Nuclear Science

Nuclear Science Committee (NSC)

Mission

To help Member countries identify, collate, develop and disseminate scientific and technical knowledge used to ensure the safe, reliable and economic operation of current nuclear systems and to develop next generation technologies.

Highlights

- A project to preserve integral nuclear data measured at different reactors or in mock-up experiments was launched. The first phase concentrates on reactor physics data.
- The results from a standard problem exercise on the use of mixed-oxide (MOX) fuels in reactors were published. The exercise was based on experimental data from the VENUS facility.
- A new working group was established to co-ordinate partitioning and transmutation activities in Member countries.
- A seminar was organised to assess the current understanding of fission gas behaviour and its impact on the fuel rods in a reactor.
- A workshop was organised to review the advancements in the scientific and technological field related to the nuclear production of hydrogen.

Reactor physics

The reactor physics programme is aimed mainly at the validation of different calculation schemes used in Member countries. Specifications for standard problem exercises or benchmarks, based on theoretical or experimental evidence, are distributed to scientists for them to calculate. The results are compared and the findings and lessons learned are then published.

One important part of the above-mentioned benchmarks are the experimental data, used as the basis for the specifications. An ambitious project was launched to preserve integral experimental data measured at different research establishments. The first phase of the project concentrates on reactor physics data measured both at research and power-producing reactors. The data will be stored at the NEA Data Bank and made available to scientists who wish to test their calculation models and methods against experimental results.

The results from the first phase of a benchmark simulating a break of a main steam line in a pressurised water reactor (PWR) have been published. The benchmark is testing the prediction capability of three-dimensional, coupled neutronics/thermal-hydraulic codes. The results from the more complex second and third phases are being analysed and the report is under preparation.

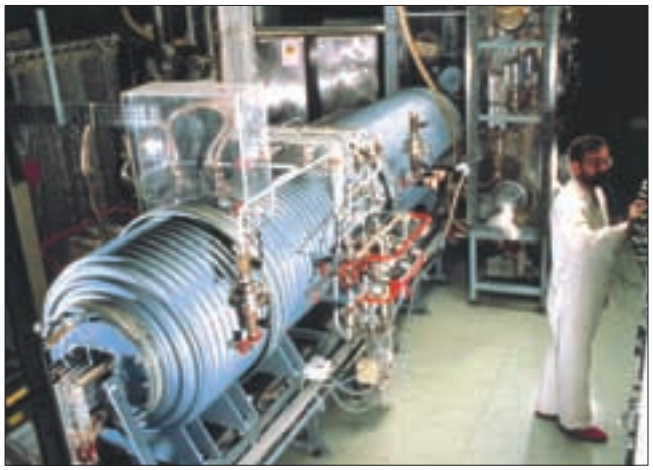
A benchmark simulating a reactor transient caused by a turbine trip in a boiling water reactor (BWR) has been undertaken. The benchmark is based on experimental data from a full-scale, power-producing reactor.

A study of the stability of a boiling water reactor (BWR) has been undertaken. The benchmark is based on measurements in a power reactor (Forsmark, Sweden) and is focused on the analysis of time series data by means of noise analysis techniques. The final report is under preparation.

Fuel cycle physics

New, more advanced and economic fuel cycles must be well-tested, both theoretically and experimentally, before being employed in power reactors. The working group on the physics of plutonium fuel and innovative fuel cycles is conducting a number of standard problem exercises related to mixed-oxide fuel (MOX). Results from an exercise based on experimental data from the VENUS zero power critical facility have been published. Another benchmark exercise related to the utilisation of MOX fuel in boiling water reactors (BWR) is ongoing. A separate expert group is studying the possibility of burning weapons-grade plutonium as mixed-oxide fuel in power-producing reactors.

A seminar on "Fission Gas Behaviour" was organised in France in September 2000. The meeting reviewed the current understanding of



Cogéma

Studies were performed by the NEA on nuclear fuel cycle physics, notably as related to the use of mixed-oxide (MOX) fuel. Shown above is a sintering oven used for the preparation of MOX fuel.

fission gas behaviour and its impact on fuel rods. MOX and other advanced fuel concepts, including high burn-up fuel, were also addressed.

The compilation of data into the International Fuel Performance Experiments (IFPE) database continues and it presently contains close to 400 fuel rod configurations. The data are available from the NEA on request. A users forum has been established to report feedback on the use of the data, to exchange information on specific experiments and to discuss difficulties in their interpretation.

Fuel cycle chemistry

There is increased interest in dry reprocessing (pyrochemical) methods for nuclear fuel. A workshop on pyrochemical separation was organised in France in March 2000 to review national and international R&D programmes in the field and the role and requirements of pyrochemical reprocessing in future fuel cycles. Following the workshop, an expert group was established mainly to draft a comprehensive state-of-the-art report on pyrochemistry separations.

The NEA also organised, in co-operation with the European Community and the Rossendorf research centre in Germany, a workshop on speciation, techniques and facilities for radioactive materials at synchrotron light sources. The workshop was held in September 2000 in Grenoble, France. The NEA will publish the proceedings.

Nuclear criticality safety

A new expert group was set up to study the outstanding Monte Carlo convergence problem for the calculation of interaction between weakly coupled fissile units.

A new version of the CD-ROM containing experiments evaluated by the International Criticality Safety Benchmark Evaluation Programme was published in September 2000. This new edition contains 284 evaluations with benchmark specifications for 2 352 critical or near-critical configurations.

The expert group on burn-up credit published a new report entitled *OECD/NEA Burn-up Credit Criticality Benchmarks Phase IIIA: Criticality Calculations of BWR Spent Fuel Assemblies in Storage and Transport.*

Partitioning and transmutation of nuclear waste

The aim of partitioning and transmutation (P&T) is to reduce the long-term inventory of radiotoxic nuclides in nuclear waste by converting them either into short-lived radioisotopes or stable isotopes. A new working group was established to co-ordinate the different disciplines covered by P&T, such as accelerators, chemistry, material science, nuclear data and reactor physics. A first meeting of the working group was held at the end of 2000.

A benchmark exercise on an accelerator-driven transmutation system (ADS) was conducted and the results are being analysed for publication. The benchmark will be followed up by another ADS-based benchmark simulating effects of accelerator beam trips.

The 6th Information Exchange Meeting on Actinide and Fission Product Partitioning and Transmutation was organised jointly with the NEA Nuclear Development Division. The meeting was held in Spain in December 2000.

Radiation shielding

The fifth meeting of the expert group on shielding aspects of accelerators, targets and irradiation facilities (SATIF-5) was held in France in July 2000. Issues discussed included medium energy transmission of neutrons through structural material and calculation with a simple phantom for neutron dosimetry, as well as a new benchmark specification related to deep penetration shielding.

A new edition of the Shielding Integral Benchmark Archive Database (SINBAD) was issued in December 2000. This was a common effort between the NEA and the Radiation Safety Information Computational Center (RSICC) in the USA. The new edition contains 42 compilations for reactor shields (in particular for pressure vessel dosimetry), fusion applications and accelerator shields, and is mainly used for data and code benchmarking.

The results from a benchmark exercise to test the prediction capability of three-dimensional deterministic radiation transport codes were published.

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