

NEA 2009

Annual Report



NUCLEAR ENERGY AGENCY
Organisation for Economic Co-operation and Development

The NEA in Brief

Governing body: the Steering Committee for Nuclear Energy

- 28** member countries
(22 in the Data Bank)
- 51** years of international service
- 7** standing technical committees
- 21** international joint projects funded by participants
- 71** professional and support staff
(NEA and the Data Bank combined)
- 556** national experts participating in NEA committees
- 3 600** experts participating annually, on average, in policy and technical meetings organised at OECD headquarters
- € 10.4** million budget for the NEA in 2009,
supplemented by voluntary contributions
- € 3.0** million budget for the Data Bank in 2009,
supplemented by voluntary contributions
- 54** publications produced in 2009

The NEA and its mission

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

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

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Message from the Director-General

2009 was a very busy year for the NEA, following on from the success of its 50th anniversary and the launching of the *Nuclear Energy Outlook* in late 2008. As the renewed interest in nuclear energy continued to grow, the Agency actively supported international co-operation and initiatives addressing the challenges and benefits of nuclear energy. A few of these merit highlighting.

In the face of potential disruptions to the supply of medical radioisotopes, critical to the health of millions around the world, on very short notice the NEA was successful in bringing together over 80 experts from 13 OECD countries and 3 non-OECD countries to address present and future challenges to reliability of supply. With the government of Canada playing a key role, steps were taken to create an NEA High-level Group on the Security of Supply of Medical Radioisotopes which is working in close co-operation with international organisations, governments, policy and regulatory officials, specialists in nuclear medicine, health industry professionals and nuclear research reactor operators. The group's efforts have already contributed to help improve the supply situation and international coordination.

The Agency also contributed to the success of the second IAEA International Ministerial Conference on Nuclear Energy in the 21st Century hosted by the Chinese government in Beijing. The OECD Secretary-General, Mr. Angel Gurría, delivered a keynote speech at the opening session, stressing in particular the contribution of nuclear energy to the security of energy supply and to the abatement of CO₂ emissions.

The NEA is in charge of the Technical Secretariat of the Multinational Design Evaluation Programme (MDEP), a unique international initiative aiming at enhancing co-operation on safety design reviews of new reactors and identifying opportunities for possible harmonisation and convergence on safety licensing review practices and requirements. The MDEP gained momentum and public recognition in 2009 with the success of the first MDEP conference, organised by the NEA at the OECD Conference Centre in order to share the first outcomes of this project among regulators, vendors, operators and standardisation organisations.

The NEA also runs the Technical Secretariat of the Generation IV International Forum (GIF), an international endeavour involving 13 countries aiming to carry out the research and development (R&D) needed to establish the feasibility and performance capabilities of the next generation of nuclear energy systems. The NEA organised the first GIF symposium in Paris, which provided an opportunity to widely communicate the achievements and goals for the six systems under consideration.

In addition to these outstanding events and initiatives prevails the core programme of work of the Agency which is reflected in this *Annual Report*. Readers will find out how the NEA continued in 2009 to provide state-of-the-art analyses and remained at the forefront on a wide range of nuclear issues, including nuclear safety and regulation, nuclear economics, nuclear law, radioactive waste management, radiological protection and nuclear science. Further, the Agency operates a unique Data Bank and manages several international joint projects.

This intense activity would not have been possible without the political support of the NEA member countries, the technical input of NEA experts and the dedication of NEA staff. I would like to reiterate my thanks to all of them, who made the NEA's achievements in 2009 a shared success.



Luis E. Echávarri
NEA Director-General



Nuclear Power in 2009

Nuclear energy development

At the end of 2009, a total of 343 reactors were connected to the grid in OECD countries, constituting about 83% of the world's total nuclear electricity generating capacity and about 22% of the total electricity supply in the OECD area. During 2009, one new reactor was connected to OECD country grids (Tomari-3, Japan) and three were shut down (Hamaoka-1 and 2, Japan and Phenix, France); construction was initiated (first concrete poured) on one reactor (Shin-Kori-4, Republic of Korea).

Although nuclear energy policies can vary widely in OECD countries, ranging from phase-out policies to clear commitments to maintain nuclear power as a significant component of the energy mix, the gap is narrowing, as governments in Germany and Sweden, among others mentioned below, are actively reconsidering such restrictions. This is largely due to an increased recognition of nuclear power's ability to enhance security of energy supply and to provide competitively priced, baseload electricity that is essentially free of greenhouse gas emissions and supported by the safe operation of the existing fleet of power reactors. Some of the significant developments that occurred in OECD countries in 2009 are:

- In Belgium, the government agreed to extend the lifetime of its three oldest reactors by ten years until 2025, in exchange for annual payments from the operators amounting to between 215 and 245 million euros.
- In the Czech Republic, a draft State Energy Concept was released calling for a significant increase in the share of nuclear power in electricity production. In August 2009, a public tender was launched to select

a contractor for the construction of two additional reactors at the Temelin site.

- In Hungary, parliament overwhelmingly granted preliminary approval to begin detailed preparation for the construction of new nuclear generating capacity at the existing Paks plant.
- In Italy, the adoption of new energy legislation in July 2009 officially ended the moratorium on nuclear energy and cleared the way for plans to build new nuclear power plants, with the long-term goal of providing 25% of the country's total electricity production.
- In Poland, the government adopted a resolution according to which a nuclear power programme shall be developed. Plans include the construction of two reactors for electricity generation, the first of which would be online by 2020.
- In the Slovak Republic, work continues to complete the construction of two reactors at the Mochovce site, where work had been halted in 1992. The government has proposed the construction of an additional two reactors, one of which at the Bohunice site where the Czech power company ČEZ has been selected to form a partnership for the construction project.
- In Spain, the nuclear regulator approved a government request to extend the lifetime of the Garona nuclear reactor (the country's oldest) by four years.
- In the United Kingdom, a draft Nuclear National Policy Statement, including a list of ten sites deemed potentially suitable for the construction of new nuclear power plants by the end of 2025, was issued by the government as part of an effort to remove unnecessary planning delays for large energy projects.

2009 Nuclear Data Summary (as of 31 December 2009)

	Operational reactors	Installed capacity (GWe net)	Uranium requirements (tonnes U)	Nuclear share of electricity production (%)
Belgium	7	5.9	1 135	51.7
Canada	20	12.7	1 600	14.8
Czech Republic	6	3.7	1 040	35.8
Finland	4	2.7	660	33.1
France	58	63.1	8 000	75.1
Germany*	17	20.4	2 600	23.4
Hungary	4	1.9	425	43.5
Japan	54	47.0*	8 870	26.0*
Mexico	2	1.4	154	4.4
Netherlands	1	0.5	60	3.2
Republic of Korea*	20	17.7	3 000	36.7
Slovak Republic	4	1.7	363	54.4
Spain	8	7.5	679	17.5
Sweden*	10	9.0	1 574	42.0
Switzerland*	5	3.2	278	39.0
United Kingdom*	19	10.1	951	13.2
United States*	104	100.7	16 424	19.6
Total (OECD)	343	309.2	47 813	21.5*

* 2008 data. Operational = connected to grid.

- In the United States, resumed construction continues of the Watts Bar-2 reactor (initially suspended in 1988), and the Department of Energy (DOE) issued a final rule in the loan guarantee programme that paves the way for federal support for clean energy projects that use innovative technology, including nuclear power. However, the new administration announced the termination of the proposed Yucca Mountain spent nuclear fuel repository, indicating that a better solution for radioactive waste disposal would have to be developed.

As governments continue to develop nuclear energy initiatives, the ongoing global financial crisis, combined with the highly capital-intensive nature of investments in nuclear power have caused delays in their development. For example, new nuclear build projects in Canada and Turkey were postponed in 2009, at least in part due to financial reasons. Concerns about the cost of building new reactors in the United Kingdom and the United States have also been expressed.

In non-OECD countries, the Ignalia-2 reactor in Lithuania was shut down as a condition for entry into the European Union. In Bulgaria, the government put the Belene new build project under review due to rising costs, and the German utility RWE opted out of the partnership founded to construct the two reactors. One reactor was commissioned in India, and construction was initiated for nine reactors in China and one in the Russian Federation, in support of plans for a robust expansion of nuclear electricity generating capacity in these three countries. This brings the total number of reactors currently under construction in the world to 55. A consortium from the Republic of Korea was selected as the winning bidder to design, build and help operate four 1 400 MWe reactors in the United Arab Emirates.

Uranium production, conversion and enrichment

Preliminary, unofficial data indicate that global uranium production rose by about 15% in 2009, principally owing to significant increases in Kazakhstan. Uranium was produced in seven OECD countries in 2009. France, Germany and Hungary contributed only small amounts as part of mine remediation activities. Australia (16%), Canada (20%), the Czech Republic (<1%) and the United States (3%) together accounted for a significant share of world production. Production in OECD countries amounted to approximately 19 885 tonnes of uranium (tU) in 2009 (an increase of almost 3% from 2008), accounting for roughly 40% of uranium requirements in the OECD area. Remaining requirements were met by non-OECD production and secondary sources (material derived from dismantling warheads, excess commercial inventories and reprocessed uranium).

The spot price of uranium reached a peak of USD 354/kgU in June 2007, then declined to about USD 138/kgU in December 2008, partially due to the economic downturn. During 2009, the spot price varied between roughly USD 105/kgU and USD 135/kgU, as upward pressure for new reactor fuel (notably in China) was offset by the impending release of DOE inventory material. Long-term price indicators declined from about USD 185/kgU to USD 155/kgU. Uranium exploration and mine development activity continued in many countries. However, the challenging financial setting, as

well as technical and permit issues, caused delays in OECD countries.

During 2009, uranium conversion facilities continued to operate in France, the United Kingdom and the United States. Operations in Canada were restarted after a six-month shutdown owing to a contract dispute with a major supplier. Construction of additional conversion capacity continued in France.

Construction of two new uranium centrifuge enrichment plants continued, one at AREVA's Georges Besse II facility in France, where rotation of the first cascade occurred in November 2009, and another at Louisiana Energy Services' National Enrichment Facility (NEF) in the United States, where construction remains on schedule and on budget for expected operation in 2010. Elsewhere in the United States, the US Enrichment Corporation stopped development of its new plant using the American centrifuge design after receiving notice that it would not be eligible for a DOE loan guarantee. The GE-Hitachi Global Laser Enrichment project continued, with an application having been made to license a full-scale commercial facility.

Nuclear safety and regulation

In 2009, the safety performance of nuclear power plants in OECD countries remained at a very high level, as in previous years. The main elements supporting this achievement are a mature industry, a robust regulatory system and a strong foundation of research. The number of nuclear power plants reaching the end of their initial design life is increasing and lifetime extensions continue to be an approach adopted by many OECD countries. The NEA continues to support regulatory authorities in their review of the adequacy of long-term operation and ageing management methods.

NEA countries agree that safety assessment and 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. Nuclear regulatory authorities and nuclear safety research institutions also continue to review operating experience feedback and to implement appropriate and timely corrective action programmes.

At the same time, several countries are licensing new reactors and NEA countries are promoting several initiatives, including the establishment of multinational programmes, to improve the efficiency of the design review of new nuclear power plants, and to share experience related to the regulation of new reactors. The initiatives seek to enhance nuclear safety worldwide, by promoting convergence on safety practices and by combining the expertise of participating regulatory authorities, while improving and expediting the safety review of new designs.

Radioactive waste management

In 2009, the new US administration announced its intention to terminate the Yucca Mountain programme and to convene a "blue ribbon" panel of experts to evaluate alternative approaches for meeting the federal responsibility to manage and ultimately dispose of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) from both com-

mercial and defence activities. The Yucca Mountain site was approved by the US President in 2002 after more than 20 years of site characterisation activities and after a joint resolution was passed by Congress for developing a repository. The US Department of Energy (DOE) submitted the license application to the US Nuclear Regulatory Commission (NRC) in June 2008, starting a three- to four-year review period for the NRC before deciding on the construction license – a decision that, if taken, will likely not be acted upon.

The Blue Ribbon Commission is to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle. It is expected to provide advice and to make recommendations on issues including alternatives for the storage, processing and disposal of civilian and defence-related spent nuclear fuel and radioactive waste. The Commission which is made up of 15 members who have a range of expertise and experience in nuclear issues, including scientists, industry representatives and former elected officials, has been tasked with producing an interim report within 18 months and a final report within 24 months.

Other national geological waste repository programmes are moving forward successfully. The Swedish Nuclear Fuel and Waste Management Company (SKB) has selected Forsmark as the site for the final repository of Sweden's spent nuclear fuel. Before construction work can begin, SKB must apply for a licence from the government, which it plans to do in 2010. The application will include an environmental impact assessment and a safety analysis of the repository. All spent nuclear fuel from Swedish nuclear power plants is planned to be disposed of in the final repository at a depth of nearly 500 metres in crystalline bedrock. In addition to the future repository, the system for managing spent nuclear fuel will also include the existing interim storage facility and an encapsulation plant in Oskarshamn, which was the second candidate site for the repository.

In Finland, the access tunnel of the ONKALO rock characterisation facility has nearly reached its final depth. In implementing ONKALO, requirements for a final disposal facility are already being taken into consideration. Submission of the construction licence application for the repository is planned for 2012. Finally, the new German government formed in October committed itself to pursuing action to end the moratorium on site exploration of the Gorleben salt dome. Further investigation of the salt dome in an open-ended manner should allow an assessment of the suitability of the site for a geological repository for spent nuclear fuel and high-level radioactive waste. Regarding repositories for long-lived, low- and intermediate-level waste, important milestones were reached in the siting of such facilities in France and Slovenia. Approximately 40 communities in the Aube District of France applied to host a low-level waste repository. In Slovenia, a decree confirming the location of a low- and intermediate-level waste repository in the municipality of Krško, in the vicinity of the Slovenian nuclear power plant, was passed by the government.

Radiological protection

During 2009, radiological protection practitioners became more familiar with the new International Commission on

Radiological Protection (ICRP) recommendations published in 2008 and began assessing their practical ramifications. The latter are being raised in the ongoing discussions of the new International Basic Safety Standards (BSS), but also in discussions of how best to manage exposures to radon, and how to manage medical exposures better. The application of the new system of radiological protection in the context of an expanding nuclear fleet was also a key topic of discussion.

While the new ICRP recommendations maintain the pillars of justification of actions, optimisation of protection and limitation of exposures, the focus of the system is now squarely on optimisation. With this heightened understanding, the drafting of the new BSS during 2009 began to draw to a close. The BSS are seen by many as the instrument for practical implementation of the ICRP recommendations and a model or framework for the development or modification of binding national regulations. It is now expected that the draft BSS will be ready for final review and approval during 2010. The draft text reflects the importance of optimising protection in all exposure situations (planned, emergency and existing).

The management of public and worker exposures from nuclear power plants continues to help reduce exposures, suggesting that the processes and structures for optimising protection have been very effective. As many NEA member countries consider the introduction or expansion of a nuclear power programme, new challenges for the regulation of public and occupational exposure will arise. For example, many plants have been granted licences for lifetime extensions such that an increasing trend in maintenance requirements will need to be addressed in order to maintain exposures at levels that are as low as reasonably achievable (ALARA). In the context of new nuclear build, a concerted effort to incorporate current experience into new plant design will be necessary. This will include both plant-design features as well as procedural aspects. The management of radioactive effluents, to control public exposures, has been effectively carried out using a best available techniques (BAT) approach.

Recent epidemiological studies have shown that between 3% and 15% of all lung cancer deaths may be the result of domestic exposure to radon, with approximately two-thirds of these occurring in homes where the average radon concentration is less than 200 Bq/m³. While the relative risk cited in these recent studies is consistent with previous understanding, the identification of statistically significant cancer deaths at such low exposures is new. The challenge to governments and regulatory authorities is that many countries have selected their radon action levels at or near 200 Bq/m³, and have traditionally focused their remediation activities in homes at much higher levels. Radon exposure management programmes for both new and existing dwellings may thus come under new assessment, particularly in the context of the new ICRP recommendations on radon.

Regarding increased medical exposures, a recently published US report has shown that 48% of per capita annual exposure in the United States now comes from medical exposures, while 50% results from natural background radiation (including radon). While this is the first time that medical radiation has constituted such a large source, these numbers are of particular significance in that the number

of individuals exposed to medical radiation is far smaller than the US population exposed to natural background radiation. Exposure from industrial sources is less than 0.1% of the total annual exposure to the US population. As might be expected, medical (48%) and radon (37%) exposure management are being revisited by government and regulatory authorities to assess whether protection is optimised in all cases.

Nuclear science

In the field of nuclear science, much attention is being given to issues related to improving the performance and safety margins of current nuclear power plants, as well as to developing the next generation of reactor systems. The main scientific challenges concerning current nuclear power plants relate to reactor lifetime extension, the employment of higher burn-up fuel cycles and the increased utilisation of mixed-oxide (MOX) fuels. Among future reactor concepts, the fast spectrum and/or high-temperature systems have attracted the most attention: the fast reactors because of their efficient utilisation of fuel and their possibility to burn minor actinides, and the high-temperature reactors due to their improved thermal efficiency and potential spin-off applications, such as process heat or hydrogen production.

The verification and validation of computer codes used in the modelling and simulation of different reactor parameters continue to be important. Improved calculation techniques, in combination with uncertainty qualifications of the basic input data and the calculation methods themselves, provide a better understanding of and confidence in the performance and safety margins, with subsequent possibilities for significant economic benefits. These validation efforts are dependent on the availability of good, well-documented experimental information for comparison with calculations. Large efforts to preserve relevant experimental information are being undertaken as part of more general knowledge management activities.

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

Nuclear law

Ensuring that adequate and equitable compensation is made available to victims who suffer injury or damage as a result of a nuclear incident occurring at a nuclear installation or during the transport of nuclear substances is a primary concern of NEA member countries. Those which signed the Protocols to amend the Paris and Brussels Supplementary Conventions in 2004 are actively working to implement the provisions of those protocols into their national legislation, provisions that significantly increase the amount of compensation to be made available, broaden the scope of damage for which compensation may be

granted and ensure that more victims will be entitled to compensation than ever before. Half of the signatories to the 2004 Protocol to amend the Paris Convention and a majority of the signatories to the 2004 Protocol to amend the Brussels Supplementary Convention are now ready to deposit their instruments of ratification of these protocols.

In addition, several member countries which are not signatories to the above-mentioned conventions continue to modernise their third party liability regimes. Increasing the liability amounts of nuclear operators is a significant step in this process. Japan, for example, has adopted new legislation, to enter into force on 1 January 2010, under which its operators will be liable for a considerably higher amount than was previously the case, with the increase having been largely inspired by the revised international nuclear liability conventions. Canada is on its way to substantially revising its 1985 Nuclear Liability and Compensation Act, including increasing its operators' liability amount to a level that is reflective of that called for under the revised conventions. Furthermore, Poland plans to ratify shortly the 1997 Protocol to amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage.

On a regional level, a legal study was published on the impact of the different nuclear liability regimes in Europe in an effort to determine whether a uniform European Union liability and compensation regime is both feasible and desirable, and whether the European Atomic Energy Community should accede to the Paris Convention.

Efforts to establish a global regime for nuclear liability and compensation are also continuing. The 1988 Joint Protocol, which establishes a link between the Paris and Vienna Conventions, now counts 26 contracting parties following the accession of Uruguay in 2009. The 1997 Convention on Supplementary Compensation for Nuclear Damage has now been ratified by four countries (the United States, Argentina, Morocco and Romania). It will enter into force 90 days after the date on which at least five states with a minimum of 400 000 "units" of installed nuclear capacity (or roughly 400 000 MWth of installed capacity as defined in the convention) have done the same.

For the first time since the inception of the European Community in 1957 and after two unsuccessful attempts, the Council of the European Union adopted EU-wide binding requirements in respect of nuclear safety. The goal of the "Council Directive establishing a Community framework for the nuclear safety of nuclear installations" is to maintain and to promote the continuous improvement of nuclear safety and to ensure that a high level of nuclear safety is provided by EU member states to protect workers and the general public against the dangers arising from ionising radiation.

Many countries are considering relaunching their nuclear power programmes, and to that end have started preparing new or revised legal and regulatory frameworks; Sweden and the United Kingdom are two such examples. Also of note is Italy's adoption of a new legislative and regulatory framework more than 20 years after a government decision to suspend nuclear power generation in that country. An important feature of this framework will be the establishment of a new nuclear regulatory body, the *Agenzia per la sicurezza nucleare*.

Technical Programmes



Nuclear Development and the Fuel Cycle

Nuclear Development Committee (NDC)

The NDC continues to support member countries in economic assessments of nuclear energy, nuclear energy policy and analyses of strategic issues related to the secure and reliable application of nuclear technology, while also examining the potential of nuclear power to mitigate greenhouse gas emissions.

Highlights

- A high-level group was established to oversee and to coordinate efforts to address the global shortage of molybdenum-99, the most widely used medical radioisotope.
- The 2009 edition of *Nuclear Energy Data* was published, providing readers with timely information on key aspects of nuclear power plant construction and the fuel cycle in OECD/NEA countries.
- The final report of the Ad hoc Expert Group on the Financing of Nuclear Power Plants was issued.

Policy and strategic issues

Nuclear power continues to attract interest from governments due to its ability to contribute to security of electricity supply in a low carbon-emitting environment, as well as to its increasing economic attractiveness as carbon pricing becomes the main driver for changing emission profiles in many countries. An NEA policy brief on "Nuclear Energy and Addressing Climate Change" was issued in conjunction with COP-15 in Copenhagen. The lack of consensus at Copenhagen on how to reduce emissions makes the potential role of nuclear technology even more important.

Progress was also made on two other related reports during the year. The first, by the Ad hoc Expert Group on Climate Change and Nuclear Energy Build Rates, is considering the potential of nuclear power to address climate change concerns. It is expected that the group will complete its report by late 2010. Preparation of the second report, the *Nuclear Energy Roadmap*, was initiated in cooperation with the International Energy Agency (IEA). This report sets out the necessary steps to achieve the nuclear expansion envisaged in the IEA *Energy Technology Perspectives 2008* "Blue Map" scenario (1 250 GWe by 2050), covering technology development, policy measures and resources. It is scheduled to be published in 2010 as part of a series of roadmaps being prepared by the IEA in response to a request from the G8 summit.

NEA staff members also participated in the IEA in-depth energy policy reviews of Belgium, Canada, the Czech Republic and France in 2009. NEA involvement brings expertise on nuclear energy to the teams conducting the

reviews, thus ensuring that they are as comprehensive as possible.

To support requests from member countries on advice on the use of nuclear technology, the Agency has continued its efforts to improve the quality of information on nuclear trends and to examine the key issue of the availability of human resources. The update of a previous publication on *Trends in the Nuclear Fuel Cycle: Economic, Environmental and Social Aspects* was a major focus of these efforts in 2009. The study will explore recent developments and likely future trends in the nuclear fuel cycle that may improve competitiveness and sustainability.

To address concerns about the current levels of nuclear energy education and training as well as knowledge preservation, the NEA began a new initiative on this subject. With the age profile of the nuclear workforce showing a substantial proportion of professionals who have already reached or are approaching retirement age, there is a real risk of losing much of the collective knowledge and experience of the industry over the next few years. This report will collect and analyse data related to the above issues, investigate the current situation and future needs, assess national and international initiatives already underway or planned and draw recommendations on policy options to remediate any gaps identified.

Security of supply of medical radioisotopes

A major issue which arose during the year was the global shortage of molybdenum-99 (Mo-99), the most widely used medical radioisotope. The NEA became actively involved in international efforts to ensure reliable supply following the unexpected, extended shutdown of Canada's research reactor which produces approximately 35% of world Mo-99 supply. Radioisotopes are used in medical diagnostic imaging techniques which enable precise and accurate, early detection and management of diseases such as heart conditions and cancer, and may significantly impact medical decisions. Disruptions in the supply chain of these medical isotopes – which decay within a matter of days or hours and thus must be produced continually – can interrupt important medical testing for millions of people worldwide every year.

In January 2009, the NEA organised a Workshop on the Security of Supply of Medical Radioisotopes attended by representatives from all stages of the production chain and nuclear medicine practitioners. Following the discussions at the workshop, the NEA Steering Committee established the High-level Group on the Security of Supply of Medical

Shares of uranium resources and production			
	Resources (%)*	Production (%)**	Production (tU)**
Australia	22.7	16	8 000
Canada	7.7	20	10 175
United States	6.2	3	1 400
Namibia	5.0	9	4 625
Niger	5.0	6	3 300
South Africa	8.0	1	600
Kazakhstan	14.9	27	13 900
Russian Federation	10.0	7	3 610
Uzbekistan	2.0	5	2 500
Ukraine	3.6	2	830
Others	14.9	4	1 880
Total	100.0	100	50 820

* Identified resources recoverable at less than USD 130/kgU (2008 data). ** 2009 estimates.

Radioisotopes (HLG-MR). The Group, comprised of 20 experts from 11 countries, the European Commission and the International Atomic Energy Agency, will oversee and assist, where necessary, efforts of the international community to address the challenges of supply reliability. The HLG-MR focused first on encouraging coordination among reactor operators to maximise supply, on ensuring that supply and demand information was available and shared amongst all stakeholders and on supporting efforts of the nuclear medicine community to use available supply as efficiently as possible. From there, the Group began assessing options to increase short-, medium- and long-term production. In carrying out this work, care is being taken to ensure that efforts being carried out by other fora are not duplicated.

As part of the HLG-MR work plan, the NEA also began a study on the economics of the upstream Mo-99 and technetium-99m (Tc-99m) supply chain, given the possibility of a market failure in the supply chain whereby the economic structure does not provide sufficient incentive for current research reactors to produce Mo-99 or for additional production reactors to be constructed. The study, expected to be completed in mid-2010, will develop a factual basis of the economics of the supply chain to develop recommendations to governments on how to create an environment that would encourage the investments needed to ensure reliable medical isotope supplies.

Economics

The final report of the Ad hoc Expert Group on the Financing of Nuclear Power Plants was published. The report examines the major challenges to financing new nuclear plants, the possible ways to structure and finance projects, and the role of governments in encouraging nuclear investments when this is part of the national energy strategy. It concludes that governments will need to provide strong policy support and to take an active role in facilitating nuclear projects. In many cases, particularly in competitive electricity markets, the government may need to provide direct or indirect support for financing.

The NEA Working Party on Nuclear Energy Economics continued to provide expert advice on key economic issues that merit investigation on an international level. Efforts focused on preparing in co-operation with the IEA, the 2010 edition of *Projected Costs of Generating Electricity*. Participation by member countries was very strong, but

soliciting the national data on electricity generating costs proved arduous due to concerns about competitiveness and commercial confidentiality. Nevertheless, persistent efforts by the Secretariats will enable the presentation of data from 17 member countries and 4 non-member countries: Brazil, China, Russia and South Africa.

First results show that, in almost all member countries that reported data, nuclear energy remains the most competitive choice for baseload power generation at a 5% discount rate. Due to its capital intensity, however, it is vulnerable to variations in the discount rate, a characteristic it shares with other low-carbon technologies, such as renewables or coal with carbon capture and storage.

Data and resource assessment

The longstanding publication, *Uranium: Resources, Production and Demand* (the "Red Book") is released biennially in co-operation with the International Atomic Energy Agency (IAEA). Preparations are underway to produce the next edition for June 2010. Preliminary results indicate that the financial crisis continues to have a moderating effect on exploration expenditures and mine development. Nonetheless, known resources continue to increase as does production, albeit less rapidly, at least in part because of lengthy mine development times in some jurisdictions.

The price of uranium and the rate of uranium mine development are clearly linked to plans and decisions on new nuclear build. Discussions to build new reactors have increased considerably but, outside of Asia, only a few construction commitments have been made. The 2009 edition of *Nuclear Energy Data* (the "Brown Book") provides readers with timely information on this issue. In addition to the 15 reactors under construction in the OECD area in 2009, the number of firmly committed reactors jumped from 13 in 2008 to 23 in 2009, mainly due to the US government considering that 9 reactors now fall in this category. Momentum towards building new nuclear power plants in the OECD area clearly continues to grow.



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Nuclear Safety and Regulation

Committee on Nuclear Regulatory Activities (CNRA)

The CNRA contributes to developing a consistent and effective regulatory response to current and future challenges, addressing in particular operational experience feedback, inspection practices, the regulation of new reactors and increased public expectations concerning safety in the use of nuclear energy.

Highlights

- The CNRA and the CSNI have maintained their focus on the safety of existing plants, although activities have also been launched on new reactors and advanced designs. Other key topics addressed during the year included the efficiency and effectiveness of regulators and technical support organisations as well as the availability of adequate nuclear skills and technical infrastructure.
- In 2009, the CNRA and the CSNI organised several workshops and conferences, most notable were those on the Implementation of Severe Accident Management Measures; In-Vessel Coolability; Simulator Studies for Human Reliability Analysis; Reactivity Insertion Accidents; and Ageing Management of Fuel Cycle Facilities.

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 (NPPs). The IRS co-ordinators exchange information about recent events during their annual meetings and jointly define topics of interest for further work.

The Working Group on Operating Experience (WGOE) has focused its activities on follow-up by each member country of lessons learnt from important events. The group continues to examine regulatory activities based on the 2006 Forsmark event and is currently assessing the report of the Task Group on Defence in Depth of Electrical Systems and Grid Interaction (DIDELSYS). At the group's last meeting, two events were selected and members reviewed their actions in response to these events. The WGOE is also working on establishing trends from international events. The WGOE continues to exchange information on regulatory practices and methodologies being applied in the assessment and use of operating experience in order to define and to assess corrective measures in response to operational events.

The WGOE issued two reports. The first examines the current status of national operating experience feedback

programmes, comparing programmes for the screening, investigation and analysis of events. It also addresses corrective actions, trending and the dissemination of information as routine aspects of the operating experience programmes. The second report focuses on operating experience feedback related to fire events and fire protection programmes. The report is intended to provide practical information for inspection programmes and to facilitate improvements in national operating experience feedback.

Regulation of new reactors

The Working Group on the Regulation of New Reactors (WGRNR) is reviewing regulatory activities concerning siting, licensing and oversight of new commercial nuclear power reactors. Given that sharing information about the licensing process, construction experience and inspection practices will be helpful to all countries, a construction experience programme is being developed. The objective of the programme is to identify the major deficiencies associated with the design and construction of NPPs, to assess the adequacy of, and to supplement if necessary, current regulatory activities to detect and correct such events, notably before the plant becomes operational, and finally to disseminate information to ensure appropriate regulatory attention is given to lessons learnt from past events.

A report on the regulation of site selection and preparation aimed at reviewing the various practices used by regulators in the regulation of nuclear power plant siting is under preparation. The report is based on a survey covering different aspects of the regulation of nuclear sites, including seismicity, security and multi-unit issues as well as regulator practices on sites where mixed activities are taking place (for example, units being constructed, operated and/or decommissioned).

An activity was also initiated with the aim of producing a report on recent regulatory experiences describing licensing structures, the resources and skills needed to perform reviews, assessments and construction oversight, the types of training needed for these activities, and the various licensing processes in member countries. A member country survey will be conducted to produce the report which is intended to enhance international understanding of reactor licensing processes.

Regulatory inspection practices

In 2009, the Working Group on Inspection Practices (WGIP) focused its efforts on the inspection of the licensee's corrective action programme and human and organisational

factors in safety culture. The inspection of safety culture remains a topic of keen interest and discussion in the group. The latter also finalised the programme for the tenth international workshop on inspection practices to be held in May 2010 in the Netherlands.

Nuclear regulators and public communication

The main activity of the Working Group on Public Communication of Nuclear Regulatory Organisations (WGPC) consisted of discussing the transparency of regulatory activities, local public information, the use of public perception surveys and crisis communication. Deliberations on transparency are considering the nuclear safety information to be given to the public regarding the safety level of nuclear installations, regulatory decisions and general issues of concern to the public. Discussions on local public information deal more specifically with the information to be provided to persons living in the vicinity of a nuclear facility, including what to do in case of an incident or

emergency. Group members also debated the use of public perception surveys by nuclear regulatory organisations (NRO) to correct and improve the image given by the regulators to the public as an independent body in charge of protecting the population. Crisis communication concerns NRO communication in the case of events which have a particular media impact. Surveys on the above subjects were conducted amongst regulators whose answers are being analysed and compiled into WGPC guidance reports.

Senior-level expert group

A senior-level expert group was formed to produce a regulatory guidance booklet on the regulator's role in assessing the licensee's oversight of vendor and other contracted services. The objective of this booklet is to examine contemporary regulatory challenges in ensuring nuclear safety in an environment in which licensees are increasing their use of contractors and subcontractors. The group's first meeting was held in November 2009; work will continue through 2010.

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 accidents and their management, ageing and structural integrity, fuel and fuel cycle safety, contributors to risk and human factors. The committee also facilitates the establishment of international joint research projects when useful.

Analysis and management of accidents

The activities of the Working Group on Analysis and Management of Accidents (WGAMA) have primarily focused on the thermal-hydraulics of the reactor coolant system; in-vessel behaviour of degraded cores; containment behaviour and protection; computational fluid dynamics (CFD); and fission product release, transport, deposition and retention. Work has also been undertaken on new and advanced reactors.

During 2009, further progress was made on the uncertainty and sensitivity evaluation of best-estimate methods (BEMUSE). Following an assessment based on calculations from an integral test, work continued on an analysis of a commercial nuclear power plant. The report on Uncertainty and Sensitivity Analysis of a Large-break Loss-of-Coolant Accident (LOCA) in the Zion Nuclear Power Plant was issued.

A CFD blind benchmark on flow mixing in a T-junction experiment was launched and is expected to be completed by the end of 2010. In addition, preparations are underway for the Workshop on Experimental Validation and Application of CFD and CMFD Codes to Nuclear Reactor Safety, to be held in September 2010.

In order to assess safety analysis code capabilities, two international standard problems (ISP) were launched on thermal-hydraulics of the reactor coolant system (ISP-50 on the Korean ATLAS facility) and on hydrogen combustion (ISP-49 based on the French ENACCEF and German THAI facilities).

Work continued on in-vessel behaviour of degraded cores and a state-of-the-art report on in-containment behaviour of aerosols was issued. An activity on core exit temperature (CET) effectiveness in accident management is being completed.

Two workshops were organised. The first one on Implementation of Severe Accident Management Measures was held jointly with the WGRISK and addressed severe accident management (SAM) measures for operating NPPs and new plant designs, as well as the integration of SAM measures into probabilistic risk assessment. The second workshop was dedicated to in-vessel melt pool retention and coolability.

Ageing and structural integrity of reactor components

The main topics addressed by the Working Group on Integrity and Ageing of Components and Structures (IAGE) concern the integrity of metal components and concrete structures, and the seismic behaviour of structures and components.

Current activities in the area of risk-informed, in-service inspection (RI-ISI) include drafting the final report on the results of the benchmark on risk-informed, in-service inspection methodologies (RISMET). Work was also carried out on finalising the report on the second phase of the Probabilistic Structural Integrity of a PWR Reactor Pressure Vessel Benchmark (PROSIR).

Several proceedings were issued. They concerned the workshop on recent findings and developments in probabilistic seismic hazard assessment methodologies and applications, the workshop organised in co-operation with the EC Joint Research Centre (JRC) on risk-informed piping integrity management, and the workshop to review the state of the art on ageing management of thick-walled concrete structures.

The IAGE initiated an activity aimed at improving the robustness of assessment methodologies for structures impacted by missiles. The purpose is to develop guidance that outlines effective methods of evaluating the integrity of structures in such circumstances.

The group also started an activity to compare the different approaches followed in member countries regarding the performance or non-performance of hydro-proof tests and the rationale behind each approach. The activity should determine whether further technical knowledge is needed to support either option, and if so what research should be undertaken.

Component fatigue is a key issue for the safety of nuclear power plants. During the last IAGE annual meetings, member countries have reported leaks and deep cracks where fatigue appeared to be the active degradation mechanism. The group has initiated an activity to assess fatigue data transferability practices in member countries.

Earthquakes recorded in the vicinity of NPPs may have higher than expected peaks and the plant's buildings need to be accurately assessed in terms of seismic response. In 2009, the IAGE initiated an activity to improve the understanding of soil structure interaction on the seismic behaviour of plant buildings, which affects the dynamic response of the internal components and structures.

Finally, the group initiated a task on high energy arcing fault events to provide the basis for deterministic correlations serving to predict damage and to establish a set of input data and boundary conditions for more detailed modelling which can be agreed upon by the international community.

Risk assessment

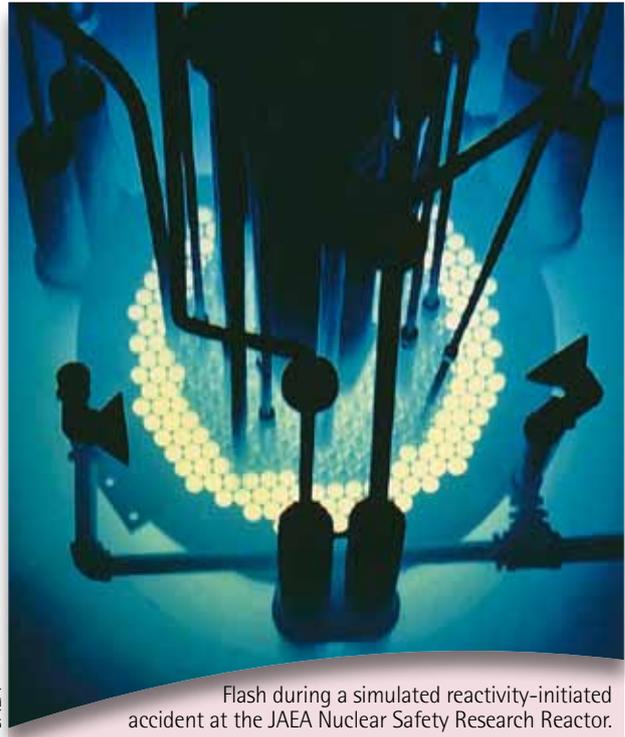
The main mission of the Working Group on Risk Assessment (WGRISK) is to advance the understanding and utilisation of probabilistic safety assessment (PSA) as a tool to support nuclear safety decision making in member countries. Tasks completed in 2009 include an analysis of the status and experience with the technical basis and use of probabilistic risk criteria for NPPs in member countries; the establishment of a low-power and shutdown PSA information base; and recommendations on methods and information sources for quantitative evaluation of digital system reliability. All corresponding reports were issued.

An international workshop was organised to discuss human reliability analysis (HRA) data collection in simulators, to plan simulator studies for HRA and to improve HRA methods using data. A survey is being conducted and a workshop will be held in April 2010 on PSA for advanced reactors. Finally, an activity was launched on PSA knowledge transfer at national and international levels in order to support the dissemination of lessons learnt and best

practices, and to identify follow-up activities for knowledge preservation.

Fuel safety

The Working Group on Fuel Safety (WGFS) is concerned with the systematic assessment of the technical basis for current safety criteria and their applicability to high burn-up, as well as to the new fuel designs and materials being introduced in nuclear power plants. The main focus of the group remains on reviewing data from reactivity-initiated accident (RIA) and loss-of-coolant accident (LOCA) experiments, and assessing how these data affect fuel safety criteria, in particular at high burn-up.



Flash during a simulated reactivity-initiated accident at the JAERI Nuclear Safety Research Reactor.

The WGFS succeeded in updating and expanding upon the 1986 CSNI state-of-the-art report on pressurised water reactor (PWR) fuel behaviour in design-basis accident (DBA) conditions, which was limited to a PWR loss-of-coolant accident (LOCA). Since the initial report, considerable efforts have been made worldwide on modelling PWR and boiling water reactor (BWR) fuel behaviour in accident conditions, in particular for high burn-up fuel. The update is being issued as two reports: the first covering nuclear fuel behaviour under LOCA conditions was issued in spring 2009, the second covering reactivity-initiated accidents (RIAs) will be issued early in 2010.

The adequacy of existing fuel performance codes for the simulation of high burn-up fuel behaviour under accident conditions was assessed by benchmarking against irradiated LOCA tests performed at the Halden reactor. The exercise consisted of two benchmarks, with pre- and post-test calculations having been carried out.

Two new tasks were initiated on the safety significance of the Halden IFA-650 LOCA test results and to LOCA cri-

teria basis and test methodology. Final objectives of both tasks are to provide recommendations to the international community.

Progress in the testing and modelling of nuclear fuel behaviour during RIAs was discussed at a workshop organised in France in September. Participants concluded that further development of analytical codes is needed and that the transposition of separate effect mechanical tests carried out in laboratories to the reactor case remains an open question.

Human and organisational factors

The Working Group on Human and Organisational Factors (WGHOF) constitutes a unique international forum for addressing safety management, human and organisational factors, and human performance in nuclear facilities. A specialists meeting on Identifying and Overcoming Barriers to Effective Consideration of Human and Organisational Factors (HOF) in Event Analysis and Root Cause Analysis was held in France in September. The objectives were to identify barriers to correctly identify, analyse and implement lessons learnt from HOF causes of events.

A technical opinion paper published in 2009 identified a set of research topics that would enhance the state of knowledge related to human and organisational factors in the operation of new nuclear plant technology. Eight research topics, among which the role of automation and personnel, organisational factors and safety culture, were defined. The paper recommended that the international community, including regulators, vendors, research institutes and other interested parties, pursue a collaborative and coordinated approach to addressing these important research areas. In follow-up, a workshop will be held on this topic in March 2010.

Fuel cycle safety

The Working Group on Fuel Cycle Safety (WGFCS) brings together regulatory and industry specialists to address a broad range of interests, including safety assessments, nuclear criticality safety, probabilistic safety assessment, safety management, decommissioning and site remediation, fire protection and human factors.

The joint NEA/IAEA Fuel Incident Notification and Analysis System (FINAS) is the only international system providing regulators and government bodies with information about lessons learnt from safety-significant events at fuel cycle facilities. During the last WGFCS meeting, members supported the development of a FINAS web training module and encouraged all members to contribute reports regularly to the system.

The WGFCS also organised a workshop in October whose main objective was to review the potential impact of ageing on the safety, regulation and operability of reprocessing and fuel fabrication facilities.

Integrated assessment of safety margins

Factors such as power uprates, longer operating cycles, new fuel designs and increased fuel burn-up, combined

with plant ageing and plant life extensions require a comprehensive, integrated assessment in order to evaluate their potential cumulative safety impact. The Task Group on Safety Margin Applications and Assessment (SM2A) is validating the methodology agreed in 2007 by evaluating the change in safety margins which would result from implementing the newly proposed rules on performing LOCA analyses. Ultimately, it is intended that the methodology will be able to be used to quantify the change in margins due to combinations of plant modifications, as well as in support of setting safety limits for advanced reactor designs. A base case, with a hypothetical 10% power uprate applied to a commercial NPP, was considered. The activity is nearing completion with a report to be issued in 2010.

Defence in depth of electrical systems and grid interaction

The July 2006 Forsmark-1 event identified a number of design deficiencies related to electrical power supply to systems and components important to safety in NPPs. In follow-up, the Task Group on Defence in Depth of Electrical Systems and Grid Interaction (DIDELSYS) was established.

In May 2009, the DIDELSYS task group organised a workshop to present and discuss lessons learnt. It issued its final technical report which provides information on the state of the art regarding the robustness of safety-related electrical systems (SRES), taking into account their interaction with other electrical equipment, the use of new technologies and the problems encountered when modernising existing NPPs. It will also provide guidelines for improving communication and coordination among grid operators, nuclear safety authorities and licensees.

Research facilities for existing and advanced reactors

Following a *CSNI Collective Statement on Support Facilities for Existing and Advanced Reactors*, a Task Group on Advanced Reactor Experimental Facilities (TAREF) was established with a mandate to examine gas-cooled reactors and sodium fast reactors in a first phase. In 2009, the activity on gas-cooled reactors was completed and the corresponding report entitled *Experimental Facilities for Gas-cooled Reactor Safety Studies* was published. The report identifies relevant safety issues and facilities to address them, and provides recommendations on strategies for facilities and international programmes in support of safety assessment. The activity on sodium fast reactors is ongoing.



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Radioactive Waste Management

Radioactive Waste Management Committee (RWMC)

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

Highlights

- The RWMC Regulators' Forum organised an International Workshop on Transparent, Proportionate and Deliverable Regulation for Geological Disposal.
- The Integration Group on the Safety Case (IGSC) held a workshop on the roles and performance of cement in geological repositories.
- An important Forum on Stakeholder Confidence (FSC) workshop was held in France on repositories and host regions. The FSC has completed studies on "partnering" for siting waste facilities and on the symbolic dimension of radioactive waste management.
- The Working Party on Decommissioning and Dismantling (WPDD) has completed studies on cost drivers and reporting practices in decommissioning, and on applying decommissioning lessons to the design and operation of new reactor systems.

Waste management policy and regulatory issues

The RWMC has a wide-ranging programme covering radioactive waste disposal safety, the decommissioning and dismantling of nuclear facilities, and stakeholder involvement as related to radioactive waste policy, implementation, research and regulation. At its March 2009 meeting, the RWMC examined the issue of human resources, identified steps for defining and presenting the waste management profession, and disseminated a document on knowledge consolidation and transfer. The RWMC also continued its efforts to provide lessons learnt in a concise flyer format for wide distribution. A new project on memory preservation is under consideration.

The RWMC Regulators' Forum (RF) continues to investigate issues connected with establishing long-term safety regulation for geological disposal and organised a workshop, hosted by the government of Japan in Tokyo, on the question of transparent, proportionate and deliverable regulation. The main lessons to be learnt from the workshop have been communicated, and a discussion document meant to engage all interested parties on the subject of

optimising geological repositories has been produced. The radiological protection community is being invited to participate in further dialogue on disposal safety criteria. The RF also completed a survey on the R&D needs of regulatory organisations.

Issues related to retrievability and reversibility (R&R) in planning geological repositories are prominent in a number of countries. A recently started project is surveying current views, issues and practices associated with R&R and will provide information of use to national debates and programmes. Important progress has been made in developing a "retrievability scale" in repository development as a tool for informing and dialoguing with the public. The project began organising an international conference on R&R, to be held in France in December 2010, with the aim of discussing and better understanding commonalities and differences and to test and refine the findings of the NEA R&R project.

Safety case for geological disposal

Through its Integration Group for the Safety Case (IGSC), the RWMC continues to define trends and best practices in developing and presenting safety cases. The results of the INTESC project were published in 2009. The report describes the state of the art for safety case development and identifies areas of consensus as well as emerging trends and remaining challenges.

The IGSC initiated a new project to review advances in methods for safety assessment (MESA), which form the technical core of a safety case. The group completed a desk study identifying important progress and major trends. Based on those results, the IGSC plans to hold a workshop on MESA and to produce a brochure on the topic.

Cementitious materials play an important role in construction and the barrier system of geological repositories. A workshop was organised in Belgium on the interactions of cementitious materials with other natural and engineered components of disposal systems. The workshop, which attracted specialists from academic, research, waste management and regulatory institutions, showed that there is good agreement regarding the processes relevant to performance and that methods exist to model them even when uncertainties remain.

The IGSC dedicated a topical session at its annual meeting to organisational aspects of developing safety cases. Aspects such as knowledge management, or broader issues such as organisational structure and inter-disciplinary coordination, have sometimes been viewed as peripheral, but this session demonstrated a growing recognition that

such factors have direct bearing on the quality of, and confidence in, the safety case.

The IGSC continues to emphasize knowledge consolidation and transfer by synthesising the main messages and lessons learnt from the recently completed multi-year projects on geological information (AMIGO) and on engineered barriers (EBS) in safety cases.



ANDRA

View of the underground research laboratory at Bure, France.

Forum on Stakeholder Confidence

The RWMC Forum on Stakeholder Confidence (FSC) continued its important role in fostering national dialogue by holding a workshop in France on the national context for high-level waste disposal. The workshop took place in April 2009 in Bure where a repository for high-level radioactive waste is to be sited. Particular attention was given to stakeholder insights regarding reversibility and retrievability (R&R).

The FSC continues to foster reflection on stakeholder dialogue as well as the improvement of decision-making processes for radioactive waste management. A study on "partnering" documents current practice of empowering repository host communities in 13 countries and reviews changes observed. Whereas organisational actions formerly concentrated on public information and outreach, today the pendulum has largely swung to giving stakeholders greater weight in formal or informal partnerships concerning facility siting and design, or monitoring. A second study enhances awareness of non-technical aspects of radioactive waste management and analyses the symbolic dimension of some of the key concepts that are dealt with in waste management, such as safety, landscape and community.

At the FSC annual meeting, two topical sessions were organised, investigating the role of regional elected authorities as stakeholders, and identifying concrete actions, procedures and legislation that foster a long-term relationship between local stakeholders and RWM actors.

Decommissioning

The RWMC Working Party on Decommissioning and Dismantling (WPDD) completed a study on the application of lessons from decommissioning to the design and operation of new reactor systems, concluding that decommissioning issues are already being considered to a large

extent during the design process. Although many design provisions aiming at improved operation and maintenance will also be beneficial for decommissioning, designers still need to consider issues that are specific to decommissioning such as developing sequential dismantling sequences and providing adequate waste management strategies.

The WPDD formed new task groups on the management of large components from decommissioning and on R&D and innovation needs for decommissioning. It began updating the listing of standardised cost items for decommissioning, commonly known as the "Yellow Book".

The Decommissioning Cost Estimation Group (DCEG) analysed decommissioning cost elements, estimation practices and reporting requirements in various countries. Its findings suggest that cost methodologies need to be updated continuously using cost data from actual decommissioning projects, and systematic approaches need to be implemented to collect these data. It also found that changes and growth of project scope may have the greatest impact on project costs. The study notes that more needs to be done to facilitate comparison of estimates.

The Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD) enlarged its membership and accepted two new participating organisations – the US Department of Energy's Office of Environmental Management and the European Commission's Joint Research Centre at Ispra (Italy). Two new projects have also joined the programme (see page 33 for more information on the CPD).

Understanding the scientific basis

To secure the scientific basis of its work, the RWMC continued to support the development and maintenance of quality-assured databases and models for use in the implementation of repositories.

The Clay Club co-sponsored an international scientific conference on faults and seals in clays, and organised a special session of the conference on radioactive waste disposal. The Clay Club's participation in this conference reinforced links with relevant research programmes on clays performed outside the radioactive waste field. The group also continued its investigation of evidence and mechanisms for self-sealing of fractures in clays. Preliminary results show that the understanding of self-sealing has progressed to a point that justifies its inclusion in safety cases for geological disposal.

The Thermochemical Database (TDB) Project, which is run by the NEA Data Bank under the scientific guidance of the RWMC, continues to develop its database of recommended chemical thermodynamic data for the safety assessment of radioactive waste repositories (see page 34 for further details on this programme).



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Radiological Protection

Committee on Radiation Protection and Public Health (CRPPH)

The objective of the CRPPH is to facilitate the understanding and implementation of a system of radiological protection that will address regulator and practitioner needs, and that more appropriately positions scientific radiological protection considerations within the broader context of social judgement and risk governance.

Highlights

- The CRPPH continued its active participation in the development of draft text for the new international Basic Safety Standards, which are being developed under the auspices of the International Atomic Energy Agency (IAEA) and co-sponsored by the NEA and several other international organisations.
- The 2nd Science and Values in Radiological Protection workshop took place in France in December, continuing the exchange of experience in the formation of policy and regulatory judgements in radiological protection.
- A report on *Strategic Aspects of Nuclear and Radiological Emergency Management*, addressing lessons learnt from the INEX-3 emergency exercise on recovery, countermeasures and decision making, was completed and submitted for approval before publication. The development of a new exercise series, INEX-4, was initiated.
- A report on work management in the nuclear power industry was published as part of the activities of the Information System on Occupational Exposure (ISOE).

Evolution of the international system of radiological protection

Following the significant efforts that the CRPPH expended in contributing to the development of the new International Commission on Radiological Protection (ICRP) general recommendations issued in *Publication 103*, the Committee has turned its attention towards their application. A key aspect of this has been the preparation of new draft text for the *International Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources* (BSS). The NEA is a co-sponsoring organisation of the BSS, and as such has endeavoured to contribute the experience of its member country organisations to the development of the BSS. This has included the participation of NEA-nominated experts and NEA secretariat staff in a considerable number of drafting meetings. This extensive work now seems to be nearing its completion, with

the draft BSS planned to be sent for broad IAEA member state consultation in early 2010. Comments and suggestions from the NEA on various BSS drafts, including the latest, have been appreciated by the IAEA and other co-sponsoring organisations.

Radiological protection science and policy judgement

Many radiological protection questions and issues seem to be increasingly addressed as public health issues rather than simply as "radiological protection" issues. The CRPPH has taken a public health perspective on four radiological protection issues, addressing radon, justification of medical exposures, decision making based on new scientific evidence, and management of individual differences. When making radiological protection decisions, the central role of optimisation in the new system of radiological protection and the shift to a public health perspective come together in the context of judgement.

In co-operation with the French Radiological Protection and Nuclear Safety Institute (IRSN) and the Nuclear Protection Evaluation Centre (CEPN), the CRPPH organised a 2nd Science and Values in Radiological Protection workshop, near Paris, France. The workshop, which was sponsored by the French Ministry of Ecology, Energy, Sustainable Development and Territorial Development (MEEDAT), examined the challenges posed by growing awareness of radiation exposure from radon, increasing medical exposures and emerging radiological risks of cardiovascular diseases. Newly published scientific data and more clearly identified trends in these areas have suggested that each of these three topics may challenge governments to reassess their current approaches and to consider alternatives. The objectives of the workshop were to better understand how science and associated uncertainties can be addressed in combination with values, and how to achieve sustainable decisions.

Stakeholders and radiological protection

The CRPPH has been a leader in studying the issue of stakeholder involvement in radiological protection decision making, and has shown that such involvement can significantly improve the quality and sustainability of radiological protection decisions. The Committee began developing a short report summarising its work in this area in order to document the evolution of thinking, and to serve as a reference point for further work. In parallel, the CRPPH also

studied how governmental radiological protection organisations have reacted to the challenges of stakeholder involvement, and how they may have adapted as a result. A specific survey focusing on how emergency management organisations have structurally and procedurally evolved to best incorporate stakeholder input into their decision-making processes has been launched to support a workshop on stakeholder involvement in post-emergency management, to be held in Washington, DC, in October 2010. The workshop will focus on exchanging experience and identifying issues related to how governments and emergency management organisations might better involve stakeholders in emergency preparedness and longer-term consequence management.

Operational radiological protection from a policy perspective

A new study of radiological protection principles and criteria for designing new nuclear power plants was completed and approved by the CRPPH for publication. This work on new build will be continued with a more detailed study of the operational use of dose constraints in nuclear power plant exposure management. To complement this, the Committee is also pursuing work on the management of effluent releases from nuclear power plants which focuses on the use of best available techniques (BAT) to control liquid and gaseous effluents, and involves collaboration between regulators, utilities and reactor vendors.

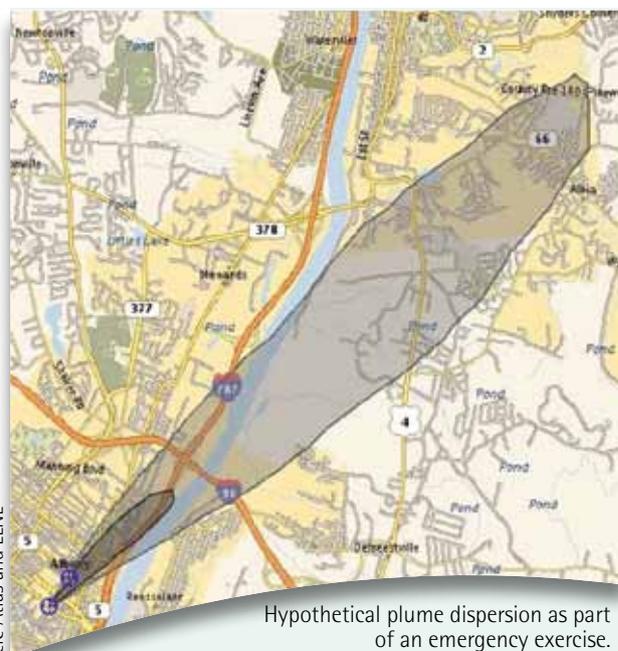
In addition, the Committee launched a study on the changes in the ICRP's protection philosophy over the last decades, as manifested in its general recommendations issued between 1976 and 2007 (Publications 26, 60 and 103), in order to better understand the impacts that this evolution has had on regulation and implementation.

Radiological protection of the environment

Since the ICRP issued its *Publication 91* on the radiological protection of non-human species in 2004, the CRPPH has followed the numerous developments in this area. Several significant projects to develop tools and methodologies to assess potential radiological effects on non-human species have been undertaken. The CRPPH is monitoring these national and international activities and commissioned an ad hoc expert group to produce a short report on these ongoing activities, including for each the objectives, deliverables and timeline. This information will be used to identify gaps, if any, that could be filled through CRPPH work, and any additional work that would facilitate national approaches to the radiological protection of the environment.

Nuclear emergency and recovery management

Decision-making processes as part of consequence management were investigated in the 3rd International Nuclear Emergency Exercise series (INEX-3). Based on the outcomes of the post-exercise evaluation workshop, the CRPPH



Working Party on Nuclear Emergency Matters (WPNEM) created expert groups to address key needs in consequence management in the areas of post-emergency countermeasures, good practices in decision making and possible implications of nuclear indemnification. Reports from these activities were completed in 2009. Planning also began for the INEX-4 exercise, which will focus on issues in consequence management and transition to recovery following a hypothetical malicious dispersal of radioactive materials in the urban environment. This series of national-level exercises is planned for the last half of 2010, to be followed by an evaluation workshop in 2011.

Occupational exposure at nuclear plants

Occupational exposure at nuclear power plants is an important issue for the CRPPH, and the sharing of operational lessons and experience, as well as the collection, analysis and exchange of occupational exposure data continues to be addressed by the Information System on Occupational Exposure (ISOE), an NEA joint project. In support of CRPPH efforts to facilitate the improvement of members' operational radiological protection capabilities, an ISOE report was published on work management to optimise radiological protection in the nuclear power industry, updating a landmark 1997 publication on this topic. The ISOE also made important steps in meeting end-user needs by completing work to migrate its data collection and analysis resources to the Internet. Further details on the ISOE programme are provided on page 34.



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Nuclear Science

Nuclear Science Committee (NSC)

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

Highlights

- A report on *Research and Test Facilities Required in Nuclear Science and Technology* was published.
- The 4th NEA Information Exchange Meeting on Nuclear Production of Hydrogen was held in Oak Brook, Illinois, USA on 14–16 April.
- An NEA Workshop on Criticality Safety Research Needs for Future Nuclear Systems was held at Idaho State University, Pocatello, Idaho, USA on 21–22 September.
- A report on the scientific aspects of *Nuclear Fuel Cycle Transition Scenario Studies*, including a European scenario, was published.

The NEA nuclear science programme conducts international benchmark exercises to validate computational methods and data used to predict the behaviour and performance of different nuclear systems. It also coordinates and drafts state-of-the-art reports and organises expert meetings and workshops as needed.

Fuel cycle physics and chemistry

Following the publication of the reports on *Nuclear Fuel Cycle Transition Scenario Studies* and on *Nuclear Fuel Cycle Synergies and Regional Scenarios for Europe*, work in this area continued in 2009 with a benchmark exercise on the performance of different scenario codes and a review of a global fuel cycle transition scenario. The results of these studies will be available in 2010.

A report on curium separation and management is being prepared for publication in 2010. The report will cover curium separation methods, storage and disposal requirements, as well as curium handling experience in different countries.

A study of homogeneous versus heterogeneous recycling of transuranics in fast reactors is being completed. The study compares criteria for choosing between different recycle modes and specific scenarios for their implementation.

It will also address fuel- and target-related issues with respect to potential limitations on the maximum allowable minor actinide content, residence time, helium production and management, and remote fabrication implications.

The potential benefits and impacts of advanced fuel cycles with partitioning and transmutation (P&T) are also being studied. A comparative analysis has been undertaken of existing studies addressing the impact of advanced fuel cycles on the performance of geological repositories. This analysis will identify possible goals for future studies and make recommendations on the appropriate criteria for evaluating the impact of P&T.

Reactor physics

A new study has been initiated on sodium fast reactor (SFR) core feedback and transient response. A comparative analysis of the safety characteristics of two different SFR cores (one large core of 3 600 MW thermal and one medium core of 1 500–2 500 MW thermal), and three fuel types (oxide, carbide and metal) will be undertaken with the goal of identifying the advantages and drawbacks of each concept based on nominal performances and global safety parameters.

A benchmark exercise on the performance of mixed-oxide (MOX) fuel in a pressurised water reactor (PWR), based on experimental data from the SCK•CEN BR3 reactor, was completed and published in 2009. It is being followed by another fuel performance benchmark of MOX fuel prepared with weapons-derived plutonium, based on irradiation tests in the advanced test reactor at the Idaho National Laboratory in the United States.

The possibility to burn minor actinides in thermal reactors is being investigated. A review of fuel and core design issues will be the object of a report. It is intended that the latter will specify whether actinide burning in thermal reactors is achievable, and if so, how and with what possible benefits and advantages.

A new depletion benchmark for a high-temperature gas-cooled reactor (HTGR), covering both prismatic and pebble bed cores, has been started. The specifications of the first phase of the benchmark were issued in 2009, and the results are expected to be published in 2010.

Material science

NEA work in the area of material science is pursued along two axes. One is more theoretical, devoted to multi-scale

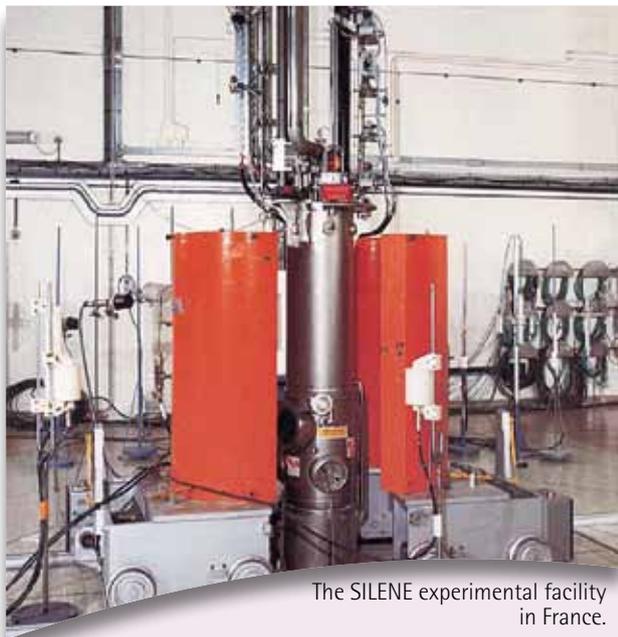
modelling of fuels and structural materials, and the other is more practical, devoted to the development of innovative fuels and structural materials.

Activities related to multi-scale modelling of fuels review and evaluate modelling and simulation techniques currently employed in the selection of materials used in nuclear systems. They include a review of standards for primary radiation damage, the validation and benchmarking of methodology, and the publication of state-of-the-art reports for the methods used in modelling fuels and structural materials.

Activities devoted to the development of innovative fuels and structural materials cover, for example, fuel fabrication techniques, irradiation performance of fuels, characterisation and post-irradiation examination methods. A state-of-the-art assessment is also being made of priority areas for research on structural materials, including the identification of areas where experimental protocols and standards are needed and where the sharing of available experimental installations could be possible.

Nuclear criticality safety

The report entitled *Inter-code Comparison Exercise for Criticality Excursion Analysis* was published. It provides results from a benchmark exercise based on pulse mode experiments with uranyl nitrate solutions using the TRACY and SILENE experimental facilities located in Japan and France.



The SILENE experimental facility in France.

The use of advanced Monte Carlo techniques for criticality safety assessment is being reviewed with the objective of guiding and encouraging practitioners to use improved methodologies in their work. Different advanced Monte Carlo techniques will be assessed, possibly by conducting benchmark exercises. Guidelines for applying new techniques to problems of importance to practitioners will be proposed.

The NEA database for spent nuclear fuel, SFCOMPO, is continuously being updated. In addition, the database is

being analysed with the aim of improving the quality of the data and possibly redefining the structure of the database to facilitate the use of the available data.

The 2009 issue of the International Criticality Safety Benchmark Evaluation Project (ICSBEP) handbook contained evaluations from 4 283 critical or sub-critical configurations and 24 criticality-alarm/shielding configurations. In addition, it included five fundamental physics measurements evaluations relevant to criticality safety applications. The searching tool and associated database (DICE) for the handbook was updated and improved.

R&D facilities in nuclear science

The study on *Research and Test Facilities Required in Nuclear Science and Technology* was published in both English and French in 2009. A Japanese edition will be released in 2010. A database, containing information about approximately 800 R&D facilities, was also developed and made available through the NEA website (www.nea.fr/rtdb/).

Integral experiments for minor actinide management

The need for new integral experiments for minor actinide management is being studied with the aim of improving the detailed design of transmutation systems, as well as the precise prediction of the composition of spent fuel. The study will focus on reviewing existing integral data, specifying missing experimental work and evaluating target accuracies of nuclear data required for minor actinide management. The final report will also provide recommendations for further international co-operation in this area.

Knowledge preservation

The NEA preserves information from important and well-documented experiments in selected nuclear application areas, such as reactor physics (IRPhE), fuel behaviour (IFPE), radiation shielding (SINBAD) and criticality safety (ICSBEP). This activity is performed in close collaboration with the NEA Data Bank. The data collected are made available to the nuclear community in a comprehensive, structured format for use in benchmark validation exercises.

Peer review

At the request of the Belgian authorities, an international peer review of the MYRRHA project was organised by the NEA. The project aims to design, construct and operate an accelerator-driven, lead-bismuth-eutectic-cooled, sub-critical, fast-neutron reactor. The main findings, conclusions and recommendations of the review were presented to the Belgian authorities and a report was published at the end of 2009.



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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 acquiring, developing, improving and validating these tools and making them available upon request.

Highlights

- Seven computer program training courses were organised with the aim of contributing to an effective utilisation of widely used codes and to obtain feedback from users.
- The fourth edition of the *International Handbook of Evaluated Reactor Physics Benchmark Experiments* was issued on DVD in March. This version contains experiments for 31 reactor configurations and 5 fundamental evaluations.
- Two JEFF reports, one on the neutron data library and the other on the radioactive decay data and fission yields sub-libraries were published.
- A report was issued on an *Evaluated Data Library for the Bulk of Fission Products*, describing the assembling and validation of a complete sub-library of evaluated data for fission product isotopes.
- A new version of the data display program JANIS (JANIS-3.1) was released at the end of 2009. It is available on the NEA website at www.nea.fr/janis.

Computer program services

The NEA Data Bank acts as a focal point for the collection, validation and dissemination of computer codes and associated application data libraries used by scientists and engineers in member countries. The collection of codes covers many different areas, ranging from reactor design, safety and radiation shielding to material behaviour and radioactive waste applications.

The number of officially nominated establishments using the computer program services in NEA Data Bank member countries is close to 900. Through a co-operative agreement with the International Atomic Energy Agency (IAEA), 87 non-OECD establishments also have access to selected computer codes and data after screening by relevant authorities.

During 2009, a total of 27 new or revised versions of computer codes were acquired. The Data Bank answered requests for nearly 1 800 programs in 2009, of which about 130 were sent to non-OECD countries under the special

co-operative agreement in place with the IAEA. Of these 1 800 distributed programs, roughly 1 600 originated from OECD countries and 200 from non-OECD countries.

A new benchmark was started in 2009 to monitor the performance of detailed Monte Carlo calculations of power densities in a full-size reactor core. The key quantity to be estimated is the power density, and specifically its standard deviation in many small regions of the core in relation to the number of neutron histories and computer time. One of the aims is to enable calculations on readily available, personal computers rather than limiting them to the fastest computer systems available only to a few scientists.

Knowledge transfer and preservation

As an important complement to the computer program service, the Data Bank organises training courses on the utilisation of the most popular computer programs. Seven training courses were held in 2009, covering such topics as radiation transport using Monte Carlo (MCNP, FLUKA, PENELOPE) as well as deterministic (ERANOS) codes, lattice physics and depletion calculations (SCALE), and case studies in neutron transport theory.

Under the scientific guidance of the NEA Nuclear Science Committee, the Data Bank verifies, preserves and disseminates well-documented integral data in the following areas: fuel performance (IFPE), shielding and dosimetry (SINBAD) and reactor physics (IRPhE). Twenty-four new or revised sets of data from integral experiment were collected and close to 2 300 sets were distributed upon request.

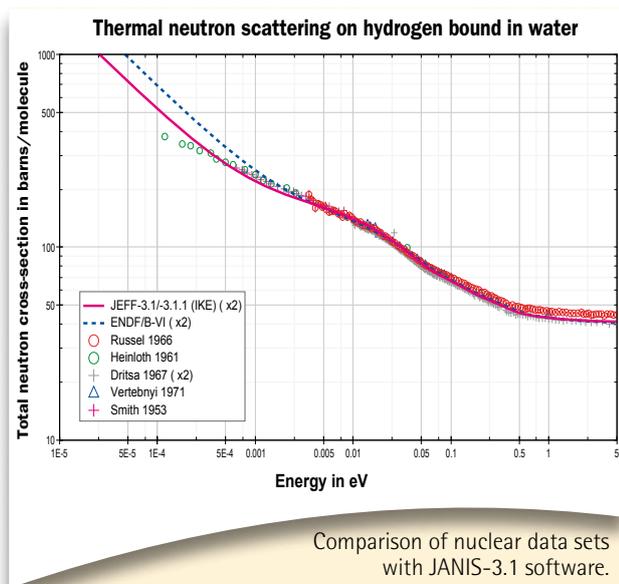
The Data Bank also assists other parts of the Agency, especially in the area of knowledge preservation. In co-operation with the NEA Nuclear Safety Division, experimental data from several international joint projects, such as those relevant for accident management, are maintained and distributed. The Data Bank is also providing support to the Information System on Occupational Exposure (ISOE) database, operated by the NEA Radiological Protection and Radioactive Waste Management Division.

Nuclear data services

The Data Bank maintains large databases containing bibliographic (CINDA), experimental (EXFOR) and evaluated (EVA) nuclear data, and makes these databases available online to scientists and engineers in member countries. In 2009, the Data Bank added data from 160 experiments on neutron- and charged-particle-induced data to the EXFOR database. It also supplemented the database with 270 experimental data sets which were revised following

feedback from users and from a subgroup of the NEA Nuclear Science Committee Working Party on International Nuclear Data Evaluation Co-operation (WPEC) specifically devoted to reviewing the quality of the EXFOR database.

An update of the nuclear data display software, JANIS-3.1, was released in December. The main improvements, apart from a number of corrections, include the possibility to display photon production data, thermal scattering cross-sections and isobaric fission yields, as well as a new tool to compare EXFOR data with evaluated libraries or to compare different evaluated libraries. The program can be downloaded or launched from the JANIS web page at www.nea.fr/janis.



The JEFF Project

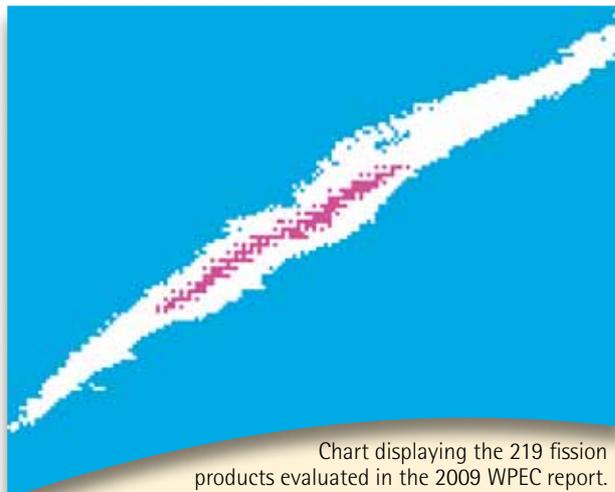
A new version of the Joint Evaluated Fission and Fusion (JEFF) data library, JEFF-3.1.1, was released in the beginning of 2009. Two JEFF reports were published: *The JEFF-3.1.1 Nuclear Data Library* (JEFF Report 22), disclosing the latest modifications to the library, and *The JEFF-3.1/-3.1.1 Radioactive Decay Data and Fission Yields Sub-libraries* (JEFF Report 20). Work on a report providing results from the validation of the JEFF-3.1/-3.1.1 data for fission and fusion applications is underway.

Plans for an improved version of the JEFF general purpose library (JEFF-3.2) have been made. A number of isotopic evaluations of the following elements have been identified for inclusion in the new library: manganese, hafnium, tantalum, tungsten, uranium, americium and plutonium.

International nuclear data evaluation co-operation

The NEA/NSC Working Party on International Nuclear Data Evaluation Co-operation (WPEC) provides a worldwide framework for improving the quality and completeness of evaluated nuclear data libraries and for promoting the efficient use of available resources through international collaboration. In 2009, a report was published entitled an *Evaluated Data Library for the Bulk of Fission Products*,

containing the description of the production and validation steps of a complete sub-library of evaluated data for fission product isotopes. This sub-library was included in the latest version of the ENDF/B-VII evaluated nuclear data library.



In addition to maintaining a high priority request list for nuclear data, the WPEC is also pursuing studies related to the production and processing of covariance data in different energy regions, a review of the quality of the experimental database EXFOR, a review of the uranium-235 capture cross-section in the keV to MeV energy region, and a study of methods and issues for the combined use of integral experiment and covariance data.

The Thermochemical Database (TDB) Project

Under the scientific guidance of the NEA Radioactive Waste Management Committee, the Data Bank evaluates recommended chemical thermodynamic data for the safety assessment of radioactive waste repositories. Details are provided in the section on Joint Projects and Other Co-operative Projects (see page 34).

In-house computer services

The Data Bank is responsible for the NEA in-house computer services comprising internet and data servers connected to a fast network. In 2009, the NEA internet server registered 1.1 million visits, during which 2.6 million web pages were browsed and some 3.3 terabytes were downloaded.



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Nuclear Law Committee (NLC)

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

Highlights

- Member countries which are party to the Paris and Brussels Supplementary Conventions on third party liability progressed towards implementing into their national legislation the provisions of the protocols to amend those conventions which were adopted in 2004.
- An overview of nuclear operator liability amounts and financial security limits was made available on the NEA website, covering all major nuclear electricity generating countries in the world.
- The NLC held a special topical session addressing the international regulatory framework for transboundary movements of radioactive waste and the legal issues that may arise relating to the "nationality" of radioactive waste.
- Two issues of the *Nuclear Law Bulletin* (NLB) were published containing topical articles on, *inter alia*, the review conference mechanism in nuclear law, nuclear-weapon-free zone treaties, nuclear new build, the new European Union (EU) Directive on nuclear safety, nuclear third party liability in the EU, the resurgence of nuclear energy in Italy and the International Thermonuclear Experimental Reactor (ITER) project on nuclear fusion.
- The ninth session of the International School of Nuclear Law was successfully held at the University of Montpellier 1.

Development and harmonisation of nuclear legislation

Ensuring adequate and equitable compensation for third party damage caused by a nuclear incident continued to attract the highest level of attention amongst member countries. Those which are party to the Paris and Brussels Supplementary Conventions on nuclear third party liability worked towards implementing the 2004 protocols amending those conventions. Several of them are facing delays

in implementation because private nuclear risk insurers are unable to provide full coverage for certain risks which nuclear operators are obliged to assume under the newly revised conventions; such risks include the cost of reinstating an impaired environment and extended prescription periods.

An overview of operator liability amounts and financial security limits was made available on the NEA website. It includes information on NEA member countries and virtually all other countries party to any international nuclear third party liability regime. It is based on information received from authorities in the respective countries, and can be found at www.nea.fr/html/law/legal-documents.html.

In many member countries, legal instruments are seen as the best means of enabling debate by all stakeholders on proposed nuclear projects to ensure that potentially adverse effects are either prevented or acceptably mitigated. The NLC assessed some of the processes that are used in member countries to ensure access to information on nuclear activities, noting that it is difficult for regulators and governments to find the right balance between the need for transparency towards the public and policy makers to allow for informed decision making, and the need to protect confidential information that is either commercially valuable or, if used in a malevolent manner, could pose risks to public health, safety and security. It further addressed the importance of legislative frameworks for stakeholder involvement and environmental impact assessments in nuclear decision making, such as selecting a site for radioactive waste management or licensing a new reactor.

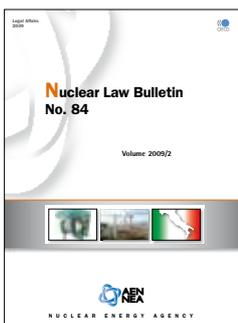
The NLC held a special topical session during a regular meeting addressing the nationality of radioactive waste and associated disposal issues. The session was designed to inform members of the NLC of the international regulatory framework governing transboundary movements of radioactive waste and of legal issues that may arise relating to the "nationality" of radioactive waste, including the disposal of radioactive waste of foreign origin. Referring to the patchwork of national legislative regimes that exists in the 30 OECD member countries, many delegates considered a single import and export approach for all OECD countries to be unachievable even though it might bring with it economies of scale. All NLC representatives did agree, however, that it is the responsibility of those OECD countries which generate radioactive waste to determine the appropriate long-term solutions for managing that waste.



2009 session of the International School of Nuclear Law.

Both the NLC and the NEA Legal Affairs Section were active in providing legal input to the NEA Committee on Radiation Protection and Public Health (CRPPH) and its Working Party on Nuclear Emergency Matters (WPNEM). They participated in meetings of the WPNEM programme committees and will contribute to both the 2010 Workshop on Stakeholder Involvement in Post-Emergency Management and the Fourth International Nuclear Emergency Management Exercise (INEX-4), which will be conducted by the WPNEM in 2010-2011.

Nuclear law publication programme



The 83rd and the 84th issues of the *Nuclear Law Bulletin* were published in June and December 2009 respectively. This unique, bilingual periodical provides up-to-date information on national and international developments in legislation, regulations and case law in the nuclear law field and includes articles and studies analysing those developments.

It has proven to be an invaluable tool for both professionals and academics. In the context of current discussions on nuclear new build, the *Nuclear Law Bulletin* has increased its focus on related articles and on bilateral and multilateral agreements. All but the latest three editions of the NLB are available online at www.nea.fr/html/law/nlb. The most recent editions are available on subscription through the OECD bookshop at www.oecdbookshop.org.

Country profiles on the regulatory and institutional framework for nuclear activities in OECD member countries are available at www.nea.fr/html/law/legislation/. A large majority of the country profiles were updated in 2009. The NEA website also proposes a listing of "Latest Legislative Developments", which tracks recent nuclear legislative

events even prior to their publication in the *Nuclear Law Bulletin*; it can be found at www.nea.fr/html/law/legislation/updates.html.

Nuclear law educational programme

The ninth session of the International School of Nuclear Law (ISNL) was held in August-September in co-operation with the University of Montpellier 1, France. Established in 2001, the ISNL aims to provide high-quality education in international nuclear law to students and legal professionals through an intensive training course. It benefits from professional expertise provided by the OECD/NEA and the International Atomic Energy Agency (IAEA). The 2010 session marks the tenth anniversary of the ISNL which is scheduled to be held from 23 August to 3 September. Further information may be obtained at www.nea.fr/html/law/isnl/.

The fifth Summer Institute of the World Nuclear University (WNU), an intensive six-week programme aimed at building future leadership in nuclear science and technology, took place at Oxford University in the United Kingdom where it is expected to make its permanent home. NEA Legal Affairs and the IAEA Office of Legal Affairs coordinated the nuclear law component. Representatives from NEA Legal Affairs also gave lectures at the WNU-organised, week-long courses held in China and Korea on key nuclear energy issues.



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Joint Projects and Other Co-operative Projects

NUCLEAR SAFETY RESEARCH

The Halden Reactor Project

The Halden Reactor Project is operated by the Norwegian Institute for Energy Technology (IFE). It has been in operation since 1958 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 prototype developments and analyses carried out at the Halden establishment in Norway. It is supported by approximately 100 organisations in 18 countries. The Halden Project benefits from stable and well-experienced organisation and a technical infrastructure that has undergone substantial developments throughout the years. The project objectives have been continuously adapted to users' needs.

In 2009, Halden began a new three-year mandate. Work in the fuel area included continued testing under loss-of-coolant accident (LOCA) conditions, carried out with high burn-up fuel. These are the only LOCA tests that are currently being performed in-pile worldwide, and complement the work done at laboratory scale in other institutions, notably in Japan and the United States. The tests carried out have provided valuable insights and have been the basis for benchmarking exercises carried out by the Working Group on Fuel Safety Properties of UO₂, gadolinia and MOX fuels under a variety of conditions relevant to operation and licensing. Long-term irradiations have been carried out with advanced and standard nuclear fuel at high initial rating conditions. Corrosion and creep behaviour of various alloys were studied. The experimental programme on the effect of water chemistry variants on fuel and reactor internals materials has been expanded. Tests to investigate the cracking behaviour of reactor internals materials in BWRs and PWRs continued, with the aim of characterising the effect of water chemistry and material ageing. The work on cable ageing has produced a technique that is being used for assessing insulation damage, and in those cases to determine the extent and location of the damage.

The programme on human factors has focused on experiments in the Halden man-machine laboratory, related data analyses, new control station designs, evaluations of human-system interfaces, process and instrumentation optimisation, and digital instrumentation and control (I&C). This involves *inter alia* the use of the Halden Virtual Reality Facility. Progress has been made in the area of human reliability assessment (HRA), aiming to provide data suitable for probabilistic safety assessments and to improve the validity of HRA methods.

The main results of the programme were reported at two Programme Group meetings held in the Slovak Republic in May and in Norway in October. The Halden Board also met twice in 2009.

The BIP Project

The Behaviour of Iodine Project (BIP), which is supported by 13 member countries, began in 2007. The work consists of separate effect and modelling studies that will augment and complement larger national and international experimental programmes. In addition, it will provide data and interpretation from three Radioiodine Test Facility (RTF) experiments. The project for iodine experiments, hosted by Atomic Energy of Canada Limited (AECL), pools international resources to achieve a consolidated understanding of the behaviour of iodine and other fission products in post-accident nuclear reactor containment buildings. Specific technical objectives that this programme hopes to achieve are:

- quantification of the relative contributions of homogeneous bulk aqueous phase processes, homogeneous aqueous phase processes in paint pores and heterogeneous processes on surfaces to organic iodine formation;
- the measurement of adsorption/desorption rate constants on containment surfaces as a function of temperature, relative humidity and carrier-gas composition;
- the provision of RTF data to participants, for use in collaborative model development and validation.

Two meetings of the project steering bodies were held in 2009 and were devoted to discussing the test results as well as the parameters and boundary conditions to be chosen for the remaining tests. Analytical work performed by participants enabled progress in model qualification for the iodine behaviour in the containment, and in the understanding of containment paint behaviour.

The Cabri Water Loop Project

The Cabri Water Loop Project, which began in 2000, is investigating the ability of high burn-up fuel to withstand the sharp power peaks that can occur in power reactors due to postulated rapid reactivity insertions in the core (RIA accidents). The project participants, from 13 member countries, intend to determine the limits for fuel failure and the potential consequences of possible ejection of fuel into the coolant environment. Different cladding materials and fuel types are being studied. Project execution involves substantial facility modifications and upgrades, and consists of 12 experiments with fuel retrieved from power reactors and refabricated to suitable length. The experimental work is being carried out at the *Institut de radio-protection et de sûreté nucléaire* (IRSN) in Cadarache, France, where the Cabri reactor is located. Programme execution can, however, involve laboratories in participating organisations, for instance, in relation to fuel fabrication and characterisation and instrumentation.

Two tests (still using the sodium loop) were carried out with high burn-up fuel having zirconium-niobium cladding material. Fuel that had been in service in Spanish and

French reactors, respectively with ZIRLO and M5 cladding, and with burn-up in excess of 70 MWd/kg, was subjected to a ~ 100 cal/g energy injection during the transients. No fuel failure was registered. Appreciable progress was made on the reconstruction of the reactor and the construction of the water loop test facility, with the new core envelope and the security tube of the pressurised water loop being implemented. In July 2009, a regulation hydrotest of the pressurised water loop was successfully carried out. The resumption of the tests in the framework of the Cabri Water Loop Project is expected in early 2011.

The Cabri tests are being complemented by additional reactivity-initiated accident (RIA) tests performed in Japan. These tests, which constitute the in-kind contribution from the Japan Atomic Energy Agency (JAEA) for its participation in the Cabri Project, will be carried out at both cold and hot coolant conditions and with both BWR and PWR fuel.

A meeting of the Cabri Technical Advisory Group was held in January 2009. A meeting of the Project Steering Committee was held in December 2009 in Paris.

The MCCI-2 Project

The aim of the Melt Coolability and Concrete Interaction (MCCI) Project is to provide experimental data on relevant severe accident phenomena 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. The programme utilises the unique expertise and infrastructure that have been developed at Argonne National Laboratory (ANL) for conducting large-scale, high-temperature reactor materials experiments. The US Nuclear Regulatory Commission (NRC) acts as the project Operating Agent.

The first phase of the programme (MCCI-1) was completed in 2005. The experiments on water ingress mechanisms showed that cooling of the melt by water is reduced at increasing concrete content, implying that water flooding is more effective in the early phase of the melt-concrete interaction. The effect of concrete type, i.e. siliceous and limestone types (used respectively in Europe and the United States), was also addressed in the first phase of the programme. Material properties such as porosity and permeability were derived. Tests also showed appreciable differences in ablation rate for siliceous and limestone concrete, which is a relevant finding that requires confirmation. A workshop on the results of MCCI-1 was organised in France in October 2007.

The second three-year programme (MCCI-2) started in 2006 and is to be completed in early 2010. Emphasis is being placed on 2D core-concrete interaction experiments, as they provide the integrated effect of many processes. The MCCI-2 Project involves organisations from 12 member countries. Two meetings of the project steering bodies were held in 2009. On these occasions, the tests results on core-concrete interaction and the test conditions for the molten core cooling test were discussed. The last meeting is sched-

uled for February 2010 to review the results of the final integral test. It is planned to organise a workshop in late 2010 to draw the lessons learnt from this project.

The PKL-2 Project

A first PKL Project was performed from 2004 to 2007 and consisted of experiments carried out in the *Primär Kreislauf* (PKL) thermal-hydraulic facility, which is operated by AREVA NP in its establishment at Erlangen, Germany. Organisations from 14 countries participated. These PKL experiments focused on the following PWR issues that have been receiving great attention within the international reactor safety community: boron dilution events after small-break, loss-of-coolant accidents (LOCAs); loss of residual heat removal during mid-loop operation with a closed reactor coolant system in context with boron dilution; and loss of residual heat removal during mid-loop operation with an open reactor coolant system.

A second phase of the project, using the same PKL loop together with the PMK loop in Hungary and the ROCOM facility at Dresden-Rossendorf (FZD), started in 2008 with the support of 14 countries. The PKL-2 tests are investigating safety issues relevant for current PWR plants as well as for new PWR design concepts. They are focusing on complex heat transfer mechanisms in the steam generators and boron precipitation processes under postulated accident situations.

Two meetings of the steering bodies were held in 2009 during which the results of the first tests were presented and the test conditions for the following series of tests were discussed.

The PRISME Project

Fire is a significant contributor to overall core damage frequency for both new and old plant designs. Questions of fire probabilistic safety analysis (PSA) that still remain open are the following:

- the propagation of heat and smoke from the room in which the fire is located to other rooms;
- the impact of heat and smoke on safety critical systems;
- the role of the ventilation network in limiting smoke and heat propagation.

The Fire Propagation in Elementary, Multi-room Scenarios (PRISME) Project (from the French *Propagation d'un incendie pour des scénarios multi-locaux élémentaires*) began in 2006 and has 13 participating countries. The project's objective is to answer questions concerning smoke and heat propagation inside a plant by means of experiments tailored for code validation purposes. In particular, the project aims to provide answers regarding the failure time for equipment situated in nearby rooms and the effect of conditions such as room-to-room communication and the configuration of the ventilation network. The results obtained for the experimentally studied scenarios will be used as a basis for qualifying fire codes (either simplified zone model codes or computational fluid dynamics codes). After qualification, these codes could be applied for simulating other fire propagation scenarios in various room configurations with a good degree of confidence.

Tests were carried out and reported upon as scheduled in 2009. Two meetings of the project steering bodies were held in April and October. The PRISME integral test scenarios were fully reviewed and the experimental conditions were agreed by the project members. The six integral tests will be conducted from April to November 2010.

The ROSA Project

A first Rig-of-safety assessment (ROSA) Project was carried out from April 2005 to March 2009 to address issues in thermal-hydraulics analyses relevant to LWR safety using the ROSA large-scale test facility of the Japan Atomic Energy Agency (JAEA). In particular, it focused on the validation of simulation models and methods for complex phenomena that may occur during transients/accidents. The project was supported by safety organisations, research laboratories and industry in 14 countries, and provided an integral and separate-effect experimental database to validate the code predictive capability and accuracy of models. In particular, temperature stratification and coolant mixing during emergency coolant injection, unstable and disruptive phenomena such as water hammer, natural circulation under high core power conditions, natural circulation with superheated steam, primary cooling through steam generator secondary depressurisation, and upper-head break and bottom break LOCA were addressed by the 12 tests carried out in this first phase. The project was successfully completed and the final report is under preparation.

A second phase of the project, called ROSA-2 and using the same large-scale test facility (LSTF), started in April 2009 with the support of 14 countries. The ROSA-2 programme is to last for three years and will consist of six tests. The subjects will be:

- intermediate break LOCAs (for risk-informed, break-size definition and verification of safety analysis codes);
- steam generator tube rupture (SGTR) and SGTR with steam line break (for improvement and new proposals regarding accident management and mitigation/emergency operation).

These tests will benefit from the utilisation of instruments newly acquired during the first ROSA Project.

The SCIP Project

The Studsvik Cladding Integrity Project (SCIP) started in July 2004 and completed its first five-year mandate in 2009, when several power ramps and a hot cell programme addressing the various failure mechanisms were executed. The nuclear fuel failure mechanisms studied in the project are:

- pellet-clad interaction (PCI): stress corrosion cracking initiated at the cladding inner surface under the combined effect of the mechanical loading and chemical environment caused by an increase in the fuel pellet temperature following a power increase;
- hydride embrittlement: time-independent fracture of existing hydrides;
- delayed hydride cracking (DHC): time-dependent crack initiation and propagation through fracture of hydrides that can form ahead of the crack tip.

In December 2008, all members of the project steering bodies indicated their interest in continuing the project for another five-year period. SCIP-2 thus began in July 2009 with the participation of 13 countries (two more than in the first phase). The main objective of SCIP-2 is to generate the high-quality experimental data needed for improving the understanding of dominant failure mechanisms for water reactor fuels and to devise means for reducing fuel failures. The major focus will be on cladding failures caused by pellet-cladding mechanical interaction, especially stress corrosion and hydrogen-assisted fracture mechanisms, as well as on the propagation of cladding cracks. Improved understanding based on experiments and analyses is needed in order to reduce the occurrence, or the risk of occurrence, of fuel failures. This understanding is to be applicable to pellet-cladding interaction conditions that can arise during normal operation or anticipated transients, as well as during long-term fuel storage. The proposed programme is intended to complement other international projects in the fuel area. Extensive analyses and theoretical modelling of the fracture mechanisms are to accompany the experimental programme.

In addition to reviewing existing Studsvik ramp data, the project will study the following fuel failure mechanisms:

- pellet-cladding mechanical interaction (PCMI), the mechanical driving force for PCI and hydrogen-induced failures;
- pellet-cladding interaction (PCI), notably when cladding fails due to stress corrosion cracking;
- hydrogen-induced failures: in particular as regards zirconium alloys, classical hydride embrittlement (HE) and delayed hydrogen cracking (DHC).



The ROSA large-scale test facility (LSTF).

JAEA

Two meetings of the project steering bodies took place in 2009. In addition, a workshop was held on hydrogen-induced failures.

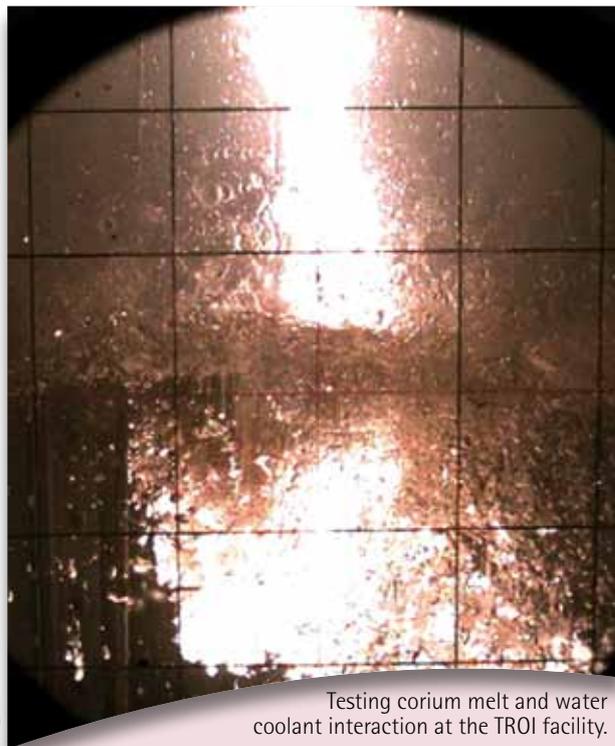
The SERENA Project

The Steam Explosion Resolution for Nuclear Application (SERENA) Project was launched in 2007 with nine member countries participating. Its predecessor programme sought to evaluate the capabilities of the current generation of fuel-coolant interaction (FCI) computer codes in predicting steam-explosion-induced loads in reactor situations, and to identify confirmatory research that would be needed to bring predictability of FCI energetics to required levels for risk management. The programme concluded that in-vessel FCI would not challenge the integrity of the containment whereas this cannot be excluded for ex-vessel FCI. However, the large scatter of the predictions indicated lack of understanding in some areas, which makes it difficult to quantify containment safety margins to ex-vessel steam explosion. The results clearly indicated that uncertainties on the role of void (gas content and distribution) and corium melt properties on initial conditions (pre-mixing) and propagation of the explosion were the key issues to be resolved to reduce the scatter of the predictions to acceptable levels. Past experimental data does not have the required level of detail to answer the question.

The present programme has been formulated to resolve the remaining uncertainties by performing a limited number of focused tests with advanced instrumentation reflecting a large spectrum of ex-vessel melt compositions and conditions, as well as the required analytical work to bring the code capabilities to a sufficient level for use in reactor case analyses. The objective of the SERENA experimental programme is threefold:

- to provide experimental data to clarify the explosion behaviour of prototypic corium melts;
- to provide experimental data for validation of explosion models for prototypic materials, including spatial distribution of fuel and void during the pre-mixing and at the time of explosion, and explosion dynamics;
- to provide experimental data for the steam explosion in more reactor-like situations to verify the geometrical extrapolation capabilities of the codes.

These goals will be achieved by using the complementary features of the TROI (Korea Atomic Energy Research Institute) and KROTOS (French *Commissariat à l'énergie atomique*) corium facilities, including analytical activities. The KROTOS facility is more suited for investigating the intrinsic FCI characteristics in one-dimensional geometry. The TROI facility is better suited for testing the FCI behaviour of these materials in reactor-like conditions by having more mass and multi-dimensional, melt-water interaction geometry. The validation of models against KROTOS data and the verification of code capabilities to calculate more reactor-oriented situations simulated in TROI will strengthen confidence in code applicability to reactor FCI scenarios. Two meetings of the steering bodies of this project were held in 2009 and the results of two new tests were presented and discussed, enabling a better specification of the test configurations to come. In parallel, analytical activities were undertaken to prepare and to assess these tests.



The SETH-2 Project

The SESAR Thermal-hydraulics (SETH) Project, supported by 14 member countries, was conducted from 2001 to 2007. It consisted of thermal-hydraulic experiments in support of accident management, which were carried out at facilities identified by the CSNI as those requiring international collaboration to sponsor their continued operation. The experiments carried out at the Paul Scherrer Institute (PSI) PANDA facility in Switzerland provided 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.

A follow-up to the project, called SETH-2, was launched in 2007 and will make use of the PANDA facility and the MISTRA facility of the French *Commissariat à l'énergie atomique* (CEA). Nine countries are participating. The project aims to resolve key computational issues for the simulation of thermal-hydraulic conditions in reactor containments and will benefit from the complementarity of the two facilities. Two meetings of the project steering bodies were held in 2009 and were devoted to presenting the new test results and to discussing the parameters and boundary conditions to be chosen for the remaining test. The project is planned to be completed during 2010.

The SFP Project

The Sandia Fuel Project (SFP) is a new NEA project supported by 13 member countries, which began in 2009. The objective of the project is to perform a highly detailed thermal-hydraulic characterisation of full-length, commercial fuel assembly mock-ups to provide data for the direct validation of severe accident codes. Code predictions based on previous results indicate that fuel assemblies can ignite and radially propagate in a complete loss-of-coolant accident. Hence, there is a need for

qualified data obtained under representative fuel configurations. The experiments should focus on thermal-hydraulic and ignition phenomena in PWR 17x17 assemblies and supplement earlier results obtained for BWR assemblies. Code validations based on both the PWR and BWR experimental results will considerably enhance the code applicability to other fuel assembly designs and configurations.

The project is scheduled to last three years and to be conducted in two phases. Phase 1 will focus on axial heating and burn propagation. Phase 2 will address radial heating and burn propagation, and will include effects of fuel rod ballooning.

The first meeting of the project steering bodies was held in 2009 during which the programme of work for 2009 and 2010 was approved.

The THAI Project

The Thermal-hydraulics, Aerosols and Iodine (THAI) Project, is supported by eight member countries and began in 2007. It consists of thermal-hydraulic experiments aiming at resolving uncertainties related to combustible hydrogen and to the behaviour of fission products, in particular iodine and aerosols. The proposed experiments are designed to fill knowledge gaps by delivering suitable data for the evaluation and simulation of the hydrogen and fission product interactions mentioned above, thus supporting the validation of accident simulation codes and models. The experiments are conducted in the THAI facility, which is operated by Becker Technologies GmbH in Germany. The *Gesellschaft für Anlagen- und Reaktorsicherheit* (GRS) and AREVA NP also support the programme.

In the case of hydrogen, uncertainties mainly arise in relation to determining conditions for the occurrence of deflagration flames, and the performance of devices, such as passive autocatalytic recombiners (PARs), designed to reduce the concentration of hydrogen gas developed in a hypothetical accident. Some concern also exists regarding the applicability of several previous experiments where helium was used to simulate hydrogen. The relevance to reactor safety is connected with the destructive potential of fast deflagrations.

In the case of fission products, a number of transport processes have not yet been investigated to a level of detail sufficient to establish reliable transport models. Such processes include iodine exchange between turbulent atmospheres and walls, relocation by wash-down (washing the walls with condensate water), airborne chemical reaction of iodine with radiolytic ozone, and aerosol resuspension from a boiling sump. The control of volatile radioactive species is relevant to the potential accident source term and the radioactivity management.

In 2009, two meetings of the project steering bodies were held to discuss the results of the hydrogen recombiner tests, the PAR poisoning tests and the aerosol wash-down scoping test. Hydrogen distribution tests performed in 2007 are used to support the ISP-49 benchmark exercise conducted in co-operation with the CSNI Working Group on Analysis and Management of Accidents (WGAMA). A follow-up proposal has been proposed with a three-year programme addressing dust transport in advanced gas-

cooled reactors, hydrogen mitigation and iodine or aerosol behaviour in specific containment conditions.

NUCLEAR SAFETY DATABASES

The COMPSIS Project

The Computer-based Systems Important to Safety (COMPSIS) Project was undertaken in 2005 by ten member countries with an initial mandate of three years. A new three-year mandate began in January 2008. To the extent that analogue control systems are being replaced by software-based control systems in nuclear power plants worldwide, and that the failure modes of both hardware and software in these new systems are rare, there is a considerable advantage in bringing the experience of several countries together. By doing so, it is hoped to contribute to the improvement of safety management and to the quality of software risk analysis for software-based equipment.

Work during the first part of the project has concentrated on the development of the COMPSIS data collection guidelines, quality assurance and data exchange interface. Countries began submitting data in 2006, however the total number of event records in the database is still very low. One meeting of the COMPSIS steering body was held in 2009.

The FIRE Project

The Fire Incidents Records Exchange (FIRE) Project started in 2002. A third phase of the project is to start in January 2010 for an additional four years. Twelve countries participate. The main purpose of the project is to collect and to analyse data related to fire events in nuclear environments, on an international scale. The specific objectives are to:

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

The structure of the database is now well-defined and arrangements have been made in all participating countries to collect and to validate data. Similar to the OPDE Project, the group is reviewing and collecting past events in addition to events having taken place during the year. The quality-assurance process is in place and has proved to be efficient on the first set of data provided. An updated version of the database, which now contains more than 365 records, is provided to participants every year. Two

meetings of the project steering body were held during 2009. A report on the collection and analysis of fire events over the period 2002–2008 was produced.

The ICDE Project

The International Common-cause Data Exchange (ICDE) Project collects and analyses operating data related to common-cause failures (CCF) that have the potential to affect several systems, including safety systems. The project has been in operation since 1998, and was extended with a new agreement covering the period April 2008–March 2011. Eleven countries participate.

The ICDE Project comprises complete, partial and incipient common-cause failure events. The project currently 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, control rod drive mechanisms, reactor protection system circuit breakers, batteries and transmitters. These components have been selected because several probabilistic safety assessments have identified them as major risk contributors in the case of common-cause failures.

Qualitative insights from data will help reduce the number of CCF events that are risk contributors, and member countries use the data for their national risk analyses. Additional activities in the area of quantification are under discussion. Reports have been produced for pumps, diesel generators, motor-operated valves, safety and relief valves, check valves, batteries, switchgear and breakers, and reactor-level measurement. Data exchange for heat exchangers and control rod drive component exchange is ongoing and reports are planned for 2010. Two project meetings were held in 2009.

The OPDE Project

The Piping Failure Data Exchange (OPDE) Project started in 2002. A new three-year phase of the project was started in June 2008. Currently, 11 countries participate. The project 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 scope of the OPDE Project includes all possible events of interest with regard to piping failures in the main safety systems. It also covers non-safety piping systems that, if leaking, could lead to common-cause initiating events such as internal flooding of vital plant areas. Steam generator tubes are excluded from the OPDE Project scope. Specific items may be added or deleted upon decision of the Project Review Group. An updated version of the database is provided to participants every six months. One Project Review Group meeting was held in 2009.

A report was produced during 2009 describing the status of the OPDE database after six years of operation (from May 2002 to May 2008), and giving some insights based on the approximately 3 600 piping failure events in the database.

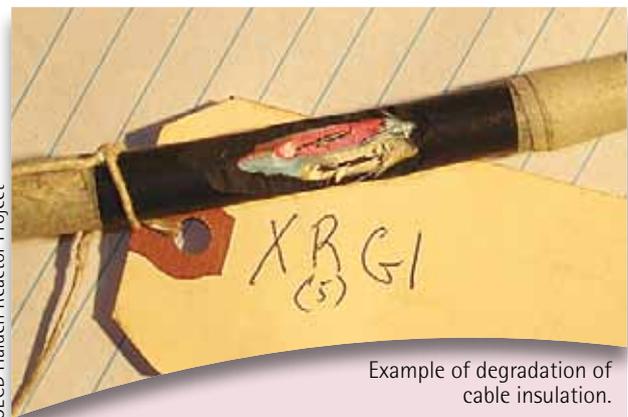
The SCAP Project

The Stress Corrosion Cracking and Cable Ageing Project (SCAP), which is supported by 15 member countries, began in 2006. The International Atomic Energy Agency (IAEA) and the European Commission also participate as observers. The project's main objectives are to:

- establish two complete databases with regard to major ageing phenomena for stress corrosion cracking (SCC) and degradation of cable insulation respectively;
- establish a knowledge base by compiling and evaluating collected data and information systematically;
- perform an assessment of the data and identify the basis for commendable practices which would help regulators and operators to enhance ageing management.

The project is scheduled to last four years and is currently focusing on the continuing population of the database as well as the assessment of the data. The assessment report will be issued at the end of the project and will provide the technical basis for commendable practices in support of regulatory activities in the fields of SCC and cable insulation.

The workshop on Commendable Practices for the Safe, Long-term Operation of Nuclear Reactors – OECD/NEA Stress Corrosion Cracking and Cable Ageing Project (SCAP) will take place on 25–26 May 2010 in Tokyo, Japan.



Example of degradation of cable insulation.

RADIOACTIVE WASTE MANAGEMENT

The CPD Programme

The NEA Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD) is a joint undertaking which functions within the framework of an agreement between 22 organisations actively executing or planning the decommissioning of nuclear facilities. It has operated under Article 5 of the NEA Statute since its inception in 1985, and a revised Agreement between

participants came into force on 1 January 2009 for a period of five years. The objective of the CPD is to acquire and to share information from operational experience in the decommissioning of nuclear installations that is useful for future projects.

The information exchange also ensures that best international practice is made widely available and encourages the application of safe, environmentally friendly and cost-effective methods in all decommissioning projects. It is based on biannual meetings of the Technical Advisory Group (TAG), during which the site of one of the participating projects is visited, and positive and less positive examples of decommissioning experience are openly exchanged for the benefit of all. Currently 51 projects under active decommissioning (31 reactors and 20 fuel facilities) are included in the information exchange.

Although part of the information exchanged within the CPD is confidential and restricted to programme participants, experience of general interest gained under the programme's auspices is released for broader use. In this context, the CPD is collecting and analysing its experience on decontamination and dismantling of concrete structures and on remote dismantling techniques.

The Sorption-3 Project

Radionuclide sorption is one of the most important processes with regard to the prevention or retardation of radionuclide migration from a geological repository to the biosphere, and the overriding objective of the Sorption Project is to demonstrate the potential of thermodynamic sorption models to improve confidence in the representation of radionuclide sorption in the context of radioactive waste disposal. This objective will be met if it can be shown that the major physical-chemical mechanisms underlying the sorption of a radioelement by different types of solid materials are understood, and if it can be demonstrated that it is possible to represent the process-defining parameters with reasonable accuracy as a function of variations in relevant system parameters.

After a first phase of the Sorption Project (1997-1998) investigating the potential of thermodynamic models for improving the presentation of sorption in performance assessments for geological repositories, and a second phase (2000-2004) demonstrating the consistency and applicability of different thermodynamic models, a third phase of the Sorption Project was started in November 2007 with a mandate until April 2010. Organisations involved in geological disposal from 12 countries are participating in the project. A guideline document will be produced on thermodynamic sorption model development and the use of such models in building a safety case.

The TDB Project

The Thermochemical Database (TDB) Project aims at meeting the specialised modelling requirements for safety assessments of radioactive waste disposal sites. Chemical thermodynamic data are collected and critically evaluated by expert review teams and the results are published in a series edited by the Data Bank. The project's current mandate runs from 2008 to 2012. Sixteen organisations from 14 countries are participating.

The review on chemical thermodynamic data for inorganic compounds and complexes of thorium (Volume 11) was published in early 2009. Completion and publication of the reviews of chemical thermodynamic data for inorganic compounds and complexes of iron (Fe) and tin (Sn) are scheduled for 2010. A study of inorganic species and compounds of molybdenum (Mo) and a review of ancillary data began in 2009 and will continue for four years. A complementary study of inorganic species and compounds of iron (Fe) will start in 2010.

RADIOLOGICAL PROTECTION

The ISOE System

Since its creation in 1992, the Information System on Occupational Exposure (ISOE), jointly sponsored by the IAEA, has been facilitating the exchange of data, analysis, lessons and experience in occupational radiological protection (RP) at nuclear power plants worldwide. The ISOE programme maintains the world's largest occupational exposure database and a network of utility and regulatory authority RP experts. As of December 2009, membership included 61 participating utilities in 27 countries and the regulatory authorities of 23 countries.

Four supporting ISOE Technical Centres (Europe, North America, Asia and the IAEA) manage the programme's day-to-day technical operations of analysis and exchange of information and experience. The ISOE occupational exposure database itself contains information on occupational exposure levels and trends at 471 reactor units in 29 countries (395 operating units and 76 under decommissioning), thus covering about 90% of the world's operating commercial power reactors. The ISOE database, publications and annual symposia along with the ISOE Network website facilitate the exchange amongst participants of operational experience and lessons learnt in the optimisation of occupational radiological protection.

In 2009, the ISOE programme continued to concentrate on the exchange of data, analysis, good practice and experience in the area of occupational exposure reduction at nuclear power plants, on improving the quality of its occupational exposure database and on migrating ISOE resources to the ISOE Network website. The four regional ISOE Technical Centres continued to support their regional members through specialised data analyses and benchmarking visits.

ISOE information and experience exchange also continued in 2009 through the International ALARA Symposium held in Vienna, and the regional ALARA symposia held in the United States and Japan. The ISOE Network web-based information portal (www.isoe-network.net) forged ahead as a "one-stop" website for ISOE information and experience exchange. In 2009, the website underwent a significant upgrade and the new web-based input modules for occupational exposure data collection were completed and approved for implementation. The ISOE ad hoc expert group for the revision of the International Basic Safety Standards (BSS) continued to provide, through the CRPPH, input into the BSS revision process with respect to good practice in occupational exposure.

Technical Secretariat



Generation IV International Forum (GIF)

Four generations of nuclear power plants are typically identified: the early prototype reactors of the 1950s as the first generation; the commercial power reactors developed in the 1970s, which still represent the vast majority of the 436 operating plants in 2010, as the second generation; reactors such as the ABWR, the AP1000 or the EPR, derived from Generation II concepts and recently built or under construction, as the third generation; and finally the fourth generation under development.

The Generation IV International Forum (GIF) was launched in 2000 as a co-operative international endeavour seeking to develop the research necessary to test the feasibility and performance of fourth generation nuclear systems, and to make them available for industrial deployment by 2030. The goals of fourth generation plants are to improve sustainability (including effective fuel utilisation and minimisation of waste), economics (competitiveness with respect to other energy sources), safety and reliability (for example, no need for offsite emergency response), and proliferation resistance and physical protection.

After a thorough review of roughly 100 concepts in 2002, GIF members selected six systems for further R&D: the gas-cooled fast reactor (GFR), the lead-cooled fast reactor (LFR), the molten salt reactor (MSR), the sodium-cooled fast reactor (SFR), the supercritical-water-cooled reactor (SCWR) and the very-high-temperature reactor (VHTR). These systems are described in the Technology Roadmap for Generation IV Nuclear Energy Systems, available on the GIF public website (www.gen-4.org/).

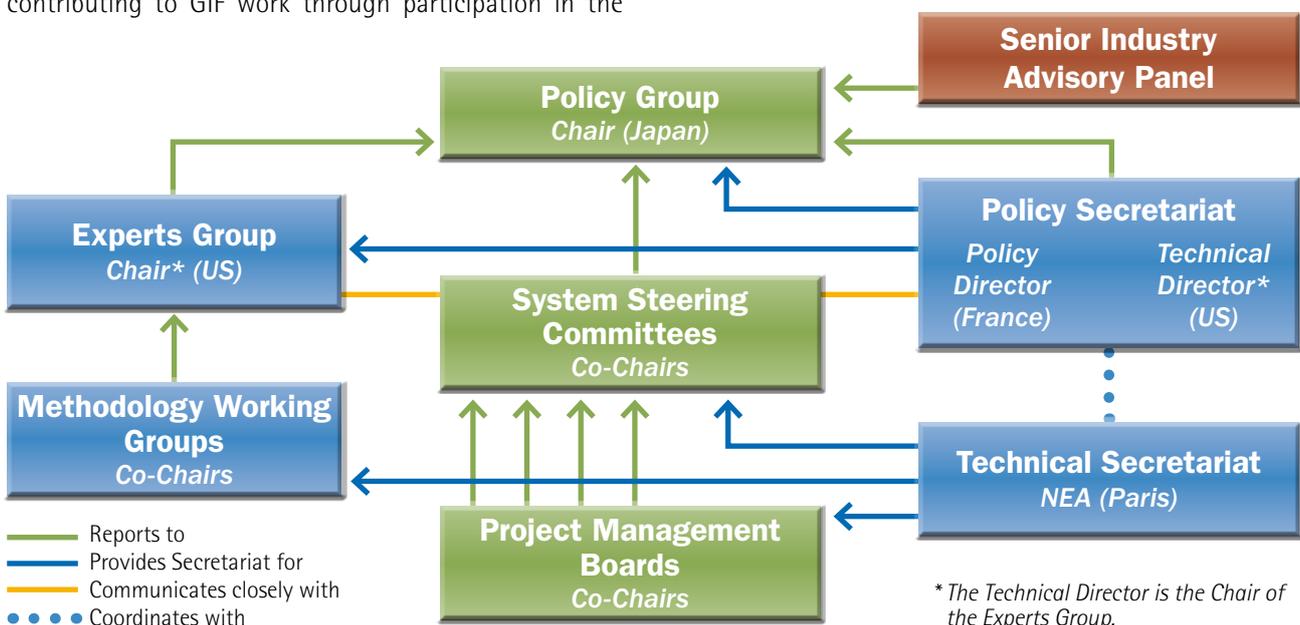
Membership in the GIF requires the signature of two major documents: the Charter of the Generation IV International Forum and the intergovernmental Framework Agreement for International Collaboration on Research and Development of Generation IV Nuclear Energy Systems. In 2009, the GIF had ten active members, i.e. the members who have signed the Charter and signed, ratified or acceded to the Framework Agreement, and are effectively contributing to GIF work through participation in the

System Steering Committees (SSC) and associated Project Management Board (PMB) of at least one of the six systems selected, or through the design of a plant or base studies (e.g. materials) in support of such a design. These members are Canada, China, Euratom, France, Japan, the Republic of Korea, the Republic of South Africa, the Russian Federation, Switzerland and the United States.

The GIF is led by the Policy Group (PG), to which all members can nominate up to two representatives. In 2003, the PG asked the NEA to provide Technical Secretariat support to the six SSCs and their associated PMBs, which are in charge of the systems development, and to the three Methodology Working Groups (MWG) on Economic Modelling, Risk and Safety, and Proliferation Resistance and Physical Protection. The NEA Steering Committee acknowledged that this role is consistent with the NEA mission, and requested that it be kept informed regularly of the corresponding ongoing activities.

In addition to supporting the SSCs, PMBs and MWGs, the NEA is hosting and managing the two GIF websites. The most important is the one restricted to GIF members, which gathers all GIF information (including meeting minutes and technical contributions to the GIF). The other is open to the public. The NEA is also providing support for the preparation and management of legal documents regarding GIF activities (such as the System or Project Arrangements), including the signature process and archiving. In 2009, Technical Secretariat support was provided for approximately 50 meetings as well as the organisation of the first GIF Symposium, held in Paris and embedded in the Global 2009 conference. This symposium provided an opportunity to widely communicate the achievements and goals for the different systems; those interested may consult the symposium proceedings on the GIF public website.

The NEA is fully compensated for its support to GIF activities through voluntary, financial and in-kind contributions made by individual GIF members.



Multinational Design Evaluation Programme (MDEP)

The MDEP is a unique international initiative undertaken by the nuclear regulators of Canada, China, Finland, France, Japan, the Republic of Korea, the Russian Federation, South Africa, the United Kingdom and the United States with the purposes of co-operating on safety design reviews of new reactors and identifying opportunities for possible harmonisation and convergence on safety licensing review practices and requirements. The International Atomic Energy Agency (IAEA) participates in many of the MDEP activities, including the harmonisation efforts.

2009 highlights

At its March 2009 annual meeting, the MDEP Policy Group, which is comprised of the heads of the ten participating national regulatory bodies, approved the conversion of the MDEP into a long-term programme that should focus on specific interim results. The Policy Group also directed the MDEP to communicate the results and achievements of MDEP activities more widely, notably to stakeholders in the industry and to non-MDEP regulators. In its role as Technical Secretariat, the NEA in co-operation with the MDEP country representatives organised and helped successfully conduct at the OECD Conference Centre, on 10-11 September 2009, the first MDEP Conference on New Reactor Design Activities to support efforts to communicate MDEP activities to important stakeholders including reactor vendors, suppliers, operators, standards development organisations, other industry entities and non-MDEP regulators. Over 170 people attended from 23 countries and 11 international organisations.

In organisational terms, in addition to the Policy Group which provides overall objectives and guidance for the

Programme, the MDEP Steering Technical Committee implements MDEP activities and directs the various working groups, such as the two design-specific and three issue-specific working groups.

The design-specific working groups include the EPR Working Group and the AP1000 Working Group, which co-operate on the safety reviews of AREVA's European pressurised reactor (EPR) and Westinghouse's AP1000 designs. The EPR Working Group includes regulators from China, Canada, Finland, France, the United Kingdom and the United States. The AP1000 Working Group involves the regulators facing reviews of that design such as Canada, China, the United Kingdom and the United States.

The issue-specific working groups have been tasked with studying the similarities and differences in regulatory requirements and practices. For instance, in the Codes and Standards Working Group, the MDEP regulators are working with the various mechanical codes standards development organisations to study why and how the codes differ among the MDEP participating countries. Similar efforts are being undertaken by the Digital Instrumentation and Control Working Group, but in the field of digital control and safety systems. The Vendor Inspection Co-operation Working Group is coordinating inspections of reactor parts manufacturers among interested MDEP countries.

Overall, the MDEP continued to make progress in 2009 on sharing design review information to ensure the safety of new reactors. MDEP efforts are proving to be key to understanding the differences and similarities among regulatory review and licensing requirements and practices, and are helping to identify opportunities for harmonisation and convergence of licensing approaches.



The MDEP Conference on New Reactor Design Activities, September 2009.

General Information



Information and Communications

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

Highlights

- The Agency produced 54 publications in 2009, of which 13 were put on sale and 41 were distributed free of charge.
- Five press releases were issued on a diverse range of topics, including on the shortage of medical radioisotopes and the intervention by the OECD Secretary-General at the International Ministerial Conference on Nuclear Energy in the 21st Century, held in Beijing, China.
- A policy paper on "Nuclear Energy and Addressing Climate Change" was released in conjunction with COP-15 in Copenhagen, made available on the NEA website and widely distributed throughout the NEA professional network.
- NEA information and publications stands were organised at seven international conferences.



A.-C. Lacoste and L. Echávarri at the MDEP press conference.

The NEA is an intergovernmental agency specialised in studying the scientific, technical and economic aspects of nuclear energy. It strives to provide high-quality, factual information in a timely manner essentially to its member countries. Through a varied information and communications programme, this information is also made available to other interested parties wishing to learn about nuclear energy's multiple aspects and the results of the Agency's work. All NEA activities are reflected in the Agency's large selection of publications and reports.

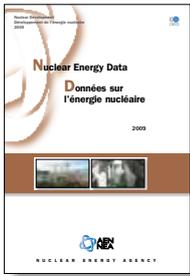
Public affairs and relations with the media

Contacts with the media were strong in 2009. One of the year's highlights was the press conference organised in September, in the margins of the Multinational Design Evaluation Programme (MDEP) Conference. MDEP objectives and initial outcomes were communicated by Messrs. A.-C. Lacoste, Chairman of the French Nuclear Safety Authority (ASN), G.B. Jaczko, Chairman of the US Nuclear Regulatory Commission (NRC) and L. Echávarri, NEA

Director-General, all three of whom also took questions from the floor. Journalists showed keen interest in this international initiative and reported on it widely.

Five press releases were issued, covering the security of supply of medical radioisotopes on two occasions, the intervention by the OECD Secretary-General at the International Ministerial Conference on Nuclear Energy in the 21st Century, the MDEP Conference and highlights from *Nuclear Energy Data 2009*. Journalists from Finland, France, Korea, the Slovak Republic, Spain, the United Kingdom and the United States requested further details regarding the renewed interest in nuclear energy and the decisions taken by a number of OECD and non-OECD countries to launch or to resume civil nuclear energy programmes. In parallel, the NEA also responded to a steady stream of media requests for nuclear figures, reflecting the Agency's position as a recognised source of reliable data and analyses. A prime example was the role of the NEA and its data in the online debate on uranium resources. Other subjects of media interest included the Generation IV International Forum (GIF), nuclear energy and climate change, trade of nuclear material and equipment, and nuclear fuel banks.

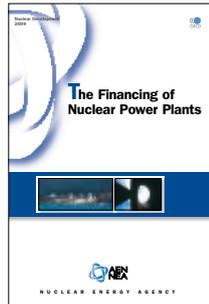
The online, password-protected area for accredited journalists continued to offer access to selected NEA publications on sale. This service has helped improve the speed of delivery, cost-effectiveness in terms of distribution and outreach.



Publications

In 2009, the Agency produced 54 publications, of which 13 were put on sale and 41 were distributed free of charge. The list of these publications is provided on page 46. Best sellers included the *Nuclear Law Bulletin*, *Nuclear Energy Data 2009*, *The Financing of Nuclear Power*

Plants and *Considering Timescales in the Post-closure Safety of Geological Disposal of Radioactive Waste*. NEA publications on sale are also being made widely available via Google Books and the OECD/NEA Nuclear Energy iLibrary. Five out of the top 12 OECD reports consulted via Google Books were NEA publications. The top two for the NEA were *Projected Costs of Generating Electricity: 2005 Update* with 4 847 visits and 92 799 pages viewed, and *Uranium 2007: Resources, Production and Demand* with 2 933 and 58 618 pages viewed. All free reports published by the NEA are made available in pdf format on the NEA website.



NEA News is the Agency's specialised journal, published in English and French, which strives to keep NEA correspondents and other interested professionals abreast of significant findings and advances in the Agency's programme of work. It provides 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. *NEA News* is available free of charge on the Agency's website at www.nea.fr/html/pub.

Internet-based communication

The NEA website continues to play a crucial role in disseminating the work of the Agency. Website traffic increased during 2009, rising to an average of over 3 400 users per day. The areas that attracted the most visitors in order of magnitude were the Data Bank, nuclear science, nuclear safety, publications and radioactive waste management. The most accessed reports in the course of the year were *Penelope 2008 - A Code System for Monte Carlo Simulation of Electron and Photon Transport* (79 000 downloads); *Nuclear Energy Today* (39 000 downloads); *Improving Nuclear Regulation* (31 000 downloads); *Chernobyl: Assessment of Radiological and Health Impacts* (27 000 downloads); and *Nuclear Fuel Cycle Transition Scenario Studies* (25 000 downloads).

The number of individual subscriptions to the Agency's *Monthly News Bulletin* was greatly increased to over 20 000 subscribers by the end of the year. Distributed free of charge, the bulletin includes monthly updates on important NEA activities and newly released reports. A sign-up form is available at www.nea.fr/general/register.

Online interaction with NEA delegates continues to expand. Most NEA committees and their working groups use some form of electronic communication, such as dedicated download areas, e-mail discussion lists or online collaborative work spaces to support their work; many now use several.

The Delegates' Area on the NEA website also continues to provide an important service for many NEA committees and working groups. This section of the website provides authorised users with OECD official documents, information on forthcoming NEA meetings, contact details for other committee members, as well as access to the presentations and background notes prepared for the Steering Committee policy debates.

Considerable preparatory work was carried out to modernise the Agency's website. The new design with its improved structure is scheduled to be launched in March 2010. Your feedback on the look and performance of the website is always welcome.

NEA visibility in international fora

NEA information and publications stands were organised at seven international conferences in 2009. These included:

- International Ministerial Conference on Nuclear Energy in the 21st Century (April, Beijing, China);
- Fourth Information Exchange Meeting on the Nuclear Production of Hydrogen (April, Chicago, Illinois, USA);
- Japan Atomic Industrial Forum (JAIF) Annual Conference (April, Tokyo, Japan);
- OECD Forum 2009 (June, Paris, France);
- Global 2009 and Top Fuel 2009, including the Generation IV International Forum (GIF) Symposium (September, Paris, France);
- American Nuclear Society (ANS) Winter Meeting (November, Washington DC, USA);
- United Nations Framework Convention on Climate Change, 15th Conference of the Parties (December, Copenhagen, Denmark).

Some 4 000 reports were distributed in conjunction with these events. The NEA was also active in co-sponsoring a number of international conferences. Of particular note were the International Ministerial Conference on Nuclear Energy in the 21st Century held in April in China, the Sixth International Symposium on the Release of Radioactive Materials from Regulatory Requirements – Provisions for Exemption and Clearance held in September in Germany, the Conference on Faults and Top Seals – From Pore to Basin Scale held in September in France, the International Conference on Opportunities and Challenges for Water-cooled Reactors in the 21st Century held in October in Austria, and the International Conference on Fast Reactors and Related Fuel Cycles – Challenges and Opportunities held in December in Japan.



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Nuclear Energy and Civil Society

Nuclear regulators and the public

Information officers from regulatory bodies meet once a year under the auspices of the Working Group on Public Communication of Nuclear Regulatory Organisations (WGPC) to exchange information and experience related to communication with the public and to carry out related studies. In 2009, the main activity of the Working Group on Public Communication of Nuclear Regulatory Organisations (WGPC) consisted of discussing the transparency of regulatory activities, local public information, the use of public perception surveys and crisis communication in the case of high media interest. Surveys were conducted on these subjects amongst regulators whose answers are being analysed and compiled into WGPC guidance reports. The reports will be issued in due course, the first of which is expected in 2010.

Radiological protection

The trend in radiological protection towards judgemental optimisation of protection is resulting in an increasingly important role for civil society in decision-making processes. The NEA Committee on Radiation Protection and Public Health (CRPPH) has been a pioneer in the study of stakeholder involvement over the years, and has remained actively engaged in this work. In 2009, the CRPPH continued its exchange of specific, concrete experience in stakeholder engagement, and in this context is organising a workshop on stakeholder engagement in post-accident consequence management. As part of the input to this workshop, the CRPPH Expert Group on Stakeholder Involvement and Organisational Structures (EGSIOS) just finished a report analysing how stakeholder involvement has impacted on emergency management organisations in terms of their processes and structures. This study complements an earlier EGSIOS report on stakeholder involvement impacts on radiological protection authorities and expert institutions. Further supporting elements for the workshop are being provided by an assessment study of

the Working Party on Nuclear Emergency Matters (WPNEM) that synthesises lessons learnt from the INEX-3 international nuclear emergency exercise on decision making in post-emergency consequence management.

In addition, the CRPPH has commissioned the preparation of a document to summarise its stakeholder involvement activities over the past 10–15 years, which will characterise the important regulatory and practical aspects of this work.

Radioactive Waste Management Committee (RWMC) Forum on Stakeholder Confidence (FSC)

The RWMC Forum on Stakeholder Confidence (FSC) met in Eastern France in April 2009 in the context of a workshop entitled Repositories and Host Regions: Envisaging the Future Together. It was organised with the assistance of the CLIS (Local Information and Oversight Committee) of the Meuse/Haute-Marne Underground Research Laboratory located at Bure, and the support of Andra, France's National Radioactive Waste Management Agency. Amongst the participants were a number of FSC delegates and invited representatives (national and international) of institutional authorities, local and district councils, civil society organisations, universities, waste management agencies and the European Commission. The theme of the workshop was the territorial implementation of France's high-level and long-lived intermediate-level radioactive waste disposal programme. Sessions addressed the French historic and legislative context, public information, reversibility, environmental monitoring and the issue of memory. Follow-up at the September 2009 regular meeting of the FSC highlighted learning about retrievability and reversibility (R&R), and emphasized the mutually beneficial exchange that can be made with the NEA group addressing R&R. Andra also reported renewed dialogue with local representatives subsequent to the workshop.



View of the offices of the Local Information and Oversight Committee at Bure.

Organisational Structure of the NEA

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

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

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

The members of the Bureau of the Steering Committee for Nuclear Energy are (as at its autumn 2009 meeting):

- Mr. Richard STRATFORD (United States), Chair
- Dr. Kjell BENDIKSEN (Norway), Vice-Chair
- Mr. Frédéric MONDOLONI (France), Vice-Chair
- Dr. József RÓNAKY (Hungary), Vice-Chair
- Mr. Takayuki SHIRAO (Japan), Vice-Chair

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

The Steering Committee for Nuclear Energy and the Agency's seven standing technical committees are serviced by **the NEA Secretariat**, composed in 2009 of 71 professional and support staff from 16 countries. Professional staff are often specialists from national administrations and research institutes, bringing their experience to the Agency for two to five years on average.

Participation in the work of the Agency by **non-member countries** is an established practice. The Russian Federation holds regular observer status in all the Agency's standing technical committees and their working groups. Poland and Slovenia participate as regular observers in several standing technical committees. Experts from selected other countries, including China and India, take part in NEA activities on a more ad hoc basis.

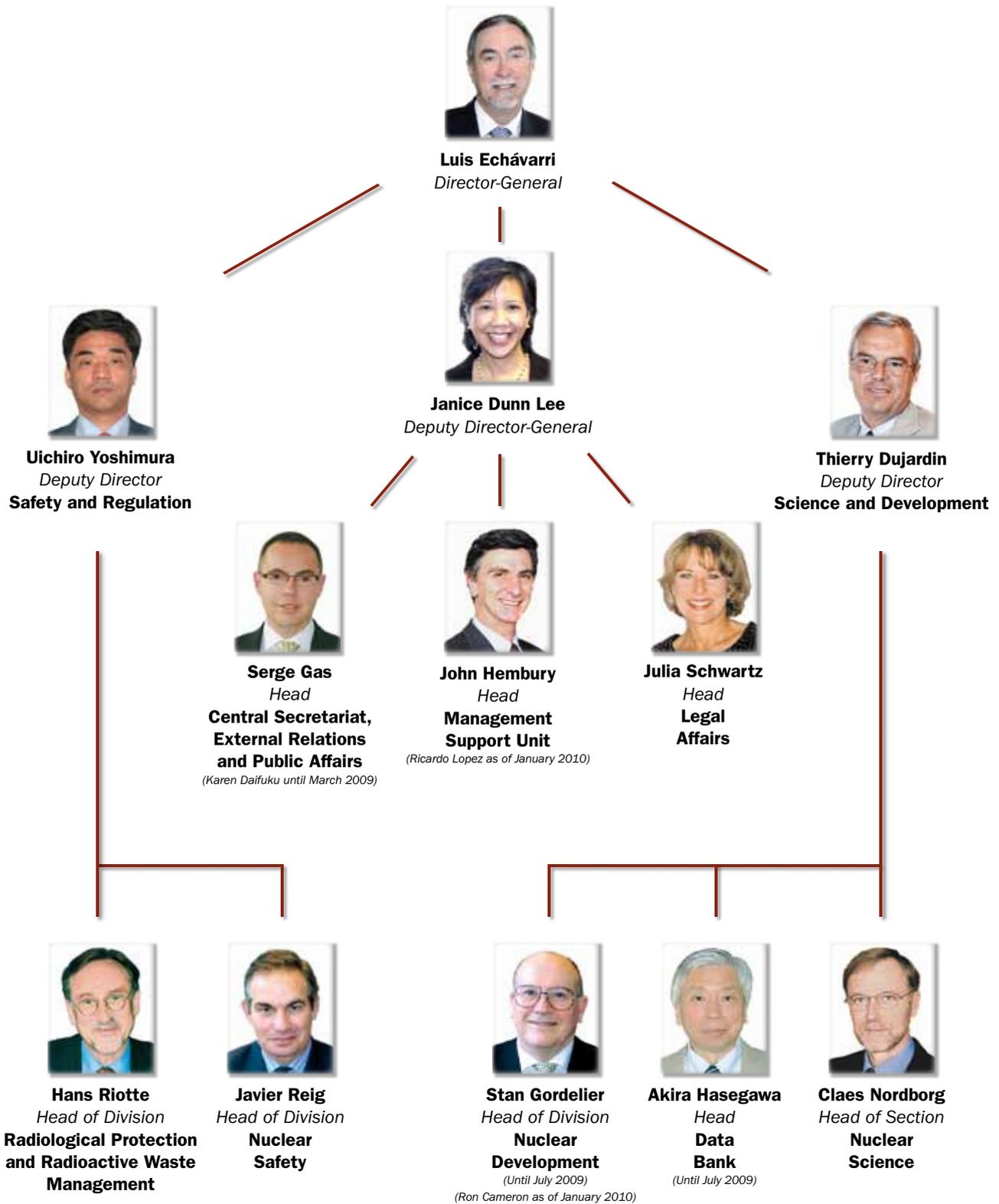


OECD Headquarters, Château de la Muette.

NEA Committee Structure in 2009



NEA Secretariat Structure in 2009



NEA Publications and Brochures Produced in 2009



► General interest

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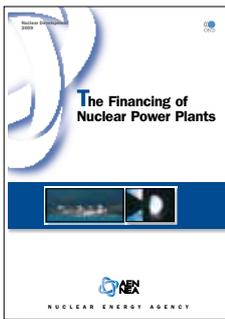
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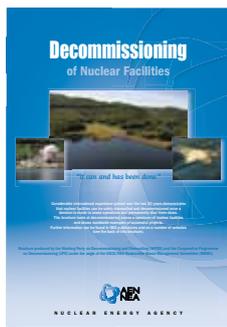
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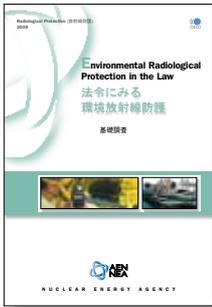
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▶ Radiological protection

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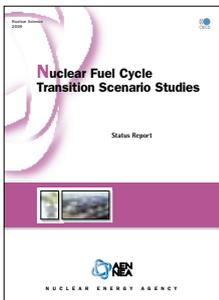
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The mission of the NEA is:

- 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
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