Nuclear Science

Nuclear Science Committee (NSC)

The NSC helps to improve the basic scientific and technical knowledge needed for the safe, reliable and economic operation of current nuclear systems and the development of next generation technologies. Special emphasis is being placed on advanced calculation methods used in light water reactor stability investigations, advanced reactor fuel performance and behaviour, and the preservation of integral experiments data.

Reactor physics

The present reactor physics programme is focused on stability problems in light water reactors, with special emphasis on complex three-dimensional coupled neutronics/thermal-hydraulics calculations.

The boiling water reactor (BWR) stability calculation exercise, based on data from the Forsmark power plant in Sweden, was completed. The final report was issued in May.

A workshop on numerical and computational aspects of nuclear core/plant simulations was organised in the United States in June to discuss the final results of the international benchmark on a pressurised water reactor (PWR) main steam-line break. The results from the first phase related to point kinetics calculations were published and the two remaining volumes, covering three-dimensional kinetics and best-estimate solutions, are under preparation.

The specifications of the benchmark exercise dealing with a turbine trip transient in a BWR was issued in 2001. The objective of the benchmark is to examine the capability of codes to analyse complex transients by comparison with actual experimental data taken from the Peach Bottom-2 reactor in the United States. The final results are expected in 2002.

Fuel cycle physics

The main emphasis of the fuel cycle physics programme is on mixed-oxide (MOX) and innovative fuels. A number of international problem exercises are being conducted, including on the feasibility of using weapons-grade plutonium as MOX fuel in power-producing reactors. The following benchmark exercises were under way or completed in 2001:

- An exercise to compare calculations for a modern BWR assembly containing MOX and UO_2/gadolinium fuel rods was completed. The results, which are internally consistent, will be published in 2002.
- The KRITZ-2 experimental benchmark was launched with the main goal of testing the modelling capability of reactor physics codes and the associated nuclear data for different reactor configurations from room temperature to about 250° C. Considerable discrepancies in the results were found using different evaluated data libraries, thus indicating a need for better basic data. The results will be published in 2002.
- The SCK•CEN in Mol, Belgium, provided three-dimensional experimental data for a benchmark with near-weapons-grade plutonium MOX fuel from the VENUS-2 reactor. The specification of this benchmark was distributed in June 2001 and the final results are expected in mid-2002.

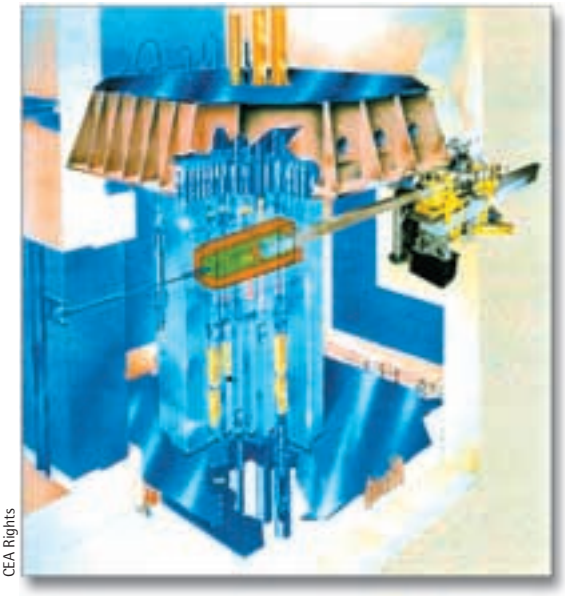
A workshop on "Advanced Reactors with Innovative Fuels" was held in the United Kingdom in October. The purpose of the workshop was to discuss the new generation of reactor designs and to exchange information on related R&D activities. The scope comprised reactor physics, fuel performance and fuel material technology, thermal-hydraulics, and core behaviour and the fuel cycle of advanced reators with different types of fuels or fuel lattices. The proceedings of the workshop will be issued by the NEA in 2002.

The International Fuel Performance Experiments (IFPE) database, containing fuel data on temperatures, fission gas releases, fuel swelling, clad deformations and mechanical interactions at normal and off-normal operation conditions, continued to be updated. The database presently contains data for 416 rods and is mainly used for model development and code validation. A new edition of the database was issued on CD-ROM in January 2001.

Partitioning and transmutation of nuclear waste

A benchmark to compare calculations of an accelerator-driven, minor actinide burner was completed and the final report will be published in early 2002. The results from this benchmark show significant discrepancies in important parameters, such as one-group microscopic cross-sections, initial keff, burn-up reactivity swing and flux distribution. These results have prompted the NEA to launch a new benchmark exercise based on data from the MUSE-4 experiment

at the MASURCA installation at CEA Cadarache, France to study hybrid (accelerator-reactor) systems. The benchmark specifications were sent out in December 2001.



CEA Rights

The MASURCA reactor at the CEA Cadarache, France, coupled with the deutron accelerator GENEPI, being used in the MUSE experiments.

An expert group on chemical partitioning was established to review separation processes relevant to partitioning and transmutation (P&T) systems. The group will make a technical assessment of separation processes for a limited set of P&T operating scenarios and will identify important research, development and demonstration necessary to bring preferred technologies to a deployable stage. In addition, it will recommend collaborative international efforts to further technology development.

Nuclear criticality safety

The primary purpose of the International Criticality Safety Benchmark Evaluation Project (ICSBEP) is to compile critical and sub-critical benchmark experiment data into a standardised format that allows criticality safety analysts to easily use the data to validate calculation tools and cross-sections libraries. A relational database, named DICE, was developed in order to make the data collection more user-friendly, allowing the user to perform specific searches and to generate summary descriptions for each experimental configuration. A new version of the data collection was issued on CD-ROM in September 2001. The new edition contains 307 evaluations describing data for 2 642 experimental configurations.

An expert group on criticality accidents was set up to provide knowledge on criticality excursions to scientists involved in the analysis of such accidents. The group will compile and evaluate criticality transient data from experimental programmes and from accidents data. In addition, the group will identify available models and computer codes for transient analyses and define suitable test exercises.

Highlights

- A workshop on "Advanced Reactors with Innovative Fuels" was organised in Chester, United Kingdom in October.
- A benchmark exercise based on the MUSE-4 hybrid reactor-accelerator experiment at the CEA Cadarache, France, was launched.
- A new database, DICE, containing data from the International Criticality Safety Benchmark Evaluation Project (ICSBEP), was developed and disseminated.
- A workshop on "Basic Studies in the Field of High-temperature Engineering" was organised in Paris, France in October.
- A report on a BWR stability benchmark, based on experimental data from the Forsmark 1 and 2 reactors in Sweden, was published.

Radiation shielding

The Shielding Integral Benchmark Archive Database (SINBAD) continued to be updated. At the end of 2001, the database contained 31 reactor shielding experiments, with special emphasis on pressure vessel dosimetry, ten fusion neutronics experiments and three accelerator shielding experiments.

An expert group studying computational methods used to model radiation transport through materials launched a new benchmark on deterministic 2- and 3-dimensional calculations of MOX fuel assemblies without spatial homogenisation. The specifications were distributed in April 2001 and the final results are expected for the beginning of 2002.

High-temperature engineering

The Second Information Exchange Meeting on Basic Studies in the Field of High-temperature Engineering was held in Paris, France in October. The meeting reviewed the latest activities in the field of high-temperature engineering, including irradiation effects on advanced materials and reactor in-core material characterisation methods. Possibilities for co-operative studies in the field of high-temperature engineering within the framework of international organisations were discussed.

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