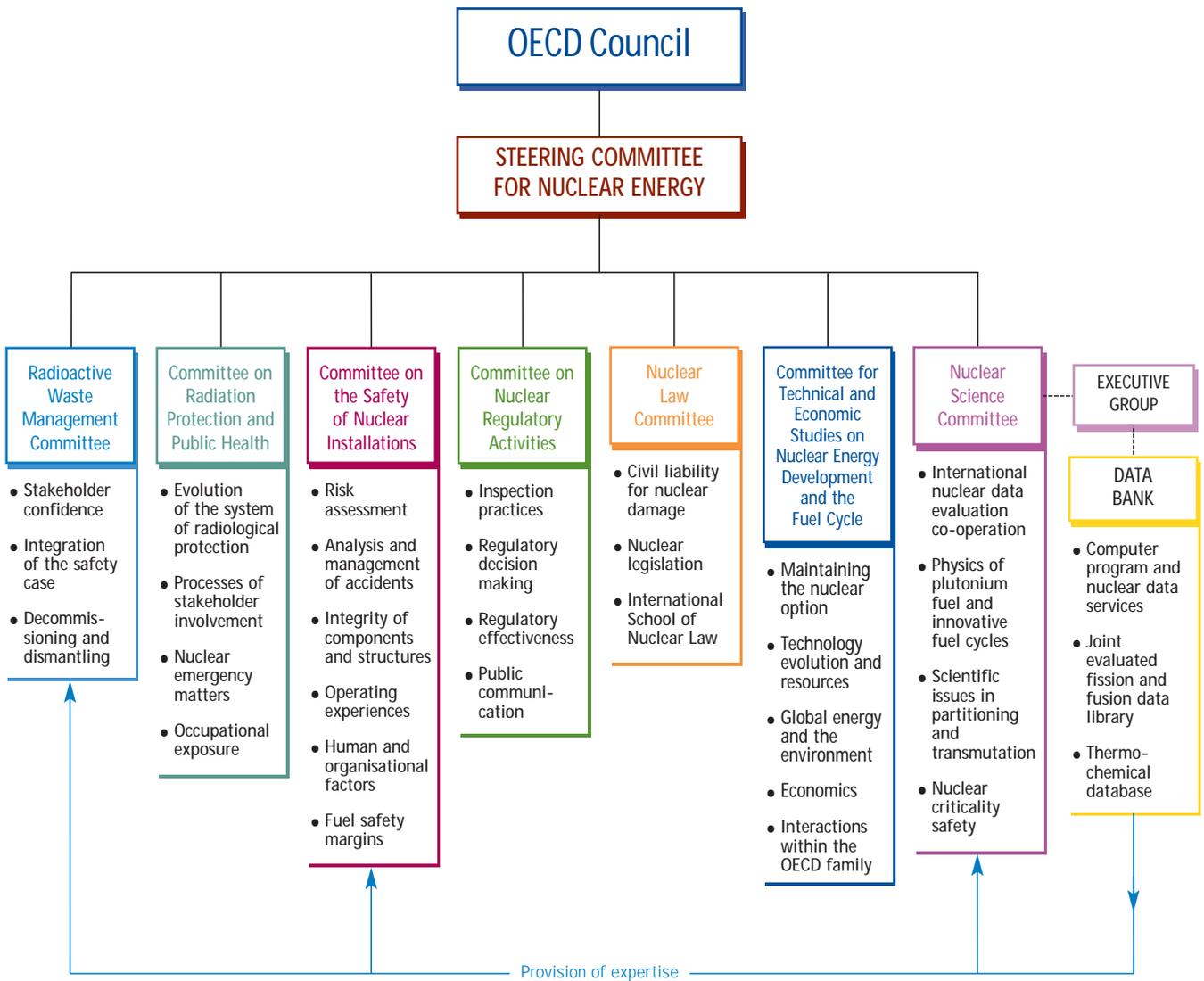
06-08 Modifications at Nuclear Power Plants: Operating Experience, Safety Significance and the Role of Human Factors and Organisations – Paris, France.

21-23 Stakeholder Participation in Decision Making Involving Radiation: Exploring Processes and Implications – Villigen, Switzerland.

November

18-21 4th Workshop of the NEA Forum on Stakeholder Confidence (FSC): Dealing with Interests, Values and Knowledge in Managing Risk – Brussels, Belgium.

Organisation Charts of the NEA



NEA Secretariat Structure in 2003



Director-General
Luis Echávarri



**Deputy
Director-General**
Carol Kessler

*Through to August 2003. Post to be held
by Gail H. Marcus from April 2004.*



**Safety and
Regulation**
Kazuo Shimomura
Deputy Director



**Science and
Development**
Thierry Dujardin
Deputy Director



**Central Secretariat,
Information and
Publications**
Jacques de la Ferté
Head

*Retired (October 2003). Post to be held
by Karen Daifuku from January 2004.*



**Legal
Affairs**
Patrick Reyners
Head



**Management
Support Unit**
John Hembury
Head



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



**Nuclear
Safety**
Gianni Frescura
Head of Division

*In memoriam (June 2003). Post to be
held by Javier Reig from January 2004.*



**Nuclear
Development**
Peter Wilmer
Head of Division



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

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14 December 1960, and which came into force on 30 September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became members subsequently through accession at the dates indicated hereafter: Japan (28 April 1964), Finland (28 January 1969), Australia (7 June 1971), New Zealand (29 May 1973), Mexico (18 May 1994), the Czech Republic (21 December 1995), Hungary (7 May 1996), Poland (22 November 1996), Korea (12 December 1996) and the Slovak Republic (14 December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1 February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20 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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