Joint Projects and Other Co-operative Projects

NUCLEAR SAFETY

The Halden Reactor Project

The Halden Reactor Project is the oldest and largest NEA project and constitutes a very important international technical network in the areas of nuclear fuel reliability, integrity of reactor internals, plant control/monitoring and human factors. The project has been operating by way of three-year renewable mandates for the past 40 years. The present mandate started at the beginning of 2000. The programme of work for the year 2000 in the fuel and materials area included fuel experiments in the high/very high burn-up range (UO_2 and MOX fuels) at normal operating conditions, and preparations for transient tests. Investigations of embrittlement and cracking behaviour of reactor internals materials have been carried out experimentally at representative reactor conditions and with the utilisation of advanced instrumentation. The programme on plant control and monitoring provided assessments of systems having the potential to improve plant performance and operational safety. The activities on human factors extended the knowledge of human performance in a control room environment and demonstrated how this knowledge can be incorporated in control room engineering solutions. The Halden Project is carried out at the Halden establishment in Norway and is supported by approximately 100 organisations in 20 countries.

The Halden Board of Management decided that a review of technical priorities, programme set-up and programme execution needed to be carried out in order to adequately prepare the direction of future programmes. The review was conducted by Board Members in 2000 with involvement of the NEA Secretariat.

Following a recommendation of the Halden Board to actively pursue the transfer of nuclear technology and know-how to the younger generation, a Halden summer school was started in August 2000. The NEA Nuclear Safety Division supported this endeavour.

The Cabri Water Loop Project

The Cabri Water Loop Project is investigating the ability of high burn-up fuel to withstand the sharp power peaks that can occur in power reactors due to rapid reactivity insertion in the core (RIA accidents). It involves substantial facility modifications and upgrades and consists of 12 experiments to be performed with fuel retrieved from power reactors and refabricated to suitable length. The project began in 2000 and will run for eight years. While the main lines of the programme of work and schedule have been defined, details of the scope and of the experimental conditions are still being discussed by the participants. The experimental work will be carried out at the *Institut de protection et de sûreté nucléaire* (IPSN) in Cadarache, France, where the Cabri reactor is located. Programme execution can, however, involve laboratories in participating organisations (for instance, in relation to fuel characterisation or post-irradiation examinations).

The Cabri Agreement was reviewed in March 2000, including recommendations from participants. Upon completion of discussions and reviews, the final version of the Agreement was prepared by the NEA Secretariat and circulated to participants. Eleven out of the twelve countries to which the Umbrella Agreement was originally addressed have signed the Agreement.

Three meetings of the Cabri Technical Advisory Group (TAG) and two meetings of the Cabri Steering Committee were held in 2000. Progress was made in defining the scope of the first tests (i.e. the types of fuel to be studied) and the scope of the pre-test and post-test examinations. Actions were identified for the acquisition of fuel, for the requirements on the test section and instrumentation, and for the definition of the thermal-hydraulic conditions of the tests.

OECD Halden Reactor Project, Norway

Halden Hammlab research facility for human factor research.

The Rasplav Project

The Rasplav[1] Project, devised to support accident management strategies for potential reactor accident scenarios involving core melt,

1. *"Rasplav" means "melt" in Russian.*

was successfully concluded. The results are contained in the project's final report that was presented and reviewed at the last Rasplav Seminar 2000 held in November.

The Rasplav Project was established as an OECD/NEA Project six years ago. It consisted of four large-scale tests complemented by a series of smaller-scale experiments, all involving the use of materials representative of power reactor cores. Experiments with these test materials in molten condition required temperatures of approximately 3000°C, which represented a major challenge, especially for large-scale tests. The experiments were carried out at the Kurchatov Institute near Moscow. The analytical work was done at the Institute of Nuclear Safety (IBRAE) of the Russian Academy of Science.

The Rasplav Project brought together Russia and 16 OECD Member countries, including the United States, Canada, the Republic of Korea, Japan and 12 European countries.

Eighty experts from 14 countries attended the final Rasplav seminar held in Munich, which was hosted by the German *Gesellschaft für Anlagen- und Reaktorsicherheit* (GRS). The executive summary of the seminar is available on the NEA website at www.nea.fr/html/ jointproj/rasplav.html.

The MASCA Project

Following a recommendation by the NEA Committee on the Safety of Nuclear Installations (CSNI), a proposal for a Rasplav follow-up project, denominated MASCA, was submitted by the Kurchatov Institute to potential participants during a meeting of technical experts organised by the NEA in spring 2000. The proposal aims to resolve remaining uncertainties on heat load to the reactor vessel and thus on the possibility of retaining melt in the vessel. These uncertainties are mainly associated with scaling effects and coupling between thermal-hydraulic and chemical behaviour in the melt. To achieve this basic objective, supporting experiments and analyses will be performed with a view to providing an understanding of the phenomena of interest, and to producing a consistent interpretation of the results by means of mechanistic models.

The technical expert meeting endorsed the Kurchatov Institute proposal and organisations from 17 countries confirmed their participation in the project. It will include tests with prototypical materials to be carried out at the Kurchatov Institute. The duration of the project is three years, with completion planned by mid-2003.

The Sandia Lower Head Failure Project

This three-year OECD/NEA project started in 1999. It brings together eight Member countries for the purpose of studying the creep rupture behaviour of models of light water reactor lower heads. This information is useful for the development of severe accident management strategies for coping with ex-vessel behaviour. To date, two of the five steel models of a lower head have been tested to failure. The project is the continuation of a similar one carried out previously at Sandia National Laboratories with US Nuclear Regulatory Commission funding.

The MCCI Project

Following a recommendation by the CSNI, experts convened by the NEA recommended that initiatives be taken to address molten core ex-vessel phenomena. The proposal for an experimental project set forth by the Argonne National Laboratory in the United States, denominated MCCI Project, was recommended.

The 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. To achieve these basic objectives, supporting experiments and analyses will be performed, with a view to providing an understanding of the phenomena of interest, and to producing a consistent interpretation of the results relevant for accident management. It is envisaged that the MCCI Project will be established during 2001.

The SETH Project

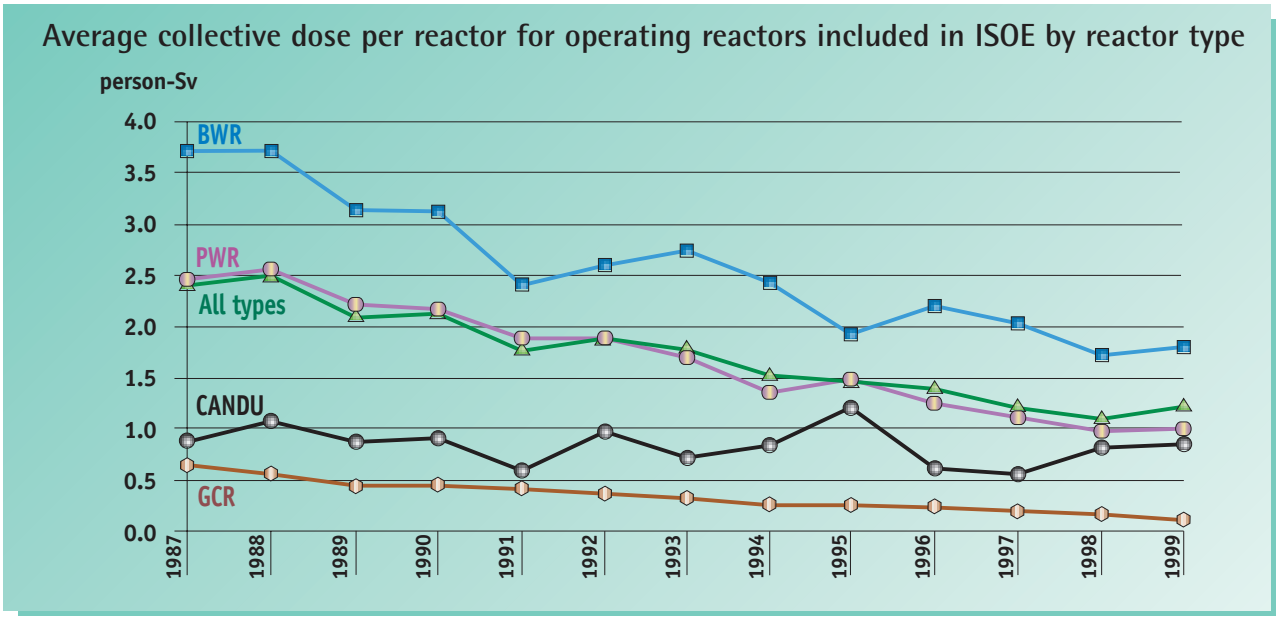
A recent CSNI report addresses the need for safety research in the area of thermal-hydraulics as well as facilities requiring international collaborative efforts for their continued operation. Two of these facilities have proposed an experimental programme, which constitutes the SETH Project, aimed at studying important thermal-hydraulic phenomena in support of accident management.

The experiments, to be carried out at the Paul Scherrer Institute PANDA facilities in Switzerland, are to provide data on containment 3D gas flow and distribution issues that are important for code prediction capability improvements, accident management and design of mitigating measures. These experiments will be conducted at large scale in multi-compartment geometries in order to provide data suitable for the improvement and validation of safety analysis codes. The tests to be carried out at the Siemens *Primär Kreislauf* in Germany will investigate two pressurised water reactor safety issues, i.e. boron dilution accidents and loss-of-heat removal during mid-loop operation (shutdown conditions). The first category of tests will verify if conditions can arise for core reactivity insertion due to boron dilution during a small-break, loss-of-coolant accident accompanied by natural circulation restart. The second test series will assess primary circuit accident management operations aimed at preventing fuel uncoverage as a consequence of loss-of-heat removal in mid-loop operation conditions.

The SETH Project has received support from 14 NEA Member countries. It is due to start in spring 2001 and will have a duration of four years.

The PLASMA Project

The PLASMA Project could be considered as a spin-off from the Halden Project in that it represented a practical utilisation and extension of



the technology developed at Halden on plant monitoring. As in the case of a previous project (SCORPIO VVER), it also represented a way to enhance interaction among Halden participants on practical plant applications.

The PLASMA Project was a collaborative effort among the Japan Atomic Energy Research Institute (JAERI), the Hungarian Academy of Sciences (KFKI), the Paks nuclear power plant in Hungary and the Halden establishment in Norway. The objective was to implement a system to monitor plant safety parameters in VVER power plants as part of VVER control upgradings. Paks was the reference plant in which the system was first implemented and demonstrated. The project had a duration of two years and was completed in 2000.

As a final step in this project, a workshop was conducted to familiarise other operators of VVER power plants with the characteristics of the PLASMA system.

ICDE Project

The International Common-cause Data Exchange (ICDE) project has been operating under NEA auspices since 1998. A new agreement covering the period 2000-2002 is being implemented. Nine NEA Member countries currently participate.

The ICDE Project aims at collecting data on all possible "events", comprising complete, partial and incipient common-cause failures (CCF). The project covers the key components of the main safety systems, such as centrifugal pumps, diesel generators, motor-operated valves, power-operated relief valves, safety relief valves, check valves, reactor protection system circuit breakers, batteries and transmitters.

These components have been selected because several probabilistic safety assessments have identified them as major risk contributors in the case of common-cause failures. Qualitative insights from analysis of the data help reduce the number of CCF events that are significant contributors to risk. In the long-term, a broad basis for quantifying CCF events will be established.

RADIATION PROTECTION

International Accident Dosimetry Inter-comparison

Over the past few years several accidents have occurred involving the occupational overexposure, sometimes very seriously, of radiation workers. Having accurate personal dosimetry in such cases is essential in order to effectively design medical treatment for highly exposed personnel, and to appropriately assess the accident and its consequences so as to avoid such situations in the future. For these reasons, the French Institute for Protection and Nuclear Safety (IPSN) and the NEA are organising an international inter-comparison of accident dosimetry, with financial assistance from the European Commission.

The performance of accident dosimetry systems will be validated through controlled irradiation in the well-characterised, mixed neutron and gamma field environment of the SILENE reactor. Because the radiation fields generated by the SILENE reactor can be varied from extremely intense to extremely low levels, several types of accident dosimetry can be tested. This includes biological methods (using blood samples for example), personal dosimeters, area radiation monitors, and even environmental radiation monitors.

The technical scenarios and organisational details of the exercise were finalised in 2000. Some 60 organisations have already indicated their interest in participating in this inter-comparison exercise, which is scheduled to take place in the spring of 2002.

ISOE: The Information System on Occupational Exposure

The objectives of the ISOE Programme, launched in 1992 and co-sponsored by the IAEA, are to promote and co-ordinate international co-operative undertakings in the area of worker protection at nuclear power plants; to collect annual occupational exposure data from commercial nuclear power plants and to analyse them for general

trends; and to provide a forum for communication among radiation protection experts.

At the end of 2000, the programme involved the participation of 450 reactors (in operation, cold shutdown or some stage of decommissioning), owned by 72 utilities in 27 countries. National regulatory authorities from 26 countries also participate in the ISOE programme. The participation of 397 operating reactors represents 92% of the operating commercial nuclear reactors worldwide (out of a total of 433), making ISOE the largest occupational exposure database in the world. During 2000, the Russian Federation joined the ISOE programme with 13 VVER reactors and one fast breeder reactor.

Regarding the average collective dose per operating reactor included in the ISOE database, a significant downward trend can be observed over the period 1987 to 1999. More information and trends can be found in the recent publication *Occupational Exposures at Nuclear Power Plants: Ninth Annual Report of the ISOE Programme, 1999* (OECD/NEA, 2000).

RADIOACTIVE WASTE MANAGEMENT AND DATA

Decommissioning

The RWMC Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD) expanded its membership to 39 projects, and implemented a co-ordinated communication programme to develop and disseminate the policy, strategy and technical views of the decommissioner. The CPD continues to play a key role in the Agency's decommissioning activities as a whole.

In addition to the specific work of the CPD, the NEA has adopted a broad, cross-cutting approach to addressing higher-level policy and regulatory issues in decommissioning. Based on the NEA's collective experience in decommissioning, as well as on the 1999 Workshop on the Regulatory Aspects of Decommissioning, an issues paper has been developed in which several key topics have been identified. The following topics will be addressed by combining the competencies of the NEA's various standing technical committees within their existing programmes of work:

- Decommissioning Policy and Strategies;
- Waste Management and Material Reuse Considerations;
- Authorised Release of Sites and Facilities;

ENRESA, Spain

Dismantling operations at Vandellos 1, Spain.

- Securing Long-Term Funding and Responsibility;
- Framework for Safety Regulation of Decommissioning.

The Thermochemical Database (TDB) Project

The NEA Thermochemical Database (TDB) Project makes available an internationally recognised and quality-assured chemical thermodynamic database of selected chemical elements for use in the safety assessment of radioactive waste repositories.

The NEA Data Bank acts as project co-ordinator and is responsible for maintaining and updating the database, providing bibliographic and data services to Member countries, and publishing the recommended thermochemical data. The review of recommended chemical thermodynamic data for neptunium (Np) and plutonium (Pu) has been completed and the manuscript was sent for publication at the end of 2000.

As part of the second phase of the TDB Project, five separate expert teams, responsible for the evaluation and selection of recommended data, have worked on the following tasks:

- updating the existing reviews of U, Am, Tc, Np and Pu;
- evaluating the simple organic compounds of U, Am, Tc, Np, Pu, Se, Ni and Zr;
- evaluating the inorganic compounds of Se, Ni and Zr.

The expert teams are expected to finalise their work in 2001.

Sorption Project

In October 1995, the NEA Sorption Project was launched to study the potential of thermodynamic models for improving representation of sorption phenomena in performance assessments of radioactive waste repositories. A first phase of the project was initiated with the objectives of gathering new information to be presented in a comprehensive status report. This phase focused on advances that have been made in the field of sorption modelling, with presentation of successful examples of radionuclide sorption in natural samples.

In a further attempt to better understand and quantify the potential contribution of sorption phenomena to the safety of geologic repositories, participants decided to launch a second phase of the project. The objective of Sorption II is to demonstrate the applicability of different chemical thermodynamic modelling approaches to support the selection of sorption parameters for safety assessments. The project is taking the form of a "benchmarking" exercise for the different modelling approaches being pursued by the participating organisations. The overall aim is to interpret selected, well-characterised datasets for sorption in complex materials. By applying the various modelling approaches in a systematic way to the same measured data, an evaluation of the merits and limitations of the approaches will be possible and thus recommendations on their use.

A total time scale of 24 months is envisaged for the project, with an intermediate milestone after the first six months. This milestone is considered important to allow an assessment of the viability of the project based on existing data sets. At present, 14 organisations from 10 Member countries participate in Sorption II.