SAFE MANAGEMENT OF DISUSED RADIOACTIVE SOURCES

LOWERING THE RISKS

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Sealed radioactive sources are extensively used in agriculture, industry, medicine and various research fields in both developed and developing countries. The number of sealed radioactive sources worldwide is estimated to be in the millions, although the existing registries indicate a much smaller number.

A sealed source is a radioactive material that is (a) permanently sealed in a capsule, or (b) closely bound within a solid matrix. The capsule or the matrix material of a sealed source should be strong enough to maintain integrity and avoid leaking under normal conditions of use and wear and also under foreseeable accidental conditions. If a source is no longer needed (e.g. replaced by a different technique) or has become unfit for the intended application (e.g. its activity has become too weak, or associated equipment is malfunctioning or obsolete, or if the source is damaged or leaking) it is classified as a spent or disused source. The activity of a disused source may still be in the order of giga-becquerels (GBq) or tera-becquerels (TBq).

Moreover, old radioactive sources were manufactured to a lower quality standard than sources manufactured over the last decade. For example, earlier sources were manufactured from powder or soluble salts making them susceptible to leakage and dissolution if exposed to water, especially since the encapsulation techniques used were also inferior to current practices.

A typical material used in old sources is radium; it was used for medical applications in the form of needles and tubes. Today radium sources constitute a significant problem, owing to the long half-life and high radiotoxicity of radium-226.

The IAEA and its Member States have taken steps to lower the risks associated with disused radioactive sources and the likelihood of incidents and accidents. Various activities are being implemented to improve the safe management of disused radioactive sources. In a 1991 technical document (*The Nature and Magnitude of the Problem of Spent Radiation Sources*, TECDOC-620), one of the first publications on this subject, the following important points were made:

- Risks from spent radioactive sources exist in both developed and developing countries. Many aspects of the problem are the same for both, but there are some major differences.
- In developed countries the main problem arises from the large number of sources which have been and are in use. Thus even if a small percentage of them is lost or unaccounted for, it can nevertheless amount to a large number.
- In developing countries it is possible that many sources were imported before proper national legislation and control were introduced, so there is likely to be a higher percentage of lost and unaccounted sources. Expertise and experience in management of spent radioactive sources is also limited in these countries.
- It may be assumed that developed countries have the regulatory infrastructure and technical expertise needed to implement a programme for managing their spent sources, which is in marked contrast to the situation in many developing countries. It is therefore much more pressing for the Agency to assist the latter, and the highest priority has been given to improving the situation in these countries.

In keeping with these points, the Agency has implemented various activities designed mostly for developing

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countries. The main types of activities are the following:

- collection, review and publication of up-to-date information and guidance;
- developing and distributing management tools (e.g. administrative procedures, computerized registries, databases);
- transfer of technology and know-how through training and other technical cooperation projects; and
- direct assistance to solve specific safety and technical problems (e.g. expert advise, action teams, responses to emergency situations).

The Agency is implementing its programme in the field of management of disused radioactive sources in the following areas: a) legal and regulatory framework, b) technology, management and safety assessment practices, and c) international co-operation. Various activities which have been implemented or planned in these areas are briefly described below.

LEGAL & REGULATORY FRAMEWORK

The objective of the activities in this area is to ensure that radioactive sources are under regulatory control from production through commercial use until disposal.

Several IAEA publications (such as the *Basic Safety Standards* and two publications within the Radioactive Waste Safety Standards programme) recommend a legal and regulatory basis for IAEA Member States on the safety of radioactive sources and on the management of radioactive waste in general. A technical document on the organization and implementation of the national regulatory infrastructure has also been published in 1999 (*Organization and Implementation of a National Regulatory Infrastructure Governing Protection Against Ionizing Radiation and the Safety of Radiation Sources: Interim Report for Comment*, TECDOC-1067). Several publications on different aspects of the safety of radioactive sources (such as illicit trafficking) are in planning or preparation.

A database called Regulatory Authority Information System (RAIS) also has been developed. RAIS, despite its different objectives, comprises a module that provides for recordkeeping of radioactive sources. RAIS provides information from a regulatory control perspective and covers all equipment that is a source of radiation (e.g. X-ray machines and linear accelerators); it includes data about licensees and many other types of information, which are of regulatory interest.

TECHNOLOGY & MANAGEMENT PRACTICES

The objective of these activities is to ensure that sealed radioactive sources are manufactured, handled, used, reused, transported, conditioned, stored and disposed of in a technically sound, economical and safe way.

Experience has shown that lack of information about disused sources has been a prime cause of loss of control, causing accidents or incidents. The IAEA has developed, as an important management tool, a simple database registry. The Sealed Radioactive Sources (SRS) Registry, has been specially designed to track and store relevant data about sealed radioactive sources. This computerized registry has been implemented in more than 30 Member States.

The publication of technical documents in the format of a technical manual provides a more practical approach and better guidance on the actual conduct of such work. In co-operation with some institutions in developed Member States, generic designs of facilities for processing and storage of disused sealed sources were developed and are being used for providing advice on how to establish such facilities at the national level (*Reference Design for a Centralized Spent Sealed Source Facility,* TECDOC-806, issued in 1995). Another document provides detailed technical information about handling, conditioning and storage of spent sealed sources (*Handling, Conditioning and Storage of Spent Sealed Radioactive Sources*, TECDOC-1145, issued in 2000).

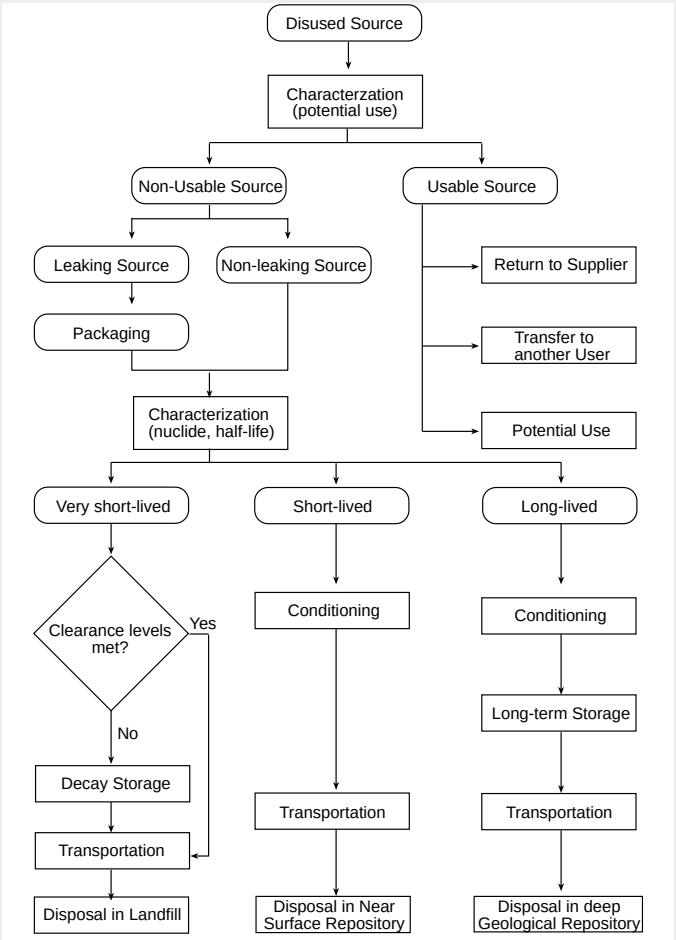
Information on practical methods to identify and locate disused sealed sources and on the conditioning and storage of disused radium sources has also been published (in 1995, *Methods to Identify and Locate Spent Radiation Sources*, TECDOC-804, and in 1996, *Conditioning and Interim Storage of Spent Radium Sources*, TECDOC-886). Further documents on risk reduction in the management of disused radioactive sources

and on their management involving storage/disposal in boreholes are in an advanced stage of preparation.

Regarding the disposal of disused radioactive sources in boreholes, a discussion paper is being finalized to assess the feasibility of using such a disposal method, particularly in countries that have no plans to develop other repositories for radioactive waste. Boreholes, which could be designed to meet the requirements of a greater confinement disposal system, appear to be a cost effective solution for the disposal of relatively small volumes of radioactive waste, including disused radioactive sources.

Other technical documents are planned to describe methods and procedures for conditioning and storing long-lived disused radioactive sources and on the management of high-activity disused sealed sources.

TYPICAL MANAGEMENT STEPS FOR MANAGING DISUSED RADIOACTIVE SOURCES



INTERNATIONAL COOPERATION

One main objective of Agency efforts is to promote cooperation among Member States, other UN organizations and non-governmental organizations (NGOs) to reduce the risk associated with the worldwide use of radioactive sources.

A specialized tool that has been developed for transferring technology and know-how is called "Demonstration of Pre-disposal Waste Management Methods and Procedures". This involves hands-on practical training for small groups in real, operating waste processing facilities. This programme has been implemented since 1996 on a regional basis, particularly for the benefit of developing Member States.

One of the main modules of this training deals with the conditioning and storage of disused sources. Demonstrations have been held so far in Chile (for Member States in Latin America), Turkey (Eastern Europe, Africa and West Asia), Philippines (East Asia & Pacific) and in the Russian Federation (for the Newly Independent States of the former USSR). Twelve demonstrations have been held in four regions so far, with participation by about 100 experts from 50 Member States. Support to the programme is being provided through the IAEA technical cooperation interregional Model Project on Sustainable Technologies to Manage Radioactive Waste.

Examples of direct assistance involving international cooperation to solve actual problems are the Agency emergency response activity (recently used in Turkey and Georgia in the course of accidents with orphan radioactive sources) and the

conditioning of radium sources. This latter project ensures that, if requested, all identified disused radium sources in a country lacking appropriate infrastructure are collected and treated in a single campaign by an expert team contracted by the Agency, thereby solving the immediate national problem with disused radium sources. The technical procedure has been internationally recognized as safe and viable, resulting in waste packages which appear to be compatible with a variety of future management options. Over the last three years, the programme has concentrated on Latin America with the help of cost-free experts from Brazil and an extra-budgetary contribution from the USA. National radium stocks have been conditioned and rendered safe in Chile, Costa Rica, Ecuador, Guatemala, Jamaica, Nicaragua, Paraguay, Peru and Uruguay. The programme has been extended to Eastern Europe, where similar operations were carried out in Croatia in cooperation with the Austrian Research Centre Seibersdorf, and in Bosnia and Herzegovina in co-operation with the Ruder Boskovic Institute of Croatia.

In 1998, the programme was further expanded to include Africa and Asia. In Africa, operations have been carried out in Ghana, Madagascar, Sudan, Tanzania and Tunisia by a South African team provided cost-free to the Agency and in Egypt by a national team.

In Asia, operations have been carried out in China and Pakistan by national teams under the guidance of the Agency and in Sri Lanka by a team from Pakistan.

The radium conditioning project is another component of the interregional Model Project on Sustainable Technologies to Manage Radioactive Waste. Altogether, radium conditioning operations have been carried out so far in 20 developing Member States.

The Agency has developed a Waste Management Data Base (WMDB). The primary purpose of the WMDB is to provide an accessible source of information on waste management (including disused sources) in all IAEA Member States. The WMDB includes information on current waste inventories and projections, policy and regulatory developments, organizations responsible for waste management activities, national strategies, waste management research and development programmes, operational activities and significant milestones.

Some developing Member States do not have the infrastructure, resources and sufficient quantities of radioactive wastes to justify developing a full size repository. However, disused sources containing long-lived radionuclides, even though properly conditioned, cannot be stored indefinitely. The Agency intends to promote co-operation among Member States, to encourage, for example, suppliers of sealed sources to take back disused sources for recycle and to accept the sources for disposal, if they cannot be recycled.

In addition, the Agency has started activities aimed at assessing the feasibility of implementing disused source disposal in boreholes. The feasibility of the option depends on the outcome of the required safety assessment that depends on the availability of specific information about the radionuclide inventory, the properties of the various barriers, both engineered and geological, and the environmental conditions of the proposed location. A technical cooperation project involving a number of African Member States has been initiated with the aim of helping them to develop the capability to perform the necessary safety assessments.

In response to the request of the 1998 IAEA General Conference, the Agency developed an Action Plan on the Safety of Radiation Sources and Security of Radioactive Materials. It was approved by the 1999 General Conference and implementation commenced immediately. Besides strengthening of relevant current activities, the Action Plan includes new initiatives in the following areas: regulatory infrastructures, management of disused sources, categorization of sources, response to abnormal events, information exchange, education and training and international undertakings.

Through established channels and new intitiatives, the IAEA is strengthening efforts to assist countries in improving the safe management of disused radiation sources, and to promote greater international cooperation in the development and implementation of solutions.❐