

International waste management— conference preview

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The world's total installed electrical generation capacity is expected to increase from 2000 GWe at present to about 2700 GWe in 1985, and to between 5200 and 6600 GWe in the year 2000. Such a growth will entail the construction and operation of about 4000 power stations of 1 GWe capacity over a period of 20 years. To meet this demand, all sources of energy will have to be used, including nuclear energy whose role will increase.

At the end of 1982, 294 nuclear power reactors with 173 GWe capacity were in operation in 25 countries, providing roughly one tenth of the total electricity generated in the world. About 215 power reactors are at present under construction in 27 countries, which will add a further generating capacity of 197 GWe. It is expected that the installed nuclear capacity will amount to 311 GWe by 1985, 425 GWe by 1990, and between 750 and 1100 GWe by the year 2000. The nuclear share of electricity production in some developed countries is as much as 40% or more and may grow to 80% by the year 2000. Although almost all nuclear power comes from thermal reactor systems, a few fast-breeder reactors are also in operation or under construction, and their development is expected to give nuclear power a leading role far into the future.

The growth of nuclear power depends very much on concerns and problems of radioactive waste disposal. The safe disposal of radioactive wastes is a vital issue.

Conscious that its Member States have had three decades' experience in managing wastes, the Agency considered it timely to review and assess the present status and knowledge of the subject, and that it was particularly important to note any deficiencies in order to re-examine current practices and technology. The Agency therefore decided to convene an international conference on the subject of waste management. The conference will be held in Seattle, Washington State, USA, from 16 to 20 May.

The Agency has held several symposia and international meetings in the past covering different aspects of radioactive waste management. There has, however, not been an IAEA conference so far giving summary reviews of the many technical, environmental, regulatory, institutional, legal, and economic aspects of waste management, their interrelationships, and their implications for the development of nuclear power. The broad objectives of the conference are: to provide a forum for international exchange of information for policy-makers and technical experts; to highlight issues of current importance; and to identify possible approaches to their solution on the basis of the knowledge accumulated from past experience, research and development, and policy considerations.

Agency activities

The Agency's activities in radioactive waste management are intended to assist national programmes and the international community in protecting man and his environment from all hazards arising from the management of radioactive wastes and effluents. The Agency provides technical and regulatory information, and guidance in the field. It collects and disseminates information, develops guidelines, and provides technical assistance and training, by arranging conferences, symposia and seminars, different types of meetings, training courses, co-ordinated research programmes, and sending experts on mission to Member States. The current programme has three main components.

Handling and treatment of radioactive waste: this component of the Agency's programme now deals more with the handling, treatment, and management of high-level wastes and alpha-bearing wastes and with the decommissioning of nuclear facilities.

In the field of high-level and alpha-bearing wastes a Technical Committee established in 1974 had several meetings and served as a forum for exchange of information on national waste-treatment and conditioning programmes. IAEA co-ordinated research programmes on "evaluation of high-level waste products" and "hazard assessment of the separation of actinides from high-level waste followed either by transmutation or separate

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disposal" gave valuable results as guidance material for Member States. Experience and trends in the handling of alpha-bearing wastes was discussed at an IAEA/CEC symposium in 1980.

Gaseous effluents and waste treatment are important in the context of protecting the environment from airborne radionuclide releases both under normal and accidental conditions. An IAEA/NEA symposium discussed this and related subjects in 1980.

A guide to the safe handling of radioactive waste at nuclear power plants has been published. Schemes and practices used at various power plants were discussed at an NEA/IAEA symposium in 1979. Work is in progress in the preparation of a Code of Practice on the management of wastes from nuclear power plants.

Decommissioning of nuclear facilities has evoked broad interest in past years. An IAEA/NEA symposium was held in 1978. Factors relevant to decommissioning of land-based nuclear reactors was the subject of a document published. Techniques for decontamination and decommissioning and the management of wastes produced therefrom, as well as decontamination as an aid to decommissioning and plant maintenance, will be discussed in reports under preparation.

Emphasis is currently being placed on conditioning of high-level wastes for storage and disposal and techniques for their handling.

Underground disposal of radioactive wastes: The topics covered in this area of the Agency's work include: generic guidance, regulatory aspects, safety assessments and criteria; investigations of repository sites; design and construction of repositories; and operation, shutdown, and surveillance of repositories. This subject is being extensively covered: 12 documents had been published by end-1982 and many more are being prepared or are planned.

Together with the NEA, the Agency held a symposium on underground disposal of radioactive waste in 1979. The Agency has established a Technical Review Committee to advise on the programme and to examine documents before they are published. The Agency provides a forum for continued international dialogue in this area which may help provide international solutions to some of the open questions, as well as harmonize national approaches.

Environmental aspects of nuclear energy: The long-term environmental impacts of industrial use of nuclear energy include: actual or potential radioactive emissions of regional and global interest; the continued use and expected increase in dumping of low-level solid wastes into the sea, and effluent releases into coastal waters; and disposal of radioactive wastes on land.

The Agency has reported on the principles and procedures for establishing release limits for radioactive materials into the environment; pathways models and

data for the environmental transfer of radionuclides; concerns regarding long-range transboundary air and water pollution.

Environmental behaviour of radionuclides of particular radiological concern has received attention and a symposium on the behaviour of tritium in the environment was held. Co-ordinated research programmes are being carried out on: the behaviour of tritium in some typical ecosystems; the source and movement of radium in aquifers and inland waterways; migration of radionuclides from the storage of radioactive waste in the terrestrial environment; the cycling behaviour of transuranics in the marine environment; and ^{14}C from nuclear facilities. In 1981 the Agency held a symposium on the migration of long-lived radionuclides in the terrestrial environment.

Of particular importance is the execution of the Agency's responsibility for radioactive matters under the London Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter. The Agency's Definition of radioactive wastes unsuitable for dumping at sea, and its Recommendations to national authorities for issuing special permits for the dumping of waste not coming under this definition, have been effective under the Convention since 1978. They are being reviewed, and the next revision will be completed by 1985. Execution of these activities involves co-operation with many international organizations and the Agency's International Laboratory of Marine Radioactivity in Monaco.

Conference programme

The conference to be held in Seattle in May will have broad review papers and also reviews of specific technical subjects. The topics identified are:

- Waste management policy and its implementation;
- Waste handling and treatment at nuclear facilities — experience, projects, technological trends, and requirements;
- Long-term storage and disposal of radioactive wastes — practices and plans;
- Environmental and safety assessments of waste management systems;
- Radioactive releases into the environment from nuclear operations — status and future; and
- International co-operation.

About 154 papers from 22 countries and 9 international organizations will be presented. The IAEA's own work in waste management will be covered in six papers, prepared jointly with national authors who were connected with the work.

The sessions on *waste management policy and its implementation, national and multinational approaches* cover the policies not only of countries having advanced, but also of others with modest waste management programmes. The following important aspects will be reviewed:

- The need for realistic information on the inventory and characterization of wastes and long-term planning for their management.
- The use of feedback information on management of low- and intermediate-level wastes to improve their management in the future.
- Optimizing with respect to time schedule for the different phases of high-level waste management, from liquid storage through vitrification to ultimate disposal. Trends to identify time-frames for implementation of these steps seem to be emerging — each country basing judgments on its specific conditions.
- Involvement of most of the countries in r & d programmes connected with waste conditioning and underground disposal, including pilot projects and *in situ* experiments, and site investigations. Some of these are being undertaken by multinational co-operative efforts.
- Although formulation of regulations and the responsibility for their implementation are the concerns of Governments, a consensus seems to be emerging that utilities will be responsible for managing the wastes they produce. The financial commitments necessary for waste management and disposal may be met by a charge on electric power, as a few countries are already doing.
- Basic radiological protection requirements for the long-term and needs to protect the environment by drawing out the required standards and regulations, are being considered as the base on which waste management strategies should be built.
- The long-term implications and economics of spent-fuel storage and disposal as against reprocessing and waste management are being examined by different countries for their overall nuclear power and waste management strategies.

The sessions on *waste handling, treatment and conditioning of radioactive wastes* will review waste handling and treatment from power and reprocessing plants; treatment of specific wastes and gaseous effluents; as well as decommissioning. Experience of the various vitrification processes for high-level wastes in different countries will be reviewed, and the engineering of such facilities, remote control, radiological safety, and how to obtain an acceptable quality product will be described. The results will be presented of laboratory work on the characterization of waste forms and their quality assurance for low- and intermediate-level wastes fixed in cement, bitumen, organic polymers, etc. There will be information on more advanced processes for liquid-waste treatment, including developments in precipitation techniques, use of inorganic ion-exchangers and other novel absorbents, membrane separations, electrical processes, and high-gradient magnetic separations. Ion-exchange treatment is important in waste management and will be covered in detail in several papers, including one IAEA review paper. Management of tritium-bearing wastes will also be covered in a joint paper summarizing the results of an IAEA co-ordinated research programme. There will be presentations on the need for providing for storage

facilities for conditioned operational wastes at the site of the power plants to ease the problems of utilities in the absence of established away-from-reactor storage or disposal sites.

Extensive experience exists in the incorporation of wastes into bitumen and the conference will review this important conditioning method and its acceptability for long-term storage. Experience and plans for treatment and conditioning of all produced wastes, co-located with fuel-reprocessing facilities, will be reported. Progress of work in obtaining new vitrification forms (e.g. Synroc); process for recovery of plutonium (acid digestion); handling and storage of conditioned high-level waste; and waste-package designs for disposal of high-level wastes in geological formations, will be covered. Volume reduction of wastes from nuclear power plants, decommissioning and decontamination activities, and management of wastes from advanced nuclear fuel cycles will be detailed in specific review papers.

Treatment of off-gases, options for management of ^{14}C wastes, recovery and storage of airborne nuclides (^{85}Kr , ^3H , ^{14}C , ^{129}I) and policies related thereto, and review of status and strategy of commercial airborne waste-management programme are expected to give insights into this problem for future applications not only for their management, but also for assessment of the radiological significances of their releases.

The sessions on *storage and disposal of radioactive wastes* cover general and national programmes in the field, as well as *in situ* experiments, repository concepts, and disposal of low- and intermediate-level wastes. Experiences in spent-fuel storage, disposal in shallow ground, rock cavities, studies on deep geological disposals, acceptable criteria, geoscientific investigations, and research and development into various disposal options will be covered in the papers being presented.

The experiences of nearly three decades of wet and dry storage of irradiated fuel and new fuel-storage concepts will be of interest. Rock cavity disposal experience and its future potential is expected to be reviewed. Several papers on the different options of high-level waste disposal in geological formations are expected to give significant information. Development of international guidelines and criteria, and improved alternative concepts for final disposal of wastes and spent fuel, are areas needing further attention. Papers will give information on research and development to identify potentially useful sites, and approaches undertaken to choose repository sites in deep geological formations: namely, inventory and classification of sites; confirmation of pre-selection; and site characterization.

A number of national concepts for storage and disposal of high-level wastes will be discussed. Underground pilot projects and research laboratories, which are essential stages in the pre-selection of repositories, are also being undertaken by many countries. Some of them are multi-

national efforts. Investigations will aim to get information on:

- Pre-construction evaluation of site: including airborne, surface, and bore-hole techniques;
- The construction phase, to assess the accuracy of techniques used for modelling the geological, geo-mechanical, and hydrogeologic environment; and
- The post-construction phase: experiments on near-field; complex interactions; buffers; rock mass, and groundwater systems, and the resultant potential for mass-transport.

Test-disposal operation with real solidified high-level wastes is also going to be studied. Reports on these proposed studies are being looked upon with interest.

Conceptual designs and studies for waste repositories in basalt, tuff, etc.; for waste packages and exploratory shafts; geohydrologic characterization and sorptive barriers; will be reported upon. Geochemical characterization, groundwater chemistry, geochemistry, and transport modelling, retardation of waste elements, analysis of performance assessments are other areas on which new information is expected at the conference.

Disposal of low- and intermediate-level wastes is of great importance at present. Practical experience during the last 20 years or so, the effectiveness of multibarrier systems, hydrogeologic aspects, and the need for stable national systems, will be reported on. Sea disposal of solid wastes will be reported. Also, research efforts on migration of specific radionuclides, understanding of fundamental transport mechanisms, and groundwater chemistry, are expected to stimulate interest.

In the sessions on *environmental and safety assessments of waste disposal* the performance requirements of the waste-isolation system will be analysed. Problems encountered in the systems analyses of effluent releases and of waste-management systems and strategies are important topics which will be covered. Application of ICRP recommendations to radioactive waste isolation, long-term radiation-protection objectives, development of acceptability criteria and long-term environmental impacts of geologic repositories, efforts in the promulgation of environmental standards for radioactive wastes, status of waste-repository licensing, and risk assessment of waste management and other fuel-cycle operations, will be reported and are being eagerly awaited. A number of papers on safety and performance assessments for deep geological repositories, which include site-specific

probabilistic risk-evaluation, description of consequence-modelling for safety analysis, geological investigations, near-field phenomena, assessment of radiological impacts, geochemical processes and geophysical investigations, modelling of long-term aspects of nuclear waste disposal, and scenario analysis, are other areas being reported. Reports on safety analysis and assessment of low- and intermediate-level wastes, including abnormal events and radiological capacity of shallow land disposal sites, will be presented. Long-term stabilization of uranium-mill tailings, costs and benefits of alternatives for mill-tailings management, are also interesting topics which will be covered.

In the sessions on *radioactive releases into the environment from nuclear operations* a number of important papers will deal with transboundary aspects of environmental protection limits, health consequences of release of radioactive effluents, environmental impact assessment of releases and establishing release limits, releases of small quantities of radionuclides and resultant dose contributions of mining, milling, fuel fabrication, reactor operations, and reprocessing waste management.

Environmental aspects of nuclides of regional and global interest, evaluation of environmental dispersion of long-lived radionuclides in the geosphere and biosphere, models for nuclide transport in geologic media, field studies of radionuclide migration are topics of interest as is also a review of global environmental transport models for ^3H , ^{14}C , ^{85}Kr and ^{129}I . Control of radioactive waste disposal into the marine environment, a subject of considerable technical and political interest, will be covered in several papers which will include environmental surveillance programmes and evaluation of guidelines for an emerging national policy.

Need for international co-operation

The presentations and discussions at the conference are expected to contribute significantly to our knowledge in the field. The very fact that the Agency is there is a forum for worldwide exchange of information on the current status and future prospects in the field is indicative of the valuable role of the organization and the benefit it can give to the international community for further growth of nuclear power. A sound approach is needed for positive policy identification for public dissemination of the real knowledge accumulated and available for safe management of radioactive waste. It is hoped that this can be achieved in Seattle.

