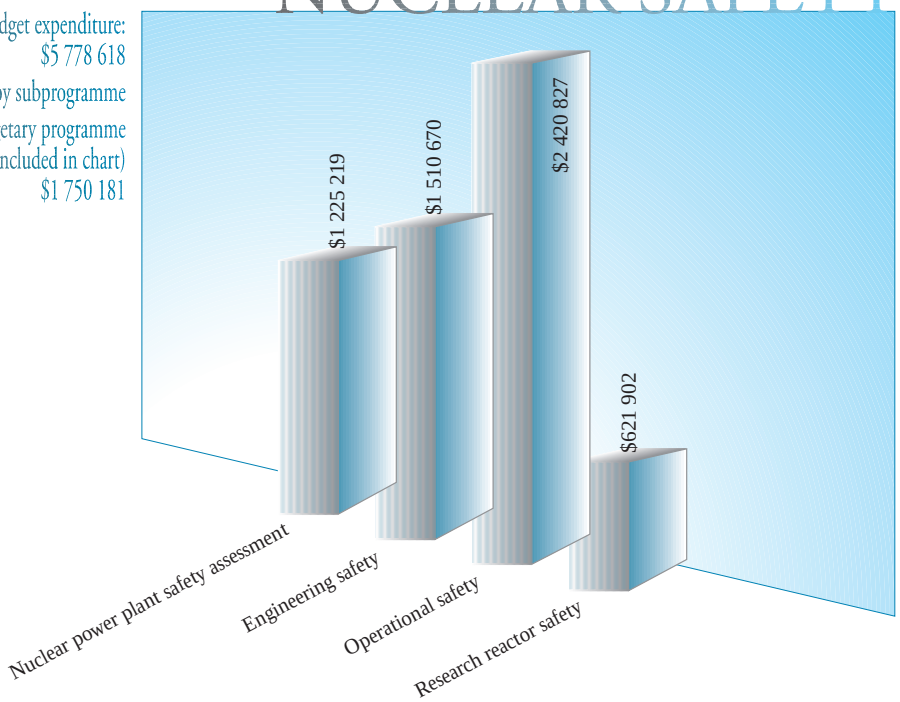
NUCLEAR SAFETY

Regular budget expenditure:
$5 778 618

Expenditure by subprogramme

Extrabudgetary programme expenditure (not included in chart)
$1 750 181



Activities concentrated on supporting intergovernmental efforts to strengthen nuclear safety around the world. The focus was on preparing for the implementation of the Convention on Nuclear Safety, fostering the exchange of information on safety issues, developing common safety standards, providing a variety of expert services and supporting co-ordinated research in Member States.

Nuclear power plant safety assessment

International consensus was reached, through a series of Agency sponsored meetings, on the main safety issues related to the design and operation of early generation WWER-1000 and RBMK nuclear power plants in eastern Europe and the former USSR, and on the importance of these issues to the plant's defence in depth. Extensive international exchange of safety principles and practices resulted in the adoption of more safety oriented operational practices by the plants. However, while Agency reviews indicated that short term safety improvements have been implemented and that national and international programmes are under way, implementation of measures requiring major plant reconstruction was still very limited.

Deficiencies were revealed as a result of Agency reviews of the safety features of older 'small series' WWER-1000 reactors, including a lack of separation of redundant safety systems such as the emergency core cooling and emergency feedwater systems. Electrical and instrumentation and control parts of the safety systems were found to be vulnerable to floods, fires and high energy pipe ruptures. It was also found that there is a single set of channels for the actuation of the reactor protection system by the technological parameters. This design is different from that of other WWERs and does not comply with current Russian safety regulations.

Reviews by the Agency and other organizations of the first generation RBMK reactors (Leningrad units 1 and 2, Kursk 1 and 2 and Chernobyl 1 and 2) highlighted such deficiencies as a design basis which is limited to a small break in specific locations of the main cooling piping. There was also general consensus that a fully independent and diverse additional shutdown system for RBMK plants of all generations should be installed as a matter of high priority. Agency experts who visited Leningrad 1 and 2 confirmed that important safety improvements were being implemented.

Engineering safety

A CRP on the seismic analysis and testing of WWER type nuclear power plants was completed. This programme compared full scale tests performed at the Paks nuclear power plant (WWER-440 model 213) in Hungary and unit 5 of the Kozloduy nuclear power plant (WWER-1000) in Bulgaria with blind prediction analyses carried out by leading consultant and designer groups. These comparisons indicated that there were constraints on the applicability of state of the art computer programs, mainly in the field of soil structure analysis. Other results obtained from this CRP included: a thorough understanding of the seismic and structural standards used for these plants and their comparison with current international practice; indication of the applicability and usefulness of the analytical versus experimental approach in the seismic re-evaluation process; and the potential use of experience data in the seismic re-evaluation and upgrading of WWER type nuclear power plants.

Thirteen Engineering Safety Review Service (ESRS)/ technical co-operation missions were carried out to study seismic and other external events at nuclear power plants and other nuclear facilities. The plants under review in eastern Europe (Kozloduy (Bulgaria), Paks (Hungary), Bohunice (Slovakia), Mochovce (Slovakia) and Armenia) are at the stage where the re-evaluations have been completed and what remains is upgrading. While in some cases 'easy fixes' have been implemented, major structural upgrades still need to be carried out. The main obstacle is the lack of financial resources. The findings of the ESRS missions as well as results from a benchmark CRP were discussed at an Agency seminar in Lyons and a symposium on the seismic safety of nuclear power plants held in Kobe, Japan.

Seven technical documents on the assessment and management of ageing of major safety related nuclear power plant components were completed. These reports include a description of components and the design basis, potential ageing mechanisms and their significance, operating guidelines to control age related degradation, inspection and monitoring requirements and technologies, and assessment and maintenance methods.

A symposium on upgrading the fire safety of nuclear power plants, held in Vienna in November, covered all elements of the upgrading process, namely the identification of fire safety related deficiencies, the search for the most appropriate corrective measures and the implementation of selected engineering or organizational solutions. The meeting focused on various fire safety reviews and audits as a means of identifying deficiencies, as well as on the process of implementing appropriate safety improvements. In related work, a safety report providing guidance on conducting a probabilistic safety assessment (PSA) for fires in nuclear power plants and detailed applications of PSAs to any operational stage of the plant was completed.

A major effort was devoted to the revision of Safety Series publications on the design and siting of nuclear power plants. The revised Code was submitted to the Nuclear Safety Standards Advisory Committee (NUSSAC) and Member States for comment. This draft is consistent with the Safety Fundamentals document *The Safety of Nuclear Installations* (Safety Series No. 110) and includes specific requirements for severe accidents, a clear separation between design basis accidents and severe accidents and more demanding requirements for design verification and safety analysis. The final draft of a revision of the Safety Guide *External Man-induced Events in Relation to Nuclear Power Plant Siting* was prepared.

A technical document was published on the implementation of defence in depth in the new generation of nuclear power plants. This document is based on *Defence in Depth in Nuclear Safety* (INSAG-10), a report of the International Nuclear Advisory Group. Aspects related to defence in depth for the next generation of light water reactors (LWRs) were addressed in detail and areas of possible enhancement for each level of defence were identified. Although the document is primarily focused on LWRs, many general considerations can be applied to other types of reactors. In this connection, the increasing interest in using nuclear plants for district heating and seawater desalination led to work being initiated on the safety aspects involved in such applications. A review of a site survey for a prototype 10 MW desalination plant highlighted the deficiency of international guidance on the safety of these facilities.

Operational safety

Four Operational Safety Review Team (OSART) missions were carried out, along with four preparatory

visits for 1998 missions and one follow-up visit. Their findings included: the need to improve safety culture; more training for the improvement of staff at all levels; concerns with configuration management; plant activities and practices that are not fully consistent with international standards; and the need to improve operational experience feedback in terms of scope, investigation of human errors and high reporting thresholds. Technical assistance missions were organized at the request of the Mexican, Chinese and Argentine authorities both before and after OSART missions to those countries.

The OSART guidelines covering operations, maintenance, management, organization and administration, training and technical support were reviewed. Other developments in this programme included the participation of representatives of the plant and the host country's regulator in OSART team training. This has been very well received by the host countries as a way of widening knowledge of the review methodology and promoting the transparency of missions. The OSART Mission Results (OSMIR) database is kept updated and currently contains the results of 36 OSART missions and 18 follow-up visits.

The majority of events reported to the International Nuclear Event Scale (INES) service in 1997 resulted from failures during operation; none were problems discovered by periodic surveillance testing. The most frequent initiating failures of the events reported were, as in the past, fires and overexposures of workers. Activities related to INES included the organization of seminars on evaluation of events in Armenia, Canada, Hungary and Spain.

The Assessment of Safety Significant Events Team (ASSET) service included four missions devoted to peer reviews of self-assessments of operational events and ten seminars covering the evaluation of consequences and the analysis of the causes of operational events. The ASSET service also organized a Technical Committee meeting to refine guidance for self-assessment using feedback from ASSET users and team experts. The main concerns at the nuclear installations visited by the ASSET service included: a need for lower internal reporting thresholds and broader reporting criteria (so that low level events are detected and appropriate action can be taken to reduce the potential for events of higher safety significance); continued development of self-assessment capabilities, finding solutions for safety problems related to equipment operability; and improvements in the safety culture.

The Incident Reporting System (IRS) was established as a worldwide scheme to complement national reporting systems. One third of the events discussed at the annual information exchange meeting of IRS national co-ordinators, held in May in Vienna, were recurring events. The participants ascribed these to two main factors: weaknesses in the feedback of operational safety experience; and the external pressures of competition and privatization. It was recommended that the feedback process of lessons learned should be tracked more closely to determine how the information is being used. Three reports on topical studies identified through IRS experience were issued covering human factor analysis, events related to foreign material intrusion and those related to corrosion, erosion and sedimentation. Joint IAEA–OECD/NEA IRS guidelines were also approved.

Research reactor safety

The new Incident Reporting System for Research Reactors (IRSRR) was launched, with 15 countries participating.

Advisory/technical co-operation missions reviewed safety related issues at research reactors in Algeria, Ghana, Kazakhstan, Malaysia, Peru, Thailand and Yugoslavia. In general, the reactors were found to be in good condition, but in most cases their safety documentation needed either improvement or updating. The mission to Kazakhstan was concerned with the upgrading of the WWR-K reactor and reviewed many aspects of the refurbishment plan and the associated documentation. Special attention and advice were given on the reactor's seismic design. The mission to Yugoslavia was concerned with the spent fuel pool at the Institute of Nuclear Science at Vinèa. Remedial actions have started in the pool in accordance with a plan developed with the Agency's assistance.

A recently published technical document, *Guidelines for the Review of Research Reactor Safety,* will help Agency missions in carrying out reviews and assist regulatory bodies and operating organizations. Three other Safety Guides in the Research Reactor Safety Series were completed dealing with: commissioning; operating limits and conditions; and maintenance, periodic testing and inspection of research reactors.