

INDUSTRY AND EARTH SCIENCES

Regular Budget expenditure: \$3 875 955

Expenditure by subprogramme

<i>Industrial applications</i>	\$987 921
<i>Water resources development</i>	\$2 888 034

No extrabudgetary programme resources

Agency activities in 1995 in the area of industry and earth sciences concentrated on applications of nuclear and radiation techniques in the industrial sector and on the utilization of isotope hydrology in water resources development and environmental management. In industrial applications, emphasis was placed on process control optimization, development of materials with improved performance, quality assurance modalities of materials through non-destructive testing, environmental mitigation using radiation technology and monitoring of industrial pollution. The increased importance given by Member States to the use of isotope techniques in water resources development and management has provided fresh momentum to Agency efforts. The management of water resources in regions suffering from scarcity, the assessment of the human impact on water resources, such as water pollution, and the proper use of geothermal water resources were all important areas of activity. Complementary studies on climate change were also pursued.

Industrial Applications

Radiation processing is being recognized as an 'environmentally friendly' technique because it replaces other processes that create pollution and actively contributes to the protection of the environment. This is well demonstrated by the use of electron beam radiation to clean flue gases from coal and oil burning electrical and heat generation plants. The technique has been effectively demonstrated in

several countries, some with support from the Agency (e.g. in Poland). The main accomplishment in 1995 was a feasibility study and the selection of basic irradiation equipment for a full scale electron beam industrial facility in Poland. This facility is expected to be in operation by 1998 to meet the regulatory requirements in effect at that time. In addition, a pilot electron beam radiation plant and a larger scale model project plant in Poland were being used for training activities.

The stability of plastics under irradiation has been under study in a CRP that started in 1994. The subject has importance for the safe operation of nuclear power plants, in industrial radiation facilities, space exploration, sterilization of medical products and other fields. In 1995, a Research Co-ordination meeting focused on several aspects of polymer irradiation, in particular the stabilization of plastics used by the medical products industry and in radiation sterilization (i.e. of syringes, needles, blood and infusion sets). New techniques for the characterization of polymer surfaces (atomic force microscopy) were presented at this meeting, as were new formulations that remain stable under irradiation.

The substantial role that nuclear technology can play in environmental conservation is illustrated by the variety of nuclear techniques now being used in the exploration and exploitation of natural resources such as coal, oil, gas and minerals. For example, the significant economic benefit that can be derived from being able to subdivide large quantities of waste materials into a class of usable

materials was the guiding principle behind a CRP which was concluded in 1995. This CRP examined the use of gamma measurements as an aid in separating usable waste material from non-usable products. Other topics investigated were the removal of heavy toxic metals from liquid industrial wastes, the validation of the containment of solid wastes, separation processes for the efficient removal of toxic compounds from bulk wastes, and monitoring of process wastes to determine their eventual reuse or method of storage. The results of these investigations will be published in an Agency technical document.

Development of Water Resources

The Agency's symposia on isotope hydrology, usually held every four years, play a major role in disseminating new achievements in the development and application of isotope techniques in hydrology, water resources management and associated environmental disciplines. The ninth symposium was held in March in Vienna with an emphasis on the practical applications of isotope techniques in managing groundwater resources. Two-thirds of the papers and posters presented at the symposium were related to such subjects as the origin and recharge of groundwater, groundwater dynamics, groundwater pollution, modelling approaches, and geothermal and palaeowater resources. The remaining contributions dealt with surface water and sediments, unsaturated zones and methodological aspects.

In order to maintain the requisite level of training for the proper implementation of water resources development projects, the Agency has been convening group fellowship training courses every two years for scientists from developing Member States. The fifth such course was held in Vienna from August to October and the participants received training in the principal fields of isotope hydrology. Special emphasis was placed on practical training in laboratory and field work, carried out in Vienna, Graz and Munich, as well as in the use of computers for mathematical modelling and data processing.

In regard to progress achieved in implementing model projects in isotope hydrology, a project in Venezuela identified the sources of groundwater recharge in the Caracas Valley and assessed the vulnerability of the groundwater to pollution. On the basis of these studies, 15 new locations for drinking water wells were identified and successfully commissioned.

Within the framework of a regional model project for Africa on the use of isotopes in groundwater resources

development (involving Egypt, Ethiopia, Morocco and Senegal), field investigations were carried out and water samples collected. These samples are being analysed in laboratories at the Agency and in India, France and the United Kingdom. First results from Moroccan isotope data indicate the prevalence of palaeowater, disproving the assumption that the groundwater system was recently replenished. This is a clear indication that continued overuse of this water will exhaust the available groundwater store, leading to a rapid decline of the water table. This has direct implications for decisions on water management practices.

The rising water level of the Caspian Sea is of considerable concern to the five states bordering this body of water. A technical co-operation programme involving a 15 day cruise was carried out in September, during which ten participants from the littoral states, three outside experts and two Agency staff members carried out studies pertaining to oceanographic, isotopic and chemical parameters of the water at different locations and at various depths. Close technical collaboration was established between the littoral states. Laboratory analyses are in progress and detailed evaluation of the data generated is expected to pave the way for a better understanding of the rise in water level and eventual remedial measures.

Several United Nations agencies and other specialized organizations are engaged in the study of global climate change. The Agency has been a pioneer in this area for more than 30 years, with a worldwide network that collects precipitation data and provides information on the isotopic composition of precipitation. In order to strengthen the foundation for collaboration between the various international organizations, the Agency convened a meeting in November at which a new framework for the involvement of various organizations was discussed. A newly established interagency steering committee is expected to coordinate activities and provide the necessary resources for the 'Global Network of Isotopes in Precipitation' (GNIP).

Considerable efforts have been directed towards improving predictions of climate changes induced by human activities and their impact on the global environment. One promising approach is the study of past climate changes through isotope investigations of climate archives. Isotope techniques have proved to be indispensable as proxy indicators of the climate and a dating tool for past climatic events. Substantial progress has been made in this field through a CRP on the use of isotope techniques in palaeoclimatology, with special reference to continental isotope indicators of palaeoclimate.

At the final Research Co-ordination meeting held in November in Munich, new data were presented on the concentration of noble gases dissolved in the groundwater of regional aquifer systems in North and South America, Europe and Africa. The evaluation of the data in terms of the air temperature difference between the Holocene and the Last Glacial Maximum provided a value of about 5°C for the tropical regions. This result challenges the widely adopted climatic reconstructions

for low latitude regions and has important implications for global climate modelling studies. Isotope studies of lacustrine sediments from several lakes located in the Tibetan plateau provided evidence of large scale changes in the intensity of the Indian monsoon and associated rainfall during the Holocene period. This confirms the vulnerability of the climate in southeast Asia to relatively small changes in the physical parameters of the atmosphere.