

Nuclear Safety and Regulation

Committee on the Safety of Nuclear Installations (CSNI) Committee on Nuclear Regulatory Activities (CNRA)

Mission

To assist Member countries in maintaining and further developing:

- the scientific and technical knowledge required to assess the safety of nuclear reactors and other nuclear installations;
- efficient and effective regulation that is based on current scientific and technical knowledge and gives priority to factors most important to the safety of nuclear power reactors and other nuclear installations.

Highlights

- The CSNI structure and working methods were extensively revised to ensure greater effectiveness, better direction of the overall programme and relevance to the needs of the Member countries.
- Considerable efforts were made to help maintain the research capabilities in OECD countries, with three new large international projects having been established. The projects deal with high burn-up fuel, severe accidents and safety thermal-hydraulics.
- The CNRA continued to address key issues being faced by regulatory bodies, including the interface between nuclear regulators and the public, ensuring future safety competence, enhancing regulatory effectiveness, and dealing with the challenges arising from competition in the electricity market.

Committee on the Safety of Nuclear Installations

Following the adoption of the CSNI Strategic Plan, a number of changes were made in the Committee's structure and working methods. In particular, the structure of the working groups was streamlined with additional emphasis being placed on technical issues, such as fuel safety margins and organisational factors. A Programme Review Group (PRG) was created to assist the CSNI Bureau in directing the overall programme. The PRG, which is composed of senior experts with broad management experience in safety research and technology, will also identify research facilities potentially suitable for future international collaboration, and compile and maintain a list of current safety topics or issues that require international attention.

Analysis and management of accidents

The CSNI activity in this area focuses on thermal-hydraulics, severe accidents and their management, and the confinement of accidental radioactive releases. A Workshop on Advanced Thermal-Hydraulics and Neutronics Codes was held to discuss long-term plans for the development of advanced codes; regulatory requirements for best-estimate code assessment; applications of thermal-hydraulics and neutronics codes for current safety issues; and the needs for integral plant transient and accident analyses. Several international standard



The reactor vessel and four steam generators at the Tsuruga nuclear power plant, Japan.

problem exercises were completed (including an exercise on rapid boron dilution transient), and there was progress on others.

Ageing and structural integrity of reactors

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

In the area of metal components, a benchmark on fatigue crack growth on a cracked pipe under cyclic four-point bending was completed. Fourteen organisations participated in this three-phase benchmark. The objectives were to compare methodologies on a) crack initiation, b) crack propagation and c) crack penetration. All calculation methodologies and criteria used were found to be valid when compared to the experimental results.

A workshop was held in March 2000 on the instrumentation and monitoring of concrete structures. Participants stressed the importance of such systems for assessing the integrity of the structures as part of plant life management policy.

In the field of seismic engineering, a paper was prepared on how ageing could affect the seismic response of structures and components. The proceedings of a workshop held in November 1999 on seismic input were issued.

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 and assists other CSNI working groups, such as those on operating experience and organisational factors, as well as maintains close relations with other international organisations.

Preparations began for two workshops planned for 2001 on errors of commission and methods for collecting data on human reliability. State-of-the-art reports were under preparation in the areas of passive systems reliability; risk monitor applications for nuclear power plants; and the use of PSA in Member countries. In addition, WGRISK began re-examining the use of level-2 PSAs; probabilistic treatment of risk in nuclear activities and installations other than nuclear reactors; and in developing a fire risk analysis data collection system.

Operating experience

The joint NEA and International Atomic Energy Agency (IAEA) Incident Reporting System (IRS) is the only international system of its kind providing regulators and governmental organisations with an assessment of safety-significant events. During the year, a report was issued on lessons learned from safety-significant events that occurred in nuclear power plants during the period 1996-1999. More than 3 000 copies of the report were distributed to senior officials in industry and government who have decision-making roles in the nuclear power industry.

Other activities in the area of operating experience included:

- an in-depth discussion on recurring events, with further work having been initiated;
- an exchange of information among IRS co-ordinators during the annual joint meeting on recent events in NPPs;
- the testing of a database on operational experience related to computer-based systems important to reactor safety;
- the preparation of a report on sump screen clogging (an important issue related to the emergency core cooling system);
- the organisation of a workshop on safety performance indicators.

Fuel safety margins

The introduction of advanced fuel and core designs, the adoption of more demanding operational modes and the implementation of more accurate, but often less conservative, design and analysis methods raise the question of whether safety margins remain adequate. As a first step in addressing this question, a group of experts completed a technical review of existing fuel safety criteria, focusing on "new design" elements introduced by the industry (e.g. new fuel and core designs, cladding materials, manufacturing processes, high burn-up, MOX, etc.). In the report summarising the results of this review, a number of fuel-related criteria are discussed without attempting to categorise them according to event type or risk significance. For each of these criteria, a brief description of the criterion as it is used in several applications, along with the rationale for having such a criterion, is presented. The report also discusses various issues as they relate to one or more criteria, including high burn-up, core management, MOX, mixed cores, incomplete control rod insertion, and axial offset anomaly.

Following these assessments, the expert group concluded that the current framework of fuel safety criteria remained generally applicable, being largely unaffected by the new or modern design elements. The levels (numbers) in the individual safety criteria may, however, change in accordance with the particular fuel and core design features. International co-operation on ongoing fuel safety research programmes in NEA Member countries will further contribute to a more detailed understanding and realistic modelling of fuel behaviour in LWR accident scenarios.

Co-operation with the CEEC and the NIS

A small programme of co-operation with central and eastern European countries (CEEC) and the New Independent States (NIS) continued in the year 2000. In particular, a report documenting the validation matrix for the thermal-hydraulic code assessment of VVERs was completed. The report also provides an explanation of the important differences between VVERs and LWRs.

NEA experts continued to provide technical support for verifying the ability of the bubbler condenser containment system of VVER-440/213 reactors to maintain its integrity following certain

Inside the reactor hall of the Mochovce VVER unit in the Slovak Republic.



Bernard Collet, Framatome, France

postulated accidents and thus limit the release of radioactive material to the environment. A report on the current situation of VVER-440/213 bubbler condenser research was completed during the year. The report recommended performing selected additional tests, undertaking further post-test analyses of the results obtained in experiments performed so far, and using post-test calculation results for bubbler condenser design qualification, code validation and modelling improvement.

Committee on Nuclear Regulatory Activities

The Committee on Nuclear Regulatory Activities continued in 2000 to implement a programme of work largely influenced by the findings of the report entitled *Future Nuclear Regulatory Challenges*. Issues addressed during the year are briefly described below.

Nuclear regulators and the public

Good governance and efficiency in decision making by government authorities are increasingly dependent upon mutual trust and confidence between those authorities and the public. A workshop on "Investing in Trust: Nuclear Regulators and the Public" provided an opportunity to exchange information and views on how national nuclear regulatory organisations can improve their interface with the public in a spirit of greater trust, confidence and accountability. It was attended by some 80 participants having responsibilities within nuclear regulatory bodies, either as top officials, communications or public relations specialists, or technical specialists with communications responsibilities. The workshop was part of a broader ongoing effort by the NEA to look into communicating with the public and involving it in decision making in the nuclear field.

Major topics explored at the workshop included:

- the nature and role of the regulator, and the composition and characteristics of discrete groups making up the public;
- the importance of communication and consultation with the public, openness and transparency, credibility and trust;
- communication experiences of regulatory organisations, which have pursued public participation;
- where to draw the line between the regulatory role and what is demanded from regulators by different groups within the public.

Assuring future nuclear safety competence

Maintaining nuclear safety competence in the regulatory authorities, and 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 ten or so years, and partly from a decline in the numbers of students graduating from courses in nuclear science and engineering. Whether

new nuclear power plants are planned in Member countries or not, there will remain an ongoing requirement in regulatory bodies and the industry for several decades to recruit qualified staff. A report recommending specific actions to be taken in order to ensure future nuclear safety competence was completed.

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. An international workshop was held this year on radiation protection inspections, regulatory inspections required for long shutdowns and subsequent restarts, and the use of objective indicators by the regulatory authority in evaluating the performance of plants. Other inspection issues studied included maintenance during operation, research reactors, fuel cycle facilities, and the inspection of contracted work.

Life extension and upgrading

A group of experts gathered information from Member countries on regulatory approaches to life extension and upgrading NPPs. The information was analysed and synthesised, and will form the basis of a new CNRA report. The report will focus on four main topics: legislative and regulatory aspects; key technical issues; key management issues; and the use of deterministic and probabilistic methods in safety evaluation. It will include a discussion of how the concepts of "life extension" and "upgrading" are viewed by different Member countries. Issues for the future and the conclusions and recommendations of the CNRA will also be provided.



K. Niederau, KKB/NOK, Switzerland

Delivery of a new high-pressure turbine to replace 25-year-old machines at a nuclear power plant in Switzerland.

Regulatory effectiveness

A small strategy group of senior experts established by the CNRA completed a report on this subject. The report includes a common definition of regulatory effectiveness, describes the difference between regulatory efficiency and regulatory effectiveness, and provides a model for assessing and measuring effectiveness based on conventional management wisdom as well as modern business



PAKS NPP, Hungary

Inspection of the Interim Storage Facility for Spent Fuel (ISFS) at the PAKS nuclear power plant in Hungary.

practice. It also discusses quality management models commonly used by regulatory bodies and the types of indicators that might be used to measure regulatory performance. Both direct indicators, i.e. indicators of effectiveness of the regulatory process, and indirect indicators of safety performance are examined in the report. The report also considers the value that a regulatory body adds to the overall nuclear safety system, discusses methods by which this value might be quantified, and provides recommendations for future CNRA activities.

Regulatory challenges arising from competition in the electricity market

A report on this topic, describing many of the challenges facing nuclear regulatory bodies as a result of the introduction of market competition, was completed during the year. It also discusses possible regulatory response strategies.

The report considers four broad categories of challenges, namely: governance issues, direct safety challenges, nuclear technology infrastructure issues, and increased pressures on the regulatory body. It concludes that, although the basic responsibility of the operator and the regulator do not change, a new regulatory approach is necessary. Elements of this new approach include:

- The regulator must fully understand the economic conditions of the competitive market.
- The regulator will have to consider how to maintain existing technical skills and what new ones should be added, particularly in areas such as market economics and organisational issues.
- The regulatory inspection programme should be re-examined to ensure that it is adequate to detect early signs of declining safety performance.

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