Co-ordinated Research Programmes on the Management of Radioactive Wastes

The IAEA's programme and budget provide for the placing of research contracts with universities, colleges, research centres, laboratories and other institutions in Member States on problems of direct interest to the Agency's work. In many cases, the Agency organizes co-ordinated research programmes in which institutes in several countries work jointly on related problems.

The management of radioactive wastes is one field where co-ordinated research programmes have proven to be effective. Normally, a co-ordinated research programme lasts from three to five years. At the outset of a programme there may be an organizational meeting of institute representatives at which the overall programme objectives are discussed together with the expected contributions from each participating institute. A mid-term review meeting may be held, and at the end of the programme the results are brought together and assessed.

The Waste Management Section of the Agency's Division of Nuclear Safety and Environmental Protection has been involved in a number of co-ordinated research programmes. A brief review of these programmes – some recently completed, some in mid-term, some just beginning and others still in the planning stage – would seem to be a suitable way of indicating their nature and what they can accomplish. In particular, the review shows how the emphasis and objectives of the programmes have changed over the past five years. A number of the programmes involving environmental protection are partially funded by the United Nations Environment Fund (UNEP) (see Figure 1).

Recently Completed Programmes

Two programmes which began in 1972–73 were completed in 1975–76. One programme involved four institutes which studied the leaching of low-level solidified waste products destined for ground burial and the migration of the leach liquor under the local conditions. A Czechoslovakian study evaluated the conditions under which the fixed wastes could be safely stored and defined geological formations to prevent the release of radioactivity into the environment. The Polish study evaluated the sorption characteristics and hydrogeological conditions at a proposed storage site, together with the leach rates of bitumenized waste products and concluded that the solidified wastes could be stored directly in the soil without further isolation from groundwater. The Korean study used tritium to trace the ground-water flow at potential disposal sites and also measured the affinity of local clay soils for the uptake of strontium and caesium. The programme in Greece concentrated on the kinetics

This report from the IAEA Waste Management Section was co-ordinated by John Grover.

Figure 1: Co-ordinated Research Programmes in the Waste Management Field

Title	Research Contracts	Research Agreements
Recently Completed Programmes		
Studies of the migration and dispersion of radionuclides in the terrestrial environment	Czechoslovakia, Greece, Korea, Poland	
The study of integrated radioactive waste management systems and their impact on the environment	Hungary, Philippines, Thailand	
Programmes Under Way		
Cycling of tritium and other radionuclides of a global character[+]	India, Mexico, Philippines, Thailand, Greece, Finland	Belgium, France, FRG, Netherlands, USA (2)
Studies of the source, distribution, movement and deposition of radium in inland waterways and aquifers[+]	Brazil, Czechoslovakia, India, Yugoslavia	Australia, France Japan, USA
Environmental evaluation and hazard assessment of the separation of the actinides from the high-level waste products from fuel reprocessing followed by either transmutation or separate disposal[+]	Czechoslovakia[*]	France[*], FRG, Italy, Sweden, UK (2), USA (2)
Programme Just Beginning		
Evaluation of solidified high-level waste products[+]	India	USA, UK, Japan, FRG, France, Canada
Proposed New Programme		
Testing methods for particulate filters	India[**], Czechoslovakia[**], Rumania[**], Hungary[**]	USA[**], UK[**], France[**], Belgium[**], FRG[**]

[+] Programmes partially funded by UNEP.

[*] These countries are expected to join the programme.

[**] Countries which will be invited to participate in the programme.

of leaching of caesium and strontium from solidified wastes embedded in asphalt or cement mixtures. The meetings of participants during the programme enabled the investigators to compare techniques.

The other programme involved three countries interested in waste management systems at their own particular institutes. A Hungarian team developed a system for the volume reduction of high salt content wastes using a non-boiling evaporation process and then the immobilization of the salt cake with a cement mixture to produce a product with an acceptably low leach rate. The programme in the Philippines involved the development of a scheme for safe management of the low-level wastes arising at the Atomic Research Centre, while in Thailand the work concentrated on the fixation of the wastes and the evaluation of the environmental aspects of disposal at the nuclear Centre.

Programmes Under Way

A programme on the behaviour of tritium in the environment was started in 1973. The broad objectives of this programme are to obtain information on the residence time, pattern of movement and distribution of tritium in typical ecosystems in order to determine the biological significance of this radionuclide under various climatic conditions. Experiments include work on soil and plant systems, domestic animals and marine organisms.

Much valuable data have been obtained from tritium studies on soil-plant systems in wide variety of ecosystems under different meteorological climates from tundra, prairie, temperate grassland and woodland, savannah and hot grassland, and tropical rain forest. Particular emphasis has been placed on vegetation having a food chain significance to animals and man. In some laboratories, advanced studies have shown the difference of behaviour of tissue-bound tritium and free tritium in biological systems.

The programme will end in late 1977 and a booklet, entitled "Behaviour of Tritium in the Environment", giving the results obtained during five years will be published and presented to the International Tritium Symposium planned for 1978.

A second programme was launched in April 1976 with the first meeting of participants held in France. It is designed to develop systematic information on the form and movement of radium in water under a wide range of environmental conditions. This information will be of great value to those authorities responsible for assessing the consequences of radium releases to water, especially from mining and milling wastes, and to those responsible for setting discharge limits.

The first step in the programme was an intercomparison test in order to harmonize the measurements and to allow the different laboratories to use the same standards. This intercomparison will end in the spring of this year. It will then be possible to select and standardize the best methods for the determination of radium in water.

The programme will then study the distribution of soluble and insoluble radium in natural water and waters affected by mining and milling operations. Changed with time and distance will be determined and the probable causes of the changes elucidated. The uptake of radium by biological systems, especially those which form part of man's food chain, will be also studied. The next coordination meeting of this programme will be held in Japan in October 1977.

The third programme began at the end of 1976 with a meeting of the participants in Vienna and concerns the future management of high-level and alpha-bearing wastes.

The high-level waste from the reprocessing of irradiated nuclear fuel contains both fission products and actinides. The latter have half-lives ranging up to millions of years compared with the major fission product elements with half-lives less than 30 years. Therefore, within 1000 years, the hazard from the fission products becomes less than that of the actinides.

If the actinides are separated from the high-level waste, they can, in principle, be used as fuel in nuclear reactors and either fissioned directly or be converted to fissile nuclides by neutron capture. In this way the actinides with long half-lives are converted to fission products with much shorter half-lives. Once the actinides are removed, the remaining fission products can be vitrified and stored or disposed of in a stable geological formation for periods up to 1000 years, at which time they will have decayed and will no longer constitute a hazard.

The objective of the programme is to develop the methodology for the analysis of the risks involved. At the first meeting, the participants discussed the overall strategy and flowsheets involved, and the way in which the costs, risks and benefits might be assessed. The first meeting was attended by observers from the Commission of European Communities (CEC) and OECD/NEA. They were provided with the details of the new Agency programme to ensure that it is co-ordinated with other international programmes in this field, in particular, that of the CEC.

Programme Just Beginning

The most recent programme to be initiated is concerned with the evaluation of solidified high-level waste products and it is hoped that the first meeting of the participants will be held in June 1977. The majority of countries with fuel reprocessing plants are proposing eventually to incorporate the high-level fission product wastes into some form of solid product.

Many solidified product forms are being developed and studied, the most promising being glasses and ceramics. Because of the long half-lives of some of the radioactive isotopes, it is essential that the products have certain desirable properties and that they retain them for long periods of time. In the event that there are changes in these properties with time, these changes must be understood and shown not to lead to a deterioration of the original desirable properties. Long-term changes could occur due to the effects of temperature and radiation; temperature will only be a factor for the first few decades, whereas the radiation dose will continue to accumulate over the lifetime of the solidified product.

The programme is divided into three main areas; leaching, the effect of radiation, and physical and mechanical properties. The object will be to compare the results from the various laboratories and assess the current state of knowledge of the properties of the various candidate materials.

Proposed New Programme

As a result of a Technical Committee meeting held in 1976 on gaseous effluents, a new programme was proposed on the international standardization of efficiency tests for

particulate filters. Many different test methods have been developed and are now used for the measurement of filter efficiency. The objective of the programme will be to compare these various methods and the national standards, and to develop an acceptable international standard test based on a simple, routine laboratory method. As a result of the programme, a training course for developing countries could be arranged at which specialists could be instructed in the agreed method.

Conclusions

The descriptions of the various programmes indicate the range of activities that are being covered. Some of the programmes are environmental in nature, others technical, some involve contracts, others mostly agreements and some a balance of the two. In some cases the theme of the programme is central to the study and develops from the Agency, in others it involves bringing together a group of countries working in a similar field, with the programmes usually initiated from the countries concerned.