

Nuclear Power

Objective

To enhance the capability of interested Member States to implement competitive and sustainable nuclear power programmes and to develop innovative nuclear technologies for the future.

Engineering and Management Support for Competitive Nuclear Power

The analysis of operating experience and the continuous improvement of operations, as well as proper plant life management systems and the provision of effective training, contribute in significant measure to the smooth running of nuclear power plants, and the consequent increase in availability and productivity. Recognizing this, the Agency published three technical documents during the year that: provide guidance on managing instrumentation and control (I&C) modernization projects; present an internationally applicable system of coding nuclear power plant outages that provides nuclear utilities with a standardized tool for reporting and learning from outage information; and provide the latest information on ageing, obsolescence and performance monitoring of safety related I&C equipment operated in harsh environments.

Guidance on effective training was contained in three technical documents that focused on nuclear power plant personnel training, transferring nuclear knowledge to the next generation of staff, and the use of control room simulators for training power plant personnel. Also, the second phase of the development of an *Electronic Nuclear Training Catalogue* (ENTRAC) was completed with the inclusion of a search function and greater capability to host training related information.

In the area of nuclear power plant life management, the Agency completed five reports covering such topics as in-service inspection, the master curve approach to reactor pressure vessel (RPV) integrity, surveillance programmes for RPVs, the nickel effect on radiation embrittlement of RPV steels, and radiation damage of WWER RPVs. A computer model for the economic assessment of plant life extension and licence renewal was finalized,

and a new software package was developed on the issue of ageing and concrete containments at nuclear power plants.

To mark the 50th anniversary of when electricity was first produced by nuclear energy — in Obninsk, Russian Federation — the Agency organized an international conference in Obninsk and in Moscow. Entitled 'Fifty Years of Nuclear Power — The Next Fifty Years', the conference highlighted the mature stage reached by nuclear power and the vital role it plays in a number of countries. There was also significant support for continued innovation in technology and infrastructure to advance spent fuel recycling, and fast reactor and waste management technologies, all of which were considered to be especially important for the expansion of nuclear energy. The conference noted that greater openness and objectivity were also needed in communications with the public and decision makers.

Nuclear Power Technology Development and Applications

The Agency's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) continued to grow, with Armenia, Chile, Czech Republic, France, Morocco and South Africa becoming members. Total membership now stands at 22. INPRO completed six national case studies and eight individual studies to test the draft methodology published in 2003 for assessing different innovative nuclear energy systems and concepts. Using the results of the studies, a revised and improved version of the methodology was completed and approved. (The INPRO schedule, or time-line, is shown in Fig. 1.)

Terms of reference were established for the next stage of INPRO, covering 2005 and 2006, to facilitate the assessment of innovative nuclear systems by Member States using the updated INPRO methodology. The project will also develop supporting models and codes, draft a user's manual; identify possibilities for collaborative R&D, strengthen collaboration with the Generation IV International Forum — another international effort to promote innovation — analyse deployment scenarios for innovative nuclear systems, and review possible multilateral nuclear fuel cycles.

Work began on a joint assessment by China, France, India, the Republic of Korea and the Russian

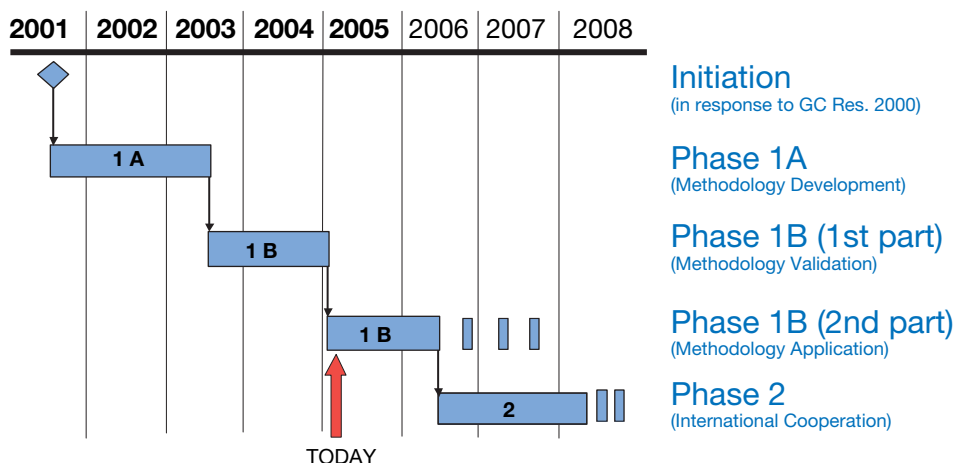


FIG. 1. Overall schedule for INPRO.

Federation to assess closed nuclear fuel cycle concepts using fast reactors through the use of the INPRO methodology.

The Agency's Technical Working Groups bring together experts from developing and industrialized Member States to pool R&D resources from national organizations towards agreed common goals. In 2004, two technical documents were published, on the status of advanced LWRs, and on the intercomparison and validation of computer codes for the thermal-hydraulic safety analysis of HWRs.

Research began in a new CRP on natural circulation phenomena and the reliability of passive safety systems that utilize natural circulation. The goal of the CRP is to improve the reliability, economics and safety of water cooled reactors through the use of passive safety systems based on natural circulation.

The final report for a CRP on the establishment of a thermophysical properties database for materials of LWRs and HWRs was completed. The result is both a technical document reporting new measurements and assessments of thermophysical properties and an associated Internet database established by Hanyang University, in the Republic of Korea. Improved data reduce the need for considerable design margins solely to compensate for limitations of calculational methodology and data uncertainties, and can thus contribute to improving the economics of new nuclear power plant designs.

The Agency hosted a workshop at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste on nuclear power plant simulators for education. One of the major objectives of this workshop, held regularly at ICTP, is to disseminate the Agency's PC based simulators of the performance of various reactor types. The Agency's software in

this area is widely used for education and includes simulators for a BWR, a conventional PWR, a passive PWR, a WWER-1000 and a CANDU.

With respect to fast reactors and accelerator driven systems (ADSs), the Agency completed a status and review report dealing with national programmes on fast reactors and hybrid systems for energy production and transmutation. Figure 2 shows the 65 MW(th) China Experimental Fast Reactor, currently under construction. In this connection, technical meetings were convened on the utilization of MONJU (the prototype Japanese fast breeder reactor) for international cooperation in fast reactor R&D, and on the application of cross-section libraries for ADSs and transmutation.

In the field of high temperature gas cooled reactors (HTGR), two Agency CRPs promoted R&D on: (a) core physics and thermal-hydraulic code benchmarks; and (b) coated fuel particle technology. In 2004, the former completed and analysed results for a second set of code benchmarks, and the latter focused on issues of HTGR fuel



FIG. 2. The China Experimental Fast Reactor under construction.

design and fabrication, fuel characterization and testing, benchmarking of fuel performance and fission product release models as well as spent fuel management. Agency activities related to the exchange of information on HTGRs included participation in the biennial international conference on high temperature reactors (HTR-2004), together with the European HTR-TN network and Tsinghua University of China. And interest in the Agency's HTGR activities continued to grow — the hit rate for the Agency's HTGR web site <http://www.iaea.org/OurWork/ST/NE/NENP/NPTDS/Projects/HTGR/index.html>

increased from 50 000 per month to 90 000 in 2004.

The application of nuclear power technology to seawater desalination has been the subject of past resolutions of the General Conference. In 2004, the Agency conducted technical cooperation projects on integrated nuclear power and desalination system design and the simulation of a nuclear desalination plant. In addition, national counterparts in Indonesia and the Republic of Korea completed a report on the economic feasibility of nuclear desalination in Madura Island, Indonesia. ■