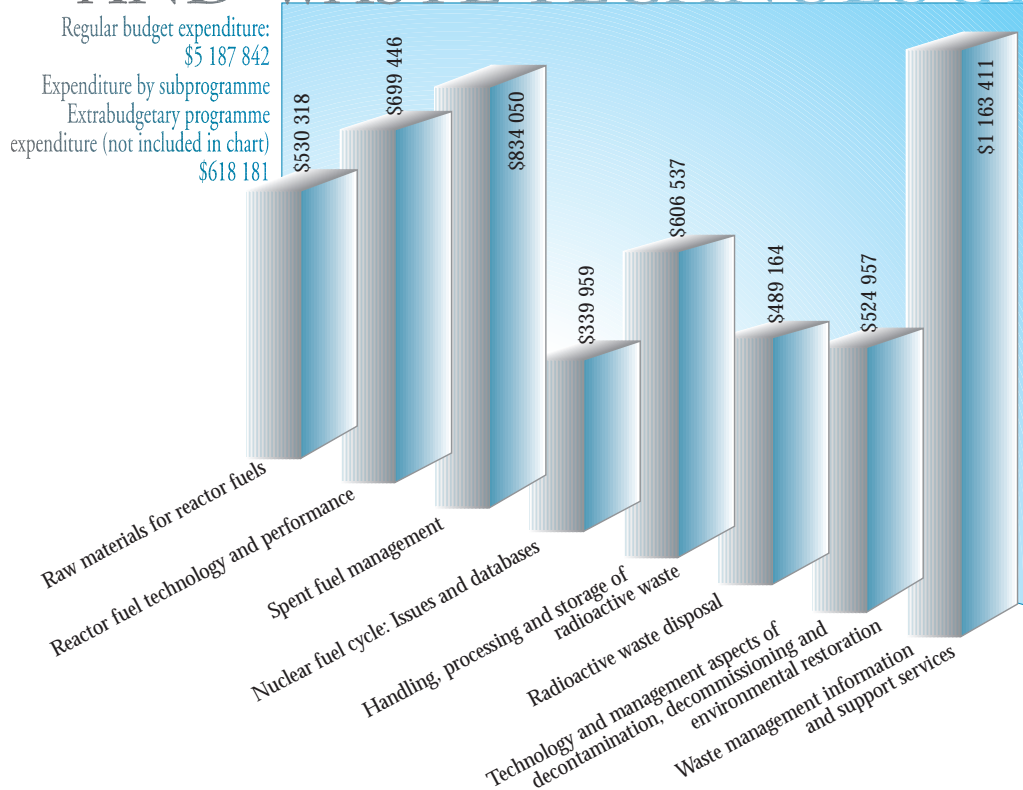


NUCLEAR FUEL CYCLE AND WASTE TECHNOLOGY



The Agency's 1997 programme on the nuclear fuel cycle covered five key areas: uranium supply and demand; light water reactor fuel performance at extended burnup; the reliability of spent fuel under long term storage; the management of spent fuel from research and test reactors; and the safe handling and storage of plutonium. An integral effort to evaluate the nuclear fuel cycle culminated in the international symposium, 'Nuclear Fuel Cycle and Reactor Strategies: Adjusting to New Realities', which aimed at a better understanding of various issues in the nuclear fuel cycle, particularly the management of plutonium.

The radioactive waste technology programme focused on: the handling, processing and disposal and storage of radioactive waste; decontamination and decommissioning of nuclear installations; environmental restoration, quality assurance and management; waste management planning and infrastructure building; and technology transfer and exchange. The progress of work and plans for future programme activities were discussed at the second meeting of the International Radioactive Waste Technology Advisory Committee (WATAC) in November. The status and trends of

national radioactive waste management programmes, discussed in WATAC at its previous meeting in 1996, were the subject of a special report, *Radioactive Waste Management Technology: Status and Trends. First Report of the International Waste Technology Advisory Committee (WATAC)*.

Raw materials for reactor fuels

Two Technical Committee meetings were held in Vienna in June in co-operation with the OECD/NEA, one to assess recent events in uranium related activities and the other to finalize *Uranium 1997 — Resources, Production and Demand*, popularly known as the 'Red Book'. The Red Book incorporates reports from 59 Member States and, for the first time, includes reports from all uranium producing countries. A companion report on environmental activities related to uranium production was also prepared for

publication by the OECD/NEA, in co-operation with the Agency.

Two guidebooks were completed as part of a series addressing such topics as environmental impact assessment, implementation of environmentally friendly mining and milling methods, good management practices and treatment of mine and mill effluents. They aim to recognize and promote the best operational practices in Member States involved in the development and operation of uranium production projects.

Reactor fuel technology and performance

The third and final Research Co-ordination meeting on stress corrosion cracking (SCC) of zirconium alloy fuel cladding was held in Chengdu, China. This CRP achieved one of its main goals, namely the transfer of know-how from the host laboratory and the supervisory group to the participants. However, the second objective of gathering crack growth data for the validation of computer codes to predict SCC was not attained. The results to date demonstrate the 'learning curves' at the participating laboratories. Many samples were destroyed in unsuccessful early tests, with success being achieved towards the end. As a result, permission will be sought to extend the CRP for one year to complete the experimental matrix.

Spent fuel management

As part of an extrabudgetary initiative begun in 1995 to improve the safety of WWER and RBMK nuclear power plants, a Technical Committee meeting was convened in October in Prague on the commissioning of dry spent fuel storage facilities. Guidance was provided to experts from eastern European Member States on the major steps involved in commissioning, licensing, protection and operation

Countries with small nuclear programmes facing the problem of fuel storage and disposal have expressed interest in the possibility of sending their fuel to a regional facility. Of particular concern is spent fuel from research reactors. In response, the Agency convened a Technical Committee meeting in Vienna in

December on the technologies and safety aspects of a regional spent fuel storage facility. Some of the conclusions were that: all types of spent fuel from power and research reactors should be considered for regional storage, including vitrified waste from reprocessing and other fissile high level wastes; both wet and dry storage methods can be used for regional storage purposes; spent fuel handling procedures and transportation should be standardized; guidelines should be developed for the licensing of a regional storage facility; and the establishment of a regional storage facility especially — but not exclusively — for countries with small amounts of spent fuel or only research reactors should be encouraged.

As part of the Japanese Government contribution to the extrabudgetary programme on the safety of WWER and RBMK nuclear power plants, the Atomic Research Institute (KFKI) in Budapest completed thermo-hydraulic calculations of spent fuel behaviour under long term dry storage conditions using the versatile COBRA-SFS code.

The return of US origin spent fuel from research reactors in Europe and Latin America to the USA continued. In support of this important non-proliferation activity, a guidelines document on the technical and administrative preparations for such shipments was prepared and complemented by an interregional training course in the USA.

Nuclear fuel cycle: Issues and databases

An international symposium, entitled 'Nuclear Fuel Cycle and Reactor Strategies: Adjusting to New Realities', was held in Vienna in June in co-operation with the European Commission, the OECD/NEA and the Uranium Institute to evaluate the fuel cycle under the new conditions emerging 20 years after the International Fuel Cycle Evaluation (INFCE). Key issues papers covered six topics: the world energy outlook; plutonium management; fuel cycle and reactor strategies up to 2050; safety, health and environmental implications; non-proliferation aspects; and international co-operation, with particular emphasis on the management of plutonium. One result of the symposium was the creation of the International Working Group on Nuclear Fuel Cycle Options.

The Nuclear Fuel Cycle Information System (NFCIS) database has been redesigned and moved to an Agency server environment for access by Agency staff. This database, an international directory of existing and planned civilian nuclear fuel cycle facilities, currently contains information on 511 facilities in 51 countries.

Handling, processing and storage of radioactive waste

'Off-site' technologies for the processing and conditioning of low level radioactive waste arising from environmental restoration are being replaced in some countries by in situ isolation and immobilization techniques. These techniques convert contaminated soils, sludge and other types of material into durable, leach resistant products that meet current waste disposal requirements. Information on these immobilization technologies was collected and analysed, and a technical document was published.

The acceptance of waste for interim storage, transportation and disposal requires that the characteristics of the waste package be known and reliably determined. In this connection, a technical report was issued to enhance the validity of international characterization data. The report provides a general frame of reference for waste characteristics that is important for the acceptance of wastes for storage, transportation and disposal, and guidance in the application of characterization methods.

A CRP on the behaviour of high level waste forms and packages in simulated repository conditions was concluded. Areas of study included optimizing the composition of waste forms for specific waste origins and comparing the results of experiments on the behaviour of wastes under simulated repository conditions. Recent data were assessed on the effect of composition and other parameters of various waste forms (glass, ceramics and spent UO_2 fuel) on long term leach behaviour in the main disposal environments presently under consideration. The research results will be used to study the modelling and prediction of long term waste form performance under repository conditions.

Radioactive waste disposal

Site selection and characterization for the disposal of radioactive waste continue to be the focus of many national programmes. This was reflected in Agency activities during the year by the completion of three reports on the technical aspects of site investigation and characterization. Two of the reports address geological and hydrogeological systems which, in most assessment scenarios, are considered to offer the most probable pathways in the event of activity release from repositories.

The first Research Co-ordination meeting on the long term behaviour of low and intermediate level waste packages under repository conditions was held in Moscow in November. Individual research programmes under the CRP were reviewed, including the study objectives, implementation plans and preliminary results. In addition, the technical framework of the CRP was determined, involving: studies on the long term mechanical durability of waste packages, radionuclide release and gas generation for different types of waste forms, container and package behaviour, and investigations at existing repositories.

Technology and management aspects of decontamination, decommissioning and environmental restoration

As most Agency reports in the field of decommissioning technology date back to the 1980s, a technical report was prepared featuring a proactive approach to the decommissioning of nuclear power plants. The report covers operating experience with current technologies, development of new technologies and strategies (e.g. the use of on-site disposal techniques for decommissioned facilities) and representative examples of experience, studies and plans in Member States.

Several technical reports dealing with site characterization, remediation strategies, technologies and the close-out of uranium mines and mills were completed. The reports are in support of a CRP on the characterization of radioactively contaminated sites with the objective of developing easy to use and rapid characterization techniques.

Waste management information and support services

One area of increasing interest to Member States is guidance on the role and practices of quality management and quality assurance. In this regard, two technical reports that define basic requirements and provide guidance on the best practices applicable to inspection, testing and waste records management for waste generators, conditioners, transporters and disposal facility operators were completed in 1997.

At the request of the United States Department of Energy (DOE), the Agency and the OECD/NEA carried out a peer review of the 1996 performance assessment of the Waste Isolation Pilot Plant, near Carlsbad in New Mexico. The facility has been sited and constructed to meet the safety criteria of the Environmental Protection Agency (EPA) and is intended to accommodate long lived actinide wastes from US defence programmes. The primary focus of the review by the team of international experts, including Agency specialists in nuclear waste technology and waste safety, was on the technical soundness of the analyses and on the DOE's approach to post-closure performance assessment, examined from an international perspective. It concluded that the performance assessment methodology was well founded and that the analyses generally were technically sound. However, the team noted that the prescriptive nature of the EPA regulations had the effect of constraining the scope of the performance assessment in a way which contrasts with general international practice. The team also identified technical areas requiring further attention by the DOE.

Development of the International Research Abstracts System (IRAIS) for the Waste Management Research Abstracts was completed. Available on the Internet,

IRAIS serves three purposes: researchers can submit their research abstracts on-line; the public can search and retrieve published research abstracts; and the Agency can automate the validation and publication of waste management research abstracts. The system is expected to reduce the cost, time and effort involved in producing the Waste Management Research Abstracts publication.

For the first time in Latin America, a demonstration of pre-disposal waste management methods and procedures was held at the waste processing and storage facility of the Lo Aguirre Nuclear Research Centre in Santiago, Chile. Participants from Bolivia, Guatemala, Paraguay, Uruguay and the host country attended the demonstration and obtained practical experience in managing radioactive wastes. A second pre-disposal demonstration for Member States from western Europe and west Asia (Jordan, Moldova and Turkey) was held at the Çekmece Nuclear Research and Training Centre in Istanbul, Turkey. Agreement was reached with MINATOM of the Russian Federation for demonstrations to be held in Moscow for the newly independent States of the former USSR and countries from eastern Europe. A similar host facility is being prepared for the Asia-Pacific region.

Progress was made in improving technical procedures for the conditioning of spent radium sources, and administrative procedures were established to make the programme more efficient. Teams of specialists from Austria and Brazil carried out the conditioning of national radium inventories in Croatia, Guatemala and Nicaragua. In Chile, a local team carried out the conditioning operation with Agency assistance. The objective of the programme is to condition spent radium sources in developing countries.

A technical co-operation Model Project was initiated to transfer and establish sustainable technologies for radioactive waste management in selected Member States. This will lead to improved radioactive waste management by providing practical and proven technologies and solutions. Country specific project objectives were also established for more than 100 developing Member States which need to upgrade their radioactive waste technology capabilities.