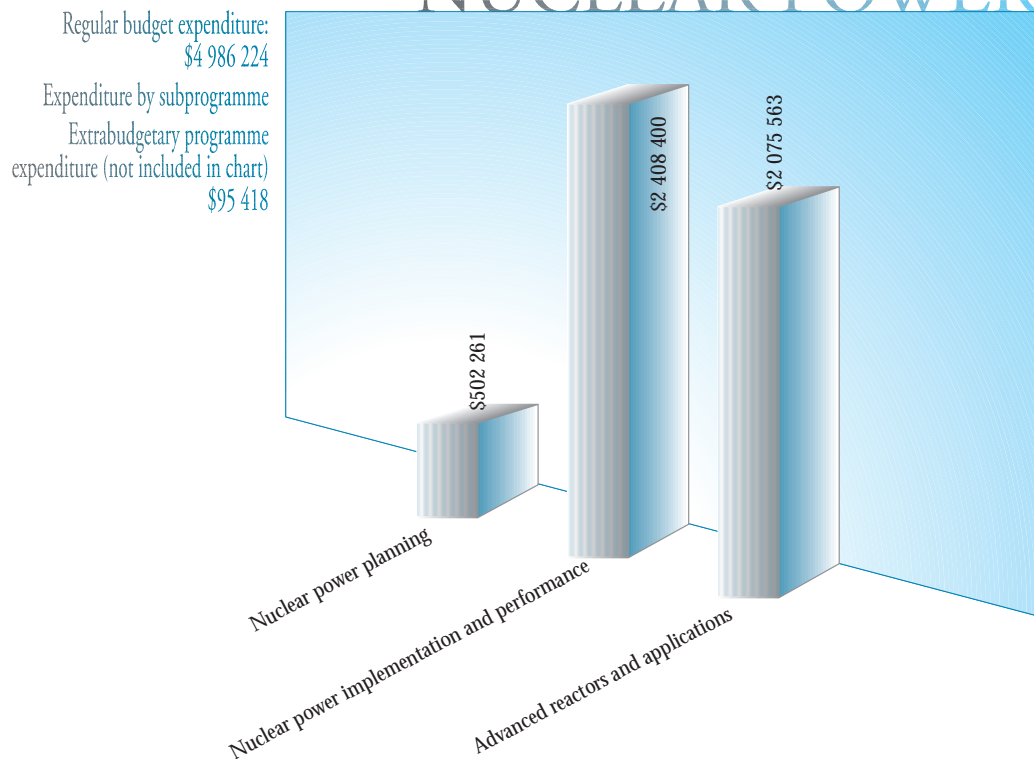


NUCLEAR POWER



The Agency's nuclear power programme continued to assist Member States in nuclear power planning and implementation and in advanced reactor technology development. Member States were also provided with various computer models to facilitate nuclear power planning and bid evaluation. An international symposium, 'Desalination of Seawater with Nuclear Energy', was organized in May in the Republic of Korea to review the research, design and development aspects of this technology. An International Desalination Advisory Group (INDAG) was established, and the first meeting was held to provide the Agency with advice and guidance in fulfilling General Conference resolutions on activities in nuclear seawater desalination.

Nuclear power planning

Assistance was provided to Belarus, Brazil, Bulgaria, Colombia, Croatia, Lithuania, Peru and Poland to assess the role of nuclear power in the future expansion of electricity supply systems. In addition, Viet Nam

received assistance in the preparation of a pre-feasibility study for the introduction of nuclear power.

A number of expert meetings were held to incorporate improvements into various computer models developed by the Agency. The improvements resulted in a new version of the WASP (Wien Automatic System Planning Package) model, WASP-IV, which is used to evaluate strategies for expanding the power generation in a country taking into account all generation options, including nuclear power. Changing market conditions facing the electricity industry led to work on enhancing the Agency's FINPLAN model for representing independent power producers and on alternative financing arrangements when analysing the financial viability of an expansion plan. An improved model for assessing nuclear power plant bid evaluations was developed that considers current needs for economic evaluations and new developments in computer technology. The improved BIDEVAL-3 software was tested by a group of experts and will be ready for distribution in 1998. In this connection, the guidebook *Economic Evaluation of Bids for Nuclear Power Plants*, which will be distributed along with the revised BIDEVAL software, was updated. Finally, technical

assistance on nuclear power plant bid evaluation and training in the use of related software was provided to Turkey.

Nuclear power implementation and performance

Training and qualification of plant personnel are key factors in improving the performance and enhancing the safety of nuclear power plants. An electronic version (on diskette) of a technical document, *The IAEA World Survey on Nuclear Power Plant Personnel Training*, was distributed to Member States. The diskette contains information from 25 Member States on training systems, organizations, training programmes, the role of management, resources allocated to training and spare capacity to train foreign personnel.

The Power Reactor Information System (PRIS) provides data on the status and operating experience of nuclear power plants around the world and supports analyses in all areas of plant performance, including safety, productivity and economics. PRIS provides two services to Member States: MicroPRIS and PRIS-PC. MicroPRIS was distributed to about 270 subscribers in 57 Member States and 10 international organizations, including the World Association of Nuclear Operators, the World Information Service on Energy, the OECD, the European Commission, the Uranium Institute, WHO, UNSCEAR and the United Nations Economic and Social Commission for Asia and the Pacific. PRIS-PC offers on-line access through a direct dial

DISTRIBUTION OF AGENCY COMPUTER MODELS

Number of releases of planning model or package

	MAED	WASP	VALORAGUA	ENPEP
Member States	66	90	41	48
International organizations	7	12	3	6
Totals	73	102	44	54

ENPEP: Energy and Power Evaluation Package; **MAED:** Model for Analysis of Energy Demand; **VALORAGUA:** 'Valor Agua' (value of water); **WASP:** Wien Automatic System Planning Package.

connection to the Agency or through the Internet and was accessed by 150 subscribers in 33 Member States and 4 international organizations. Both services have been provided free of charge to Member States since 1989. The number of subscribers has grown by more than 25% per year, with the rate rising to about 40% with the release of PRIS-PC. The Agency also began work on incorporating a mapping system and additional information on reactor design characteristics into PRIS.

A technical document evaluating reactor performance has identified good practices and qualitative and quantitative measures of these practices from some of the world's most productive nuclear power plants. The report, which will be issued early in 1998, presents short and medium term actions and results from the application of the best operational practices. To help operators improve plant performance, a technical document was published on the best practices for cost effective maintenance of nuclear power plants, specifically optimizing outage duration, reducing outage extensions and improving human performance.

The qualification of non-destructive examination (NDE) systems is vital to the reliability of in-service inspections of the main components of a nuclear power plant. A joint European Commission/OECD/IAEA specialists meeting studied this issue and concluded that these procedures contribute to safe and reliable long term operation and also reduce the price of nuclear electricity to the consumer.

A specialists meeting on the methodology for pressurized thermal shock (PTS) evaluation was held in Esztergom, Hungary, in May. While PTS encompasses many disciplines, this meeting dealt with the assessment of structural integrity. In support of this, a new CRP on assuring the structural integrity of the reactor pressure vessel (RPV) was initiated with the goal of establishing a uniform procedure for small specimen testing in order to obtain fracture mechanics data for subsequent RPV integrity assessments.

The problem of RPV irradiation embrittlement is known worldwide and is of continuing interest owing to the unique safety significance of the RPV. A specialists meeting in Vladimir, the Russian Federation, exchanged information on the effects of thermal ageing and irradiation on RPV materials and made a number of recommendations on further investigations and special studies to improve current knowledge on the effect of irradiation embrittlement of RPV steels. There

was also a need for a specific catalogue of irradiation facilities that can be used for RPV steel irradiation.

Many ageing instrumentation and control (I&C) systems in nuclear power plants need to be modernized in a reliable and cost effective manner to improve plant performance and enhance safety. However, challenges include determining the systems to be modernized, the technology to be used and the necessary measures to support licensing. In response, the Agency began a comprehensive review of I&C modernization. The review report identified methodologies, guidelines, processes, concerns and good practices in this area.

Quality assurance is a key component for safe and reliable operation of nuclear power plants. Independent assessments of such systems are increasingly being used by nuclear power plant management to: evaluate the effectiveness of management processes and the adequacy of work performance; monitor item and service quality; and facilitate improvements. The managers of nuclear utilities in two Member States requested Agency assistance in performing independent evaluations of specific plant quality issues. In the first case, a peer review dealing with operational quality assurance was carried out in September at the Laguna Verde nuclear power plant in Mexico within the framework of an Agency regional project in Latin America. The peer review team was composed of specialists from Argentina, Brazil and the Agency. In the second case, a peer review of the quality assurance system implemented at the Asco nuclear power plant in Spain was performed by experts from other Spanish nuclear power plants and the Agency.

Advanced reactors and applications

Meetings were held to discuss the development of small and medium sized reactors and to establish detailed criteria and recommendations on user requirements to assist developing countries in this area.

Development of a personal computer program simulating the responses of a number of reactor types to operating and accident conditions was completed. The purpose is to provide students and junior engineers with a visual aid in comparing the operational response characteristics of different reactors.

Interest in the gas cooled reactor (GCR) programme continued to grow with the addition of Indonesia and South Africa as new members of the Agency's International Working Group. Activity focused on the evaluation of modular high temperature gas cooled reactors (HTGRs) coupled to closed cycle gas turbine power conversion systems as high efficiency sources for the generation of electricity and for high temperature heat for such processes as hydrogen production. Experimental results to be obtained from advanced test HTGRs currently under construction in China and Japan will be offered to Member States in support of a new Agency CRP on the evaluation of HTGR performance.

Activities in water cooled reactor technology focused on technologies for improving economic competitiveness even as safety requirements are further strengthened. They included publication of a status report on advanced light water reactor (LWR) designs, a report on advances in heavy water reactor (HWR) technology and a document defining terms for describing new, advanced nuclear power plants. Another document provides guidelines for the design of new water cooled nuclear power plants which should ensure efficient and effective acquisition of safeguards data while minimizing the impact of safeguards activities on plant operations. A CRP on thermo-physical properties of materials for water cooled reactors was concluded and a document published presenting the data collected.

The International Working Group on Advanced Technologies for Heavy Water Reactors (IWG-HWR), formed in 1997, held its first meeting in Vienna in June. The goal of this new IWG is to review projects and programmes on HWRs in Member States and to recommend areas for technology development. Two areas recommended for further study are the status and projected evolution of HWRs and pressure tube inspection and diagnostics.

The 30th meeting of the International Working Group on Fast Reactors (IWGFR) was held in Beijing. The Group reviewed and discussed fast reactor projects and programmes in Member States and recommended a review of experience in unusual occurrences during liquid metal cooled fast reactor (LMFR) operation, and of methods and codes for the calculation of thermohydraulic parameters of the reactor core.

A joint IAEA/European Commission benchmark exercise was carried out for a hypothetical accident

involving unprotected loss of coolant flow in a BN-800 plutonium fuelled reactor with a near zero void core. The exercise resulted in recommendations for core design improvements to prevent positive void coefficients in fast reactors.

There were several developments in the LMFR area: connection to the electricity grid of the Indian Experimental Fast Breeder Reactor in July and the Government's decision to allocate funds for construction of the first 500 MW(e) prototype LMFR; greater experience with commercial scale LMFRs owing to the stable operation of the 600 MW(e) BN-600 in the Russian Federation for energy production and the 520 MW(th) BN-350 in Kazakhstan (mainly for seawater desalination); approval of the Experimental Fast Reactor (CEFR) project by China; and continuation of the French programme (in co-operation with Germany and the United Kingdom) on the effective transmutation of ultra long lived nuclear waste and plutonium incineration.

The International Nuclear Desalination Advisory Group (INDAG) was established in September 1997 to provide the Agency with advice and guidance in fulfilling General Conference resolutions on activities in nuclear seawater desalination. An international symposium on this subject was held in May in the Republic of Korea in co-operation with the International Desalination Association (IDA) and other international organizations. It highlighted the need for continued international and regional co-operation and information exchange, including activities dealing with public acceptance and demonstration of the economic feasibility of such plants. There was consensus that nuclear desalination is technically feasible, though cost and social acceptability were recognized as major hurdles. International and regional co-operation, including close collaboration with the IDA, were suggested as possible methods to overcome these problems. A CRP on optimizing the coupling of nuclear reactors and desalination systems was initiated to examine the technical aspects of nuclear desalination. Compilation began of a guidebook that will include an overview and special aspects and considerations relevant to the introduction of nuclear desalination.

The recycling of plutonium and fission products and actinides in various types of fission reactors, accelerator driven systems and molten salt reactors is under investigation in several Member States. The need to strengthen international co-operation in these fields was emphasized at a Technical Committee meeting in

Madrid in September on the feasibility of hybrid concepts for nuclear energy generation and transmutation. To harmonize efforts, a database of current and planned experimental facilities for accelerator driven systems and related R&D is being prepared.

Thorium fuel cycle perspectives were discussed at an Advisory Group meeting in Vienna in April. It was concluded that a re-examination of this fuel cycle is necessary so that the advantages, problems and possible solutions can be realistically assessed under present conditions.