

TECHNOLOGY TRANSFER AND THE MANAGEMENT OF RADIOACTIVE WASTE

Arnold Bonne Ph.D. and Candace Chan-Sands
International Atomic Energy Agency
Vienna, Austria

ABSTRACT

One of the International Atomic Energy Agency's (IAEA) fundamental roles is to act as a centre for the transfer of nuclear technologies, including those for managing radioactive wastes. In the area of waste management technology, the Agency is actively working to improve and develop new and efficient means to fulfill that responsibility. The work takes into consideration that:

- Almost eighty percent of the IAEA's 128 Member States do not have nuclear power and use radionuclides principally for research, medical, industrial, and agricultural applications, for example, whereby the type of assistance they need varies.
- Radioactive wastes arise in different types and forms, and over the past decades, the technologies to effectively manage them have been developed and put into practice in many countries. The challenge is identifying the best ways and means to transfer demonstrated technologies, and associated experience, to all countries, especially developing IAEA Member States.
- Global technology trends and changing economic and political conditions are affecting nuclear energy's development. These include an expanding international framework for nuclear safety norms and standards; greater awareness of environmental implications; and the move towards deregulation and privatization of certain sectors, including energy and the management of radioactive waste. The developments require at the international level the establishment of more direct links with regional and local organizations, the use of modern information technologies for exchanging technical know-how and experience, and the transfer of practical tools and assistance for supporting management strategies and decisions.

Recognizing the above responsibilities and challenges, IAEA efforts related to radioactive waste management technologies, into the next century, are framed around three major areas: the development and implementation of mechanisms for better technology transfer and information exchange; the promotion of sustainable and safer processes and procedures; and the provision of peer reviews and direct technical assistance that help facilitate bilateral and multinational efforts.

To illustrate some specific elements of the overall programme, this paper reviews selected technology-transfer activities that have been initiated in the field.

TRANSFERRING EXPERIENCE & TOOLS

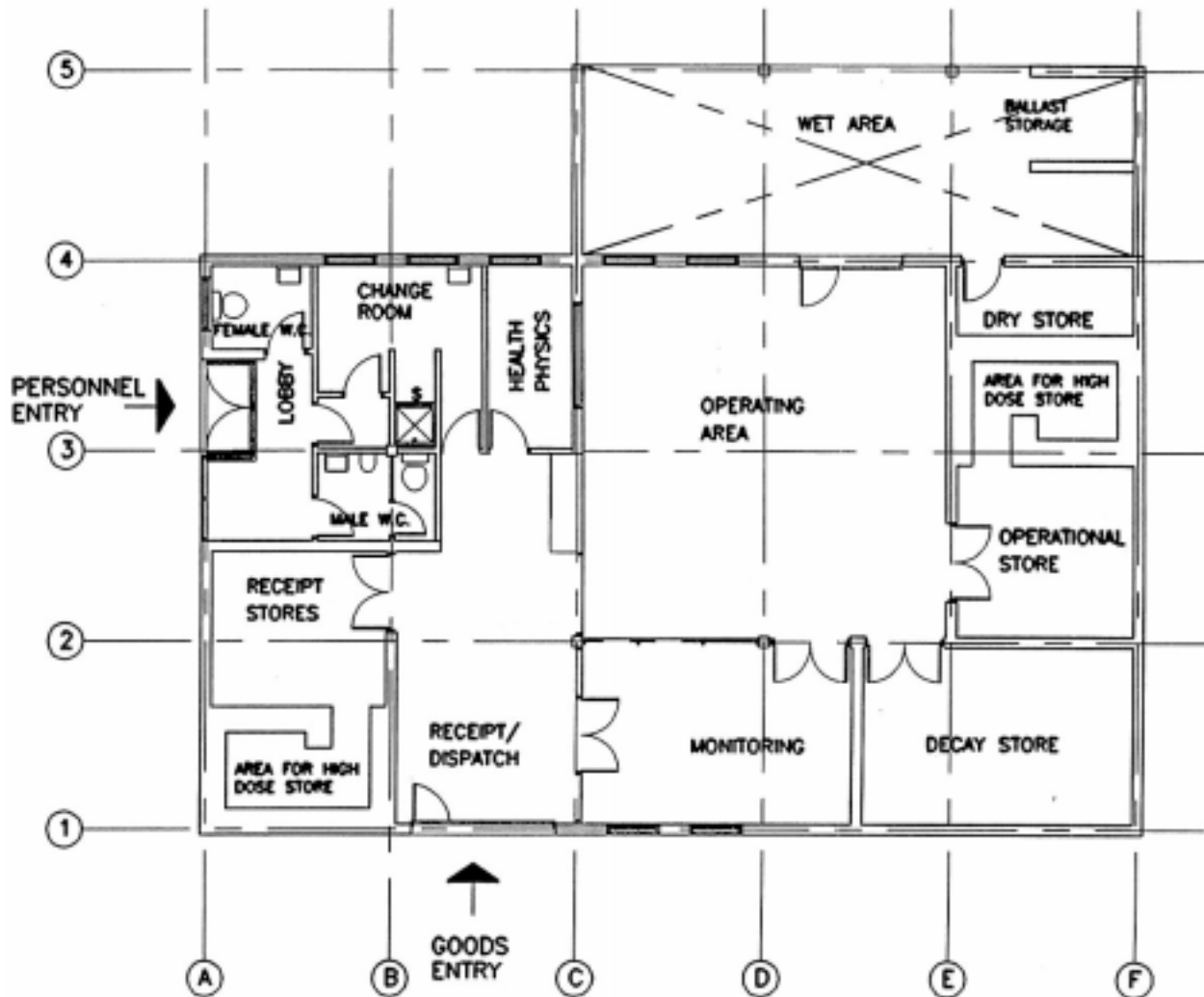
Over the coming decade, the IAEA will be working to further improve its support to developing countries that need to upgrade their technological capabilities for managing radioactive waste. Additional emphasis also is being placed on the efficient exchange of technical information and experience. To facilitate technology transfer, a number of waste management technology "packages" have been prepared. The package components are specifically designed to also support the Agency's efforts under its Model Project called Sustainable Technologies for Managing Radioactive Waste. The packages include:

Spent Radiation Sources Registry. This computerized registry assists countries in keeping accurate records and tracking all their sealed radioactive sources from the cradle to the grave. It is one of the integral elements in the Agency's spent sources programme that aims to assist Member States to control and record all sealed radiation sources. This computerized tool is provided to Member States on request free of charge and includes training on its use and administration. To date, more than 50 requests have been received for the tool package, over 40 countries have the registry system, and more than 35 administrators have been trained (see **Figure 1**) in the use of and administration of the system.





Reference Designs for the Spent Sealed Sources Facility and Waste Processing and Storage Facility. These reference packages feature model conceptual designs of the respective facilities with proven and verified technologies and processes that can be easily adapted to meet specific waste management needs of a country. **Figure 2** shows a design for a storage facility. They also provide the IAEA with an effective and economically feasible way to assist countries with similar waste management needs.



Conditioning of Spent Radium Sources. This project aims to help countries solve problems involving old radium sources. For much of this century, radium sources were widely used in medical and industrial applications all over the world. Because of radium's unfavorable characteristics, almost all countries now have stopped using the sources. About 30,000 spent radium sources now need to be safely stored and managed - many of them in the developing world. Radium's long half-life means that the sources eventually need to be disposed of in deep geological repositories, which are not available yet. For many years, the IAEA has been giving advice to countries on how radium sources can be conditioned for safe storage, pending their final disposal. But many countries do not have the technical infrastructure needed to ensure that the conditioning operation can be done properly and with the necessary quality assurance. To address problems, the IAEA is providing hands-on assistance to developing countries that have stopped using radium sources (See **Figure 3**). The approach involves the collection, treatment, and conditioning of all identified spent radium sources in a country by expert teams in a single campaign. The programme began in 1996 in the Latin American region, where as of December 1998, six national campaigns have been completed in Uruguay, Nicaragua, Guatemala, Chile, Ecuador and Paraguay. One campaign in the Europe and East Asia region was successfully completed in Croatia in 1997. In November 1998, Ghana's national inventory of radium sources

were conditioned by a newly formed expert team from South Africa. For the near future, the Agency will use a similar approach to establish an expert team for Asia as well as to implement conditioning campaigns.



Demonstration of Pre-disposal Waste Management Methods and Procedures. This project focuses on practical hands-on training using actual radioactive waste in an environment similar to that existing in the trainees' home countries. In combination with other IAEA training approaches, the project helps ensure that countries have trained staff (scientists and technicians) who know how to collect, segregate, treat, condition, and store radioactive waste from nuclear applications, using methods and technologies existing in their countries. Even the most simple mechanical or chemical operations may become complicated and require special attention when radioactive material is processed - and industrial, environmental, and radiation protection requirements must be met. The training demonstrations are organized in cooperation with Member States offering suitable waste processing facilities. Such facilities are being selected in all regions. To date, demonstrations have been held at the Cekmece Nuclear Research and Training Centre in Istanbul, Turkey for participants from the European and West Asian region and at the Lo Aguirre Nuclear Research Centre in Santiago, Chile for participants from Latin American countries. In December 1998, the first demonstration for the West Asia - Pacific region was implemented at Philippine Nuclear Research Institute in the Philippines with 7 participants (See **Figure 4**). Agreement recently was reached with the Ministry of Atomic Energy of the Russian Federation for demonstrations in Moscow for Newly Independent States and other countries in Eastern Europe.

For 1999, 4 demonstrations are planned for the 4 region. Participation is open to Member States involved in the INT/4/131 Model Project



More information about the above activities, packages and tools is available upon request or send inquiries through the following webpage -

<http://www.iaea.org/programmes/~nefw-cha/neddept.htm>

In support of these and other activities, the IAEA is developing modern information systems and tools for exchanging technical data and reference materials. These include the Waste Management Database, which provides technical information on waste management programmes and activities in IAEA Member States, and computerized summaries of research-in-progress abstracts, including activities related to the decommissioning of nuclear facilities and environmental restoration. These services, provided through the International Research Abstracts Information System (IR AIS) are now available in different computer media. Scientists and researchers world wide now can access valuable reference materials on radioactive waste management over the Internet. IR AIS - the Agency's first Internet-based application - is a three-in-one system that allows researchers to search and retrieve published research abstracts, and the Agency to automate the validation and publication of waste management research abstracts. It is expected to reduce the cost, time, and manual effort involved in producing Waste Management Research Abstracts, a publication of the IAEA. IR AIS can be access from:
<http://www.iaea.org/programmes/irais>.

TARGETING & COORDINATING ASSISTANCE

In many cases, countries are seeking assistance in specific areas of waste management, the advice of international experts in the field, or support for cooperative projects. One channel they have used is the Waste Management Assessment and Technical Review Programme (WATRP), which is designed for countries having developed nuclear programmes. Under the programme, the Agency coordinates peer reviews by international expert teams on proposed or ongoing radioactive waste management programmes; planning, operation or decommissioning of facilities; or organizational and regulatory matters, such as safety assessments. WATRP reviews - which have also assisted national efforts to improve public confidence of programmes - remains an important component of the IAEA's waste management programme.

Other types of technical support are being directed at emerging needs in Central and Eastern Europe, among other regions. In the Newly Independent States of the Former Soviet Union and in some East European Countries, for example, spent sealed radiation sources, of various types and characteristics, once used in industry and research were stored/disposed of mainly in boreholes in near-surface disposal facilities. With the political changes in these countries and the establishment of new regulatory authorities, national legislation and standards for nuclear, radiation and waste safety are being revised or developed. Continued IAEA technical support to these countries in a number of areas is expected over the near term.

At the request of Member States, the Agency also is facilitating bilateral and multinational efforts to address specific problems. In the Russian Federation, for example, one of most complicated ecological problems is the management of radioactive waste accumulated as a result of past activities in production of nuclear weapons, use of nuclear energy for peaceful purposes, and as a consequence of the reductions in the nuclear arsenals. Efforts have been undertaken by Member States to address these problems and the need was identified for setting up a contact group of experts to assist in coordinating their efforts. A Contact Expert Group (CEG) was established in September 1995 by interested countries with the aim to avoid redundancy and duplication, assure that priorities are properly assessed and made known to international community, and provide points of contacts to facilitate co-operation. The Agency was asked to perform the CEG Secretariat's duties. The CEG includes experts from twelve countries and organizations - Belgium, France, Finland, Germany, Norway, Russian Federation, Sweden, UK, USA, the European Union, the International Institute for Applied Systems Analysis, and the International Science and Technology Center - as well as two observers from Japan and the Nordic Environmental Finance Corporation.

The Group recently targeted the country's North-West region as a top priority for global cooperative projects. The region has one of the highest concentrations in the world of nuclear reactors, spent fuel, and radioactive waste, and experts informed the IAEA in December 1997 of major problems being faced, including the availability of funds, in efforts to improve the situation. The Group has reported that radioactive waste accumulated in the Russian Federation by 1995 amounted to more than half a billion cubic meters with an activity of about two billion curies. In addition around 8500 tonnes of spent nuclear fuel with an activity of around four billion curies has been stored. Of 120 nuclear submarines taken out of operation, the spent nuclear fuel

has been unloaded from only 42. In 1997, a total of about 150 nuclear submarines were listed as out of operation. In reaching its findings, the CEG reviewed reports by the Russian Federation ministries, institutes and organizations and the results of a number of specialized studies sponsored by CEG members. (see paper xxx for more details)

Another initiative involves cooperation with the Paldiski International Expert Reference Group (PIERG). It was established in 1994 to support the negotiations between the Republic of Estonia and the Russian Federation on the transfer, to the Estonian Authorities, of the former Soviet Nuclear Training Center where two nuclear submarine reactors and all auxiliary operating facilities were located near the city of Paldiski. After the successful transfer of the site in September 1995, the PIERG work has concentrated on how to safely decommission the facility and, through its members, finance the implementation of individual tasks within the decommissioning process.

The IAEA presence in PIERG has ensured that the advice provided has been in line with IAEA recommendations and internationally accepted practice. During the past four years the safety situation has improved; the spent fuel has been returned to Russia; a strategic plan for decommissioning the facility has been established; the radiological characterization of the site has been completed; a new interim store for conditioned waste has been completed; and, most of the stored liquid and solid waste has been conditioned. Among the most important improvements overall have been the enhanced competence of the staff, both on the operator and regulatory side, involved in the decommissioning work and the initiation of steps to establish a new safety culture within the operating organization.

MOVING AHEAD

In addition to IAEA-supported activities outlined in this article, the Agency's programme in radioactive waste management technologies places considerable emphasis on the promotion of safer procedures and processes. This includes re-enforcing the target of "minimum acceptable requirements" that the IAEA developed as a reference baseline for a set of conditions that must be satisfied to provide an acceptable minimum level of safety in dealing with radioactive waste. Also covered are aspects of quality control and management, which is becoming a more vital component particularly for disposal operations. In many countries, the confirmation of a quality management programme is required before waste management processes and facilities are licensed, as well as during operations.

Another initiative promotes the development and availability in IAEA Member States of "most appropriate technologies" that take into account economic, safety and environmental factors; the IAEA is preparing a report on this subject. Also drawing greater interest from Member States are the validation and qualification of waste management technologies.

Experience has shown that the use of the atom must be linked with the safe management of radioactive waste from all of its many uses. This imperative invariably involves taking steps to ensure that countries have the required knowledge and technological tools.

A key aspect of the IAEA programme is directed to creating an awareness among Member States of their responsibility to plan, develop, and implement effective national waste management programmes. The dynamic process entails a continuous evaluation of the needs of Member States to ensure that Agency resources are allocated and balanced to achieve the maximum benefits and results. As important, it involves ongoing assessments of new ways and means - from technology packages to technical support - that will be of practical assistance to countries, or that help them pool their resources and expertise for regional or global initiatives for effective waste management.
