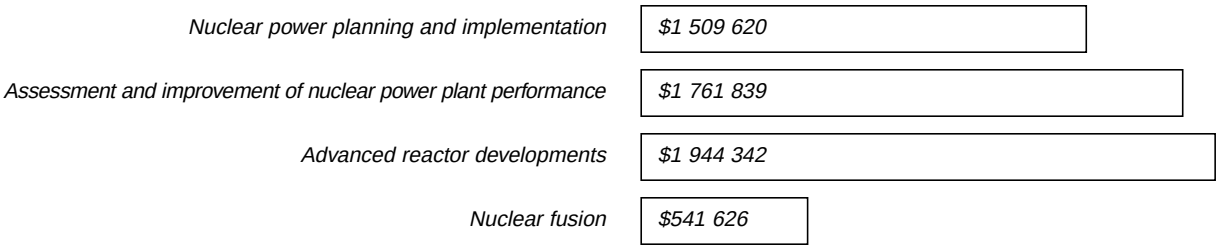
NUCLEAR POWER

Regular Budget expenditure: $5 757 427

Expenditure by subprogramme



Extrabudgetary programme resources utilized (not included in chart): $235 016

The Agency's activities in 1995 in the area of nuclear power were focused on several areas: developing improved versions of software for energy, electricity and nuclear power planning; assistance in planning studies in developing Member States using the Agency's software; on-line services and systematic monitoring of power reactor information; technology issues on nuclear power plant life management and the human–machine interface; revision of quality assurance standards; technology improvement for advanced nuclear reactors; seawater desalination using nuclear energy; and the transmutation of actinides.

Nuclear Power Planning and Implementation

The need for the Agency to provide assistance in nuclear power programme planning to developing Member States has increased over the years. In 1995, Belarus, Brazil and Poland were added to the list of countries receiving technical co-operation assistance in applying the Energy and Power Evaluation Package (ENPEP), which can be used to assess the nuclear power option. In addition, Albania, Estonia, The Former Yugoslav Republic of Macedonia, Lithuania, Latvia, Moldova and Viet Nam received assistance in defining a framework for technical co-operation projects on energy, electricity and nuclear power planning.

The large number of operating nuclear power plants in Member States makes it imperative that operation and maintenance personnel receive specific training in the reliable and safe operation of these plants. Recognizing this, the Agency in 1995 incorporated a systematic approach to the training of operations and maintenance personnel in a revised version of the Agency's guidebook on nuclear power plant training.

Distribution of computer models

	Number of releases of planning model or package			
	MAED	WASP	VALORAGUA	ENPEP
Member States	43	88	36	39
International organizations	5	12	2	5
Totals	48	100	38	42

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

The adoption of an integrated approach to energy, electricity and nuclear power programme planning is assisted greatly by the use of the Agency's Wien Automatic System Planning Package (WASP). The newest version of WASP, known as WASP-III Plus, has been fully documented through the publication of a user's manual in the Agency's Computer Manual Series. In addition, a significantly improved version of WASP, called WASP-IV, was integrated into a single package and is expected to be completed in 1996–1997.

Assessment and Improvement of Nuclear Power Plant Performance

Information for Member States on the status and operating experience of nuclear power plants is provided by the Agency's Power Reactor Information System (PRIS) database. A new version, called PRIS-PC, was made available on-line for direct access through the public telephone network. Internet access will be possible by the end of 1996. A subset of the PRIS database for PC users, MicroPRIS, is now being accessed by 225 users in 54 Member States and 8 international organizations.

An extensive revision was carried out during the year of the complete set of NUSS safety standards and guides on quality assurance. Through the revision of the Code and the associated 14 related Safety Guides, the Agency is seeking to emphasize that managers and workers both contribute to ensuring quality and achieving safety. The Code is thus organized into three functional categories — management, performance and assessment — to underline that quality assurance is everyone's responsibility. This performance based approach to quality assurance serves to correct a common misunderstanding that quality assurance consists only of formalistic requirements of limited practical value.

Computerized support systems for nuclear power plants are already in operation or under development in several Member States. These systems, based on intelligent data processing, are increasingly used for achieving better productivity and improved reliability in nuclear power plants, along with enhanced operational safety. Recognizing the significant progress made by the nuclear industry in developing this technology over the last 25 years, the Agency initiated a CRP in 1992 on operator support systems in nuclear power plants, which was completed in 1995. On the basis of the results obtained, the Agency completed the development of a database that provides consistent and updated reference information on existing operator support systems and related activities in Member States. In the same area, a technical report on the verification and validation of software related to nuclear power plant control and instrumentation was completed. This document contains comprehensive information on computer based systems that play a significant role in the safe operation of nuclear power plants.

An already established database on nuclear power plant life management, which included results from a CRP on the optimization of reactor pressure vessel surveillance programmes and their analysis (Phase III), was expanded and given the title International Reactor Pressure Vessel Database.

Advanced Reactor Developments

Interest in small and medium size reactors (SMRs) for use in non-electrical applications as well as power generation is steadily increasing among Member States. The reactors will most likely find use in such areas as seawater desalination, district heating, oil recovery enhancement, coal gasification and methanol production. The Agency's activities in the field of SMRs focused on providing technical support for these projects. A Technical Committee meeting on small reactors with minimized staffing and/or remote monitoring, held in Mississauga, Canada, in May, assessed the level of interest in small reactors in various countries and explored potential applications and technical approaches of common interest.

An Advisory Group meeting on the introduction of SMRs was held in Rabat, Morocco, in October to review the experience acquired by Member States during the deployment of such reactors. The meeting confirmed that there is a continuing interest in SMR deployment in North African, Middle Eastern and Far Eastern countries, that considerable operating experience has been gained (which can benefit developing countries), but that more information related to the deployment of SMRs is needed. Local participation and technology transfer were recognized as important elements in the introduction of SMRs.

The large capital costs involved in the development of improved and advanced nuclear power plant designs have led to many national and international co-operative efforts. The Agency's role in this context is to serve as a forum for information exchange on national programmes, scientific

and technical issues. In one such international co-operative research activity, the Agency collected and systematized a database of thermophysical properties for a broad spectrum of light and heavy water reactor materials over a wide temperature range. The establishment of such a consistent set of information provides an international source of data for independent examination of the performance and safety of various advanced reactor designs.

A Technical Committee meeting on the design, development and testing of safety systems for advanced water cooled reactors was convened in Piacenza, Italy, in May. The results presented at this meeting indicated that the basic designs of safety systems for large evolutionary plants are well established and have been derived from experience with existing plants.

A Technical Committee meeting on the identification of severe accidents for the design of future nuclear power plants was convened in Vienna as part of the Agency's ongoing activities to establish design safety principles. In addition to agreeing on a consistent set of severe accident phenomena, there was consensus that internal and external events should be addressed and that the resulting design features should provide prevention and mitigation, with priority given to preventive measures.

At the final Research Co-ordination meeting for a CRP on acoustic signal processing for the detection of boiling or sodium water reaction in liquid metal fast reactors (LMFRs), held in Obninsk, the Russian Federation in July, it was reported that the CRP had been able to evaluate different signal processing techniques with real field data. The results were thus invaluable to the designers of acoustic leak detection systems. In the long run, this could help enhance the economics of LMFRs through better surveillance of the reactor core and steam generators. Signal processing techniques developed in this CRP for anomaly detection (i.e. boiling or leaks) can be used to detect other types of anomalies in thermomechanical equipment (such as cavitation and rattling) in fast and thermal reactors.

One of the goals of a CRP on the intercomparison of LMFR seismic analysis codes was to validate and improve the codes used for reactor core seismic analysis through benchmark exercises. At the final Research Co-ordination meeting for this CRP, which was held in Bologna, Italy, these codes were validated on the basis of an intercomparison of experimental and analytical data. It was noted that the results derived from this CRP had a broad range of applicability, since they could be used for different types of reactors.

In 1994, the Agency was requested to initiate the Options Identification Programme (OIP) with the aim of selecting a limited set of practical options for nuclear desalination demonstration facilities. The options were to be based on reactor and desalination technologies which were readily available without any further development. A working group of representatives from interested Member States and the Agency selected the following practical candidates for demonstration projects: a reverse osmosis desalination process coupled to an existing or newly built water cooled reactor of medium-size capacity, and a multi-effect distillation process coupled to a small size reactor in the 20–50 MW(e) range. Either of these options could be implemented in the relatively near future.

A Technical Committee meeting on advanced fuels with reduced actinide generation, held in Vienna in November, identified reactor/fuel combinations, including thermal reactors, fast reactors and accelerator driven systems with fuels or targets from the uranium/plutonium and thorium/uranium families in order to reduce actinide generation. This area of work is of considerable interest for alleviating the problems of plutonium buildup and long lived wastes.

Nuclear Fusion

As part of Agency activities to assist Member States in nuclear fusion research, three Technical Committee meetings were held during 1995. The first meeting, on alpha particles in fusion research, was held at the Princeton Plasma Physics Laboratory, USA, in April. The proceedings were published in the 35th anniversary special issue of the journal *Nuclear Fusion*. The second meeting, on *H* mode physics and also held at the Princeton Plasma Physics Laboratory, reviewed *H* mode transition physics, theory, scaling, edge localized modes, active control, and the potential benefits of *H* mode operations for reactors. The third meeting, on research using small tokamaks, was held in Ahmedabad, India, in December. The topics reviewed included plasma theory, heating, energy confinement, MHD activity and diagnostics in 14 tokamaks.

The final Research Co-ordination meeting for a CRP on the development of software for numerical simulation and data processing in fusion energy was held in Vienna in November. As a result of this CRP, better numerical simulation techniques and computer codes are now available which will help guide future plasma physics research. Many of the newly developed codes are already running in institutes that did not participate in this CRP.

A report on the interim design, cost review and safety analysis for the International Thermonuclear Experimental Reactor (ITER) was produced. This document comes at the mid-point in activities concerned with ITER engineering design. The Agency provided an atomic and molecular physics database to the ITER project and published various administrative and technical documents, including the *ITER Monthly Newsletter.*