

Nuclear Safety and Regulation

Committee on the Safety of Nuclear Installations (CSNI)

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

Regulator and industry co-operation on safety research

A group of senior experts representing research organisations, the nuclear industry and regulatory bodies analysed the potential advantages and disadvantages of regulator-industry collaboration in safety research and provided recommendations on how to overcome possible difficulties. The group's report is intended to provide research managers with information on current practices, to identify means of establishing effective collaboration and to highlight possible areas of concern. Principles to be used in deciding when and how to collaborate are also discussed in the report. These principles are meant to ensure that transparency and the independence of the regulatory decision-making process are maintained.

Nuclear installations and external hazards

A workshop on nuclear installations and external hazards was held in Paris in April. The workshop allowed specialists from 19 countries to exchange information on the methodologies used to analyse impacts and large fires affecting concrete structures. The workshop concluded that well-established methods exist for some aspects of the analysis, but for others, important gaps exist that will require research and analytical development to achieve adequate capability.

Advanced reactor safety issues and research needs

A workshop was organised on this subject in collaboration with the International Atomic Energy Agency (IAEA). Its purpose was to bring together a broad cross-section of parties – designers, utilities, regulators and researchers – with a potential stake in the development and deployment of advanced nuclear power plants. The meeting discussed safety issues raised by various advanced reactor concepts, the scope of research needed to address these issues and a potential approach to their resolution.

Analysis and management of accidents

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

In the area of thermal-hydraulics, the main objective of current work is to improve and expand the application of best-estimate

Cracks in the stainless steel lining at the bottom of the reactor vessel at Three Mile Island Unit 2 (USA), scene of a nuclear accident in 1979.



GPU Nuclear, United States

codes, including uncertainty analysis, in nuclear power plant safety and design evaluations. This also involves the coupling of current thermal-hydraulic system codes with codes in the areas of 3-D neutronics, structure mechanics, computational fluid dynamics (CFD) and containment, as well as, on a longer time scale, the application of CFD codes to nuclear safety. A joint workshop was organised with the IAEA on the use of CFD codes for safety analysis of reactor systems, including containment. The International Standard Problem (ISP) 42 exercise, based on experiments at the Swiss PANDA facilities, was completed during the year.

Other ISP exercises were being carried out or were completed in the following areas in 2002:

- in-vessel behaviour of degraded cores: ISP-46 (PHEBUS facility) and ISP-45 (QUENCH facility);
- containment behaviour: ISP-47 (TOSQAN, MISTRA and ThAI facilities);
- fission product release, transport, deposition and retention: ISP-46 (PHEBUS facility), a follow-up exercise to ISP-41 (RTF and CAIMAN facilities) and ISP-44 (KAEVER facility).

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

A meeting was held to discuss future plans regarding the PHEBUS facility in France and its possible use as part of an international programme; large consensus and broad interest in the technical community was obtained.

Safety aspects of improved performance

In recent years, largely as a result of economic pressures arising from the liberalisation of electricity markets, the nuclear industry has tried to maximise the outputs of operating plants. This has resulted in changes to the main parameters of the reactor core. Such modifications require an in-depth safety analysis to evaluate the possible safety impact. More generally, the effect of cumulative, small, design and operational changes that are not individually tested can produce significant differences to the original design. A comprehensive, integrated assessment is needed in order to evaluate the impact of multiple synergistic safety margin reductions (related to power uprates, longer operating cycles, fuel design, increased fuel burn-up, etc.), combined with plant ageing and plant life extension. Extensive discussions during the year culminated in the development of an action plan in this area.

Risk assessment

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

■ Three international research projects were established in 2002:

- MCCI (Melt Coolability and Concrete Interaction), a research project to study the interaction of molten core and concrete;
- OPDE (Piping Failure Data Exchange), a database on nuclear piping failures; and
- FIRE, a database on fire events in nuclear installations.

■ The CSNI and the CNRA completed 27 reports dealing with both technical and regulatory policy issues. The reports on industry/regulator collaboration on safety research and on the regulatory challenges of decommissioning nuclear reactors are of particular note.

■ The CSNI and the CNRA organised 15 workshops; notably the workshops on the safety research needs of advanced reactors, on nuclear installations and external hazards, and on regulator-industry interface issues.

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

In 2002 a report was issued on "The Use and Development of PSA in NEA Member Countries", as were proceedings on "Human Reliability: Errors of Commission from Research to Application", and on "Passive System Reliability". Two major workshops were held: one on human reliability analysis and one on the development and use of risk monitors. In addition, WGRisk is proposing to start work on several new tasks including the use of risk information in the regulatory process, the use of Level 2 PSA information for emergency planning and the development of methods to quantify common cause failure data.

Ageing and structural integrity of reactors

The main topics investigated include the ageing of metal components and concrete structures, and seismic behaviour. Two workshops and a seminar were held and six technical reports were issued. In particular, a reference report summarising technical aspects of ageing for the long-term operation of NPPs was issued.

In the area of metal components, a future programme of work has been defined in three major areas: non-destructive examination, reactor pressure vessel integrity and thermal fatigue.

Regarding concrete structures, a report on long-term behaviour of concrete structures was published. This report also provides the basis to define future research activities in this new area. Another report reviewing member country capabilities and priorities with regard to finite element analysis of ageing concrete structures was published. A workshop on the evaluation of defects, repair criteria and methods of repair for concrete structures on nuclear power plants was held.

In the field of seismic engineering, a workshop was held in October on relations between seismological data and seismic engineering analysis. Participants showed wide interest and stressed the importance of communication between seismologists and structural engineers. A report drawing lessons learnt from high magnitude earthquakes with respect to nuclear codes was published as was a report on discrepancies between nuclear and non-nuclear codes.

Operating experience

The joint NEA/IAEA Incident Reporting System (IRS) is the only international system providing regulators and governmental bodies with information and lessons learnt from safety-significant events occurring in nuclear power plants. During their annual meetings, the IRS co-ordinators exchange information about recent events and discuss their safety significance. In 2002, the safety issues identified from the analysis of the IRS reports were recurrence of events; events due to weaknesses in detection capability; events related to plant modifications; and loss of corporate knowledge. Actions to clearly identify the lessons and bring them to the attention of the nuclear safety community are ongoing or planned in all these areas. They included a report related to the proper operation of the emergency

core cooling system in the event of an accident and a workshop to discuss actions required to prevent recurring events.

Fuel safety margins

The NEA Special Expert Group on Fuel Safety Margins is seeking, in particular, to systematically assess the technical basis for current safety criteria and their applicability to high burn-up, as well as to the new fuel designs and materials being introduced in nuclear power plants. A topical meeting was organised in May in collaboration with the IRSN Cadarache in order to review reactivity initiated accident (RIA) fuel acceptance criteria. The meeting showed that the performance of existing and new cladding materials under RIA situations, especially at high burn-up, is not well understood at this time. In consequence, there is a need to increase the database, to introduce relevant burn-up dependent limits for these materials and to verify the safety margins, as is being done in the CABRI and NSRR experimental programmes.

Human and organisational factors

The Special Expert Group on Human and Organisational Factors (SEGHOF) concentrated its activities on developing a state-of-the-art report on the scientific methods for safety management and a technical opinion paper about the management of change. A workshop on the former issue was organised in Paris during April with wide participation by utilities, regulators and research bodies. SEGHOF will consider the findings of the workshop in its integrated plan to be issued during 2003. Two workshop proceedings were issued in 2002. In addition, a new task about human and organisational factors related to NPP modifications was begun.

Nuclear Regulation

Committee on Nuclear Regulatory Activities (CNRA)

The CNRA contributes to developing a consistent and effective regulatory response to current and future regulatory challenges. These challenges include the interface between the public and the regulator, the effectiveness of the regulatory process, the introduction of competition in the electricity market, the maintenance of a high level of safety competence and the development of advanced reactors.

Regulatory challenges of decommissioning nuclear reactors

A group of senior regulators developed a report outlining the broad set of issues that may arise during the decommissioning of nuclear reactors and that the regulatory body should be prepared to deal with in the framework of its regulatory system. Major regulatory policy issues discussed in the report include assurance of adequate funds, waste storage or disposal sites, material release criteria and site

release criteria. Regulatory challenges include human and organisational factors; shutdown and preparation of dismantling; radiological and environmental controls; safety and security; waste management; and licence termination.

Nuclear regulators and the public

Efficiency in decision making by governmental authorities is increasingly dependent upon public trust. Public communication is one of

the keys to the future of nuclear power. A working group on public communication of nuclear regulatory organisations discussed topics such as how their organisations handled public questions following the 11 September 2001 events in the US, how to deal with questions from the public concerning terrorist attacks on nuclear installations, the public impact in the US and other countries of the Davis-Besse reactor vessel head corrosion, the public impact from cover-ups of inspection findings by several Japanese utilities, how to communicate to the public information related to radiological releases of nuclear installations, and experience gained with the organisation of public meetings. For further details concerning the work of this group, see the section on "Nuclear Energy and Civil Society" (page 32).

Assuring future nuclear safety competence

Maintaining nuclear safety competencies in the regulatory authorities, and industry, will be one of the most critical challenges to effective regulation of the nuclear power industry in coming decades. It is increasingly clear that in many technical fields transmittal of information and knowledge from the older to the younger generations does not work properly anymore, and that training and competence transfer are becoming inadequate. The CNRA organised a survey to review the current situation in member countries and determine the progress achieved on the recommendations made in a report published in 2001.

Regulatory inspection practices

Inspectors from regulatory bodies meet periodically to exchange information and experience related to regulatory safety inspections, discuss commendable inspection practices and carry out studies. The sixth international workshop covering these issues took place in 2002. In addition, a report on "Inspection of Nuclear Fuel Cycle Facilities" was issued.

Current studies address several inspection issues including: inspection of research reactors; inspection of site selection, construction and commissioning; and inspections of contracted work. A seventh international workshop is being planned for 2004 on inspection activities related to risk-informed inspections, inspection

In-service inspection robot at the Bugey nuclear power plant in France.



of plants at or near end-of-life and inspections of the performance of licensee organisations.

Regulatory effectiveness

Work in this area continued in 2002 and a pilot project on measuring regulatory effectiveness began. Regulatory authorities from 10 member countries are involved in this exercise which consists of using a subset of the 45 indicators of regulatory effectiveness previously identified. Planning was also started for a workshop scheduled in June 2003 on "Measuring, Assessing and Communicating Regulatory Effectiveness" (MACRE 2003). The objective is to establish an exchange at high level between member countries on the different perspectives for measuring and assessing regulatory effectiveness, with a goal towards better defining the roles of the key players, understanding achievements over the past few years and applying lessons learnt.

A report including the results of the pilot project and other documents (e.g. definitions, etc.) will be prepared as background material for MACRE 2003. In addition, an update of the report on *Improving Nuclear Regulatory Effectiveness*, to include *inter alia* the work on indicators, will be made.

Regulator-licensee interface

An international gathering of high-level executives from nuclear regulatory organisations and nuclear utilities was held on 18-19 June in Paris, France. Organised jointly with the World Association of Nuclear Operators (WANO), the forum examined ways to improve regulator-licensee communications and to understand the rationale used by the parties to enhance the effectiveness and efficiency of both.



Discussions focused on three main areas: market competition, asset management, and measuring and communicating safety performance. Follow-up activities are currently under discussion by both the NEA and WANO.



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