

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, contributing to their resolution, and helping to establish international research projects.

Analysis and management of accidents

CSNI activities regarding the analysis and management of accidents continue to be very important. They cover aspects of thermal-hydraulics, severe accidents and their management, and the confinement of accidental radioactive releases.

In the area of thermal-hydraulics, most activities concentrated on international standard problem (ISP) exercises, based on experiments performed in the PANDA, KAEVER and QUENCH facilities in Switzerland and Germany. ISP exercises are comparative exercises in which computer code predictions or recalculations of a given physical problem with different best-estimate computer codes are compared with each other and above all with the results of a carefully specified experimental study. Fission product work also focused on an ISP exercise, this time based on experiments performed in the RTF facility in the United States.

In the area of severe accidents, the SERENA (Steam Explosion Resolution for Nuclear Applications) Programme was set up. The objective of the programme is to obtain international technical consensus on fuel/coolant interaction processes and on methods to estimate reliably the magnitude of containment loading under realistic conditions.

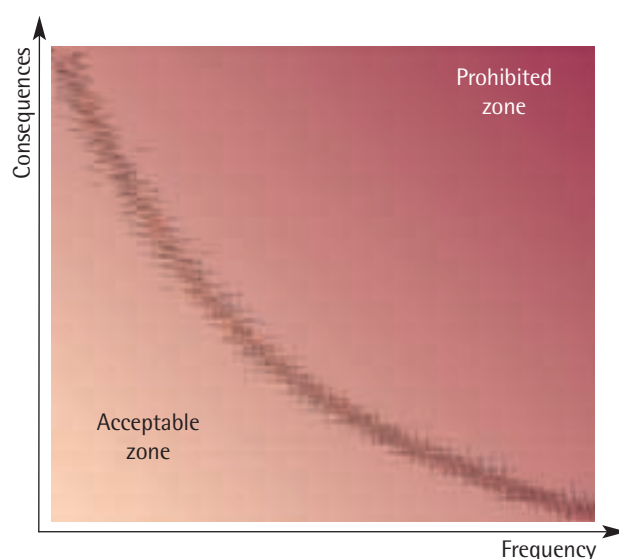
Workshops were held on "Operator Training for Severe Accident Management and Instrumentation Capabilities During Severe Accidents", and "Implementation of Severe Accident Management Measures".

Risk assessment

The main mission of the working group on risk assessment (WGRISK) is to advance the understanding and utilisation of probabilistic safety assessment (PSA) in ensuring the continued safety of nuclear installations in Member countries. While PSA methodology has matured greatly over the past years, further work is required. WGRISK has been active in several areas, including human reliability, software reliability, passive systems reliability and low power and shutdown risk. In order to maintain a current perspective, the working group collaborates

with other CSNI groups, such as those on operating experience and organisational factors, and maintains close co-ordination with other international organisations. A new database on fire events, called OECD-FIRE, is being established.

A workshop on "Building the New Human Reliability Analysis (HRA): Errors of Commission from Research to Application" took place in May in Washington, DC. State-of-the-art reports are being completed on passive systems reliability; risk monitor applications for nuclear power plants; and the use of PSA in Member countries. A second workshop on human reliability analysis was delayed until early 2002. Planning is under way for workshops on passive systems PSA and risk monitors.



Risk assessment and the probability/consequence diagram: the concept of event probability and its associated consequences have been incorporated into safety analysis procedures by taking account of the fact that the probability of an accident must be inversely proportional to the severity of the potential consequences for the public and the environment.

Ageing and structural integrity of reactors

The main topics investigated in this area include metal components, concrete structures and seismic behaviour. One workshop was held and four reports were issued.

In the area of metal components, a report was released on a benchmark which focused on methodologies for evaluating fatigue crack growth on piping and allowed participants to fine-tune the models, parameters and tools used. In addition, three main areas have been identified for future work: non-destructive examination, reactor pressure vessel integrity and thermal fatigue.

Regarding concrete structures, a report on long-term behaviour of concrete structures was completed. This report defines future activities in this new area. Activities on containment are ongoing and a workshop on the evaluation of defects, repair criteria and methods of repair for concrete structures at nuclear power plants is planned for 2002.

In the field of seismic engineering, a workshop was held in March 2001 on the seismic re-evaluation of all nuclear facilities. Participants showed wide interest and stressed the importance of such re-evaluation as part of plant life management policy.

Operating experience

The joint NEA/IAEA Incident Reporting System (IRS) continues to be the only international system of its kind providing regulators and governmental organisations with an assessment of safety-significant events. IRS co-ordinators exchanged information about significant events at their annual joint meeting; it was noted that several events involving failures of electrical systems had occurred. An in-depth study was thus initiated. Other work being carried out in this area is described below:

- An in-depth discussion was held on events related to deregulation. The main conclusions were that it was too early to assess the impact on safety, and better methods to detect early possible deterioration in the safety performance were necessary.
- The International Common-cause Data Exchange (ICDE) continued to collect data with the objective of improving the qualitative understanding of common-cause failure events. Databases for selected components were established (see the section on Joint Projects for further details).
- A database on operational experience related to computer-based systems important to reactor safety continued to be tested in connection with its trial period.
- A report on the knowledge base for sump screen clogging (an important issue related to the emergency core cooling system) was finalised.
- A workshop was held on safety performance analysis and a report on safety performance indicators was prepared.

Fuel safety margins

Most of the currently existing fuel safety criteria were established during the 1960s and early 1970s, and verified against experiments

- The SETH Project, which is intended to study experimentally thermal-hydraulic phenomena of interest to accident management, has been established with the financial and technical support of 14 NEA Member countries. Three other projects are in preparation and will be established early in 2002. The total budget of the CSNI-sponsored safety research projects is US\$ 120 million.

- The CSNI and the CNRA issued 31 reports during the year. The CSNI reports deal with technical subjects including operating experience and human factors, structural integrity and ageing, accident management and fuel safety margins. The CNRA reports cover such topics as assuring future nuclear safety competence and regulatory effectiveness.

- Several workshops were organised during the year, with one on "Research in a Regulatory Context" bringing together senior regulators, researchers and licensees to define commonalities and differences in their approaches to research and to propose ways of solving current problems.

with fuel that were available at that time, often with unirradiated specimens. In the safety evaluations performed at that time, the use of conservative assumptions was the basic method for ensuring safety. One of the key questions that remained unsolved in such an approach was how conservative were the safety evaluations, and consequently what was the level of the "safety margins" obtained.

A Special Expert Group on Fuel Safety Margins continued its work in this area with the objective of improving current understanding and addressing issues related to fuel safety margins. It seeks in particular to systematically assess the technical basis for current safety criteria and their applicability to high burn-up, and to the new fuel designs and materials being introduced in nuclear power plants.

In March 2001 a topical meeting was organised to review loss-of-coolant-accident (LOCA) fuel acceptance criteria, in particular the 17 per cent maximum oxidation of cladding criterion and its applicability to high burn-up fuel with different cladding materials. The meeting showed that performance of new cladding materials under LOCA situations, especially at high burn-up, is not well understood at this time. Therefore, it is important to verify the safety margins for high burn-up fuel with new cladding alloys and to introduce, as necessary, relevant burn-up dependent limits for these new materials.

Human and organisational factors

The Special Expert Group on Human and Organisational Factors concentrated its activities on developing two state-of-the-art reports (SOARs), one on the management of change, and the other on the

scientific approach to safety management. To provide input to the SOARs, two workshops were organised. Many Member countries are looking for methods to evaluate changes and good practices, and seeking input from relevant areas outside the nuclear community. Methods are being evaluated and proposed for use when appropriate.

Computer-based instrumentation and control systems

A workshop on "Licensing and Operating Experience of Computer-based Instrumentation and Control (I&C) Systems" was held in the Czech Republic to review the current state of the art. During the past five years, computer-based I&C systems have been installed and operated in both safety and non-safety systems in a number of nuclear power plants all over the world. Overall, great progress has been made in the application of computer-based I&C systems. The life cycle processes adopted by most of the countries are based on the

requirements of national or international standards which have similar structures and methodologies. At the same time new problems have emerged, for example, certification of commercial off-the-shelf products, previously developed software and previously existing software, obsolescence of digital spare parts, reclassification of some computer-based systems, and regulatory efficiency and effectiveness for computer-based systems important to safety. Future concerns from the regulatory point of view relate to the adoption of the established qualification methods for software-based I&C systems, new developments in software technology and the improvement of licensing procedures.

As progress in digital technology is very rapid, there is a need to follow this progress and to accumulate operating experience. Collecting and evaluating operational experience of computer-based systems as initiated by the CSNI Task Force on Computer-based Control Systems Important to Safety (COMPSIS) will be essential for evaluating the reliability characteristics of such systems and devices.

Nuclear Regulation

Committee on Nuclear Regulatory Activities (CNRA)

The CNRA works towards developing a consistent and effective regulatory response to current and future regulatory challenges, such as interface between the public and the regulator, regulatory effectiveness, the introduction of competition in the electricity market, the development of advanced reactors and the decommissioning of nuclear facilities.

Nuclear regulators and the public

Good governance and efficiency in decision making by governmental authorities are increasingly dependent upon mutual trust and confidence between those authorities and the public. During a workshop held at the end of 2000, there was consensus that ways should be found to continue sharing information and experience in the field of public communication by nuclear regulatory organisations. In response to that request, the CNRA set up a working group on public communication to share information, news, documents and experiences; to discuss developments, progress, techniques and achievements; and to develop an action plan in the area of nuclear regulatory communication. The group exchanged information on the way participating organisations had reacted to the September 11 events in the United States.

Assuring future nuclear safety competence

Maintaining nuclear safety competencies in nuclear regulatory bodies and the industry will be one of the most critical challenges to effective regulation of the nuclear power industry in the coming decades. The challenge arises partly from the age profile of staff in the regulatory bodies, which could result in the loss of much of the present nuclear safety knowledge base due to retirements over the next decade or so. It is also partly caused by a decline in the number of students graduating from courses in nuclear science and engineering and thus available for recruitment to fill the vacancies left by retirements. Whatever the future of nuclear generation programmes, i.e. regardless of whether new nuclear power plants will be built in Member countries, there will be an ongoing requirement in nuclear regulatory bodies and the industry for several decades to

recruit qualified staff. In addition, it is increasingly clear from CSNI activities 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 continued to discuss the conclusions of a study it sponsored in this area, and to compare national experiences with a view to identifying international responses to the problems.

Regulatory inspection practices

Inspectors from regulatory bodies meet periodically to exchange information and experience related to regulatory safety inspections, discuss commendable inspection practices and carry out studies. Reports were issued on the "Inspection of Maintenance on Safety Systems During NPP Operation", "The Effectiveness of Nuclear Regulatory Inspections", a "Status Report on Regulatory Inspection Philosophy, Inspection Organisation and Inspection Practices" and "The Effectiveness of Licensees in Inspecting the Management of Safety".

The NEA is currently studying several inspection issues including: inspection of research reactors; inspection of fuel cycle facilities; inspection of contracted work; and improving inspection programmes for site selection, fabrication and construction of NPPs. The sixth international workshop on regulatory inspection practices is being planned for 2002 and will cover inspection activities related to events and incidents; inspecting internal and external hazards; and the inspection of the effects of economic deregulation.

Research in the regulatory context

One of the key challenges currently confronting the nuclear community is to define and maintain adequate capability in regulatory research. Approximately 100 senior regulators, researchers and utility representatives were brought together in June 2001 in a workshop on this subject to identify the commonalities and differences that exist in their approaches to research. In addition, a survey was conducted to establish current and future trends in regulatory research in NEA Member countries.

The conclusions of this activity, which is documented in a collective statement by the CSNI and the CNRA (see www.nea.fr/html/nsd/reports/nea-3288-statement.pdf), highlight the need for the regulator to be able to supervise or commission independent confirmatory and anticipatory research.

A number of specific recommendations were made for further work by the NEA. These include ways to review issues that hinder close co-operation between industry and the regulatory authority, and the development of the type of criteria to be used for the "close out" of specific research activities.

Regulatory effectiveness

A report by a group of senior-level experts was published on *Improving Nuclear Regulatory Effectiveness*. Following the recommendations of



K. Niederau, KKB/NOK, Switzerland

Reinstallation of the main reactor coolant pump after inspection and overhaul at the Beznau nuclear power plant, Switzerland.

the report, the CNRA created a Task Group on Regulatory Effectiveness Indicators, which is developing a model set of indicators on the effectiveness of the regulatory process. Building upon the definition of an effective regulator as defined in the report, the Task Group selected 45 candidate areas for performance indicators distributed over the five effectiveness attributes. The Group was fully aware of the "pros and cons" of indicators and decided on an approach that would make extensive use of pilot projects. The pilot projects will run for at least one year beginning in March 2002. Periodic reports and updates will be provided to the CNRA throughout this period. An interim working paper entitled "Indicators for Nuclear Regulatory Effectiveness and Efficiency", to be produced by the Task Group, will be combined with key elements of the original report to produce a final report to the CNRA following completion of the pilot projects.



Contact: Gianni Frescura

Head, Nuclear Safety Division

Tel.: +33 (0)1 45 24 10 50

Fax: +33 (0)1 45 24 11 29

E-mail: frescura@nea.fr