

Technical Cooperation for Improving Cradle-to-Grave Control of Sealed Radioactive Sources in the Mediterranean Region – 14655

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ABSTRACT

The Mediterranean Sea is one of the most transited maritime highways in the world, connecting 20 seashore countries and these with the rest of the world. The Mediterranean Sea enables the movement of persons and goods among seaside countries and from them to interior countries of Europe, Asia and Africa. Radioactive sources used for industry, medicine, agriculture or research are part of this trading and movement of goods. Associated to this intense traffic, some occurrences have been reported at borders and inland of trade accidentally involving radioactive sources or contaminated materials which needed to be properly addressed upon positive detection. In some cases, orphan radioactive sources have reached industrial processes resulting in inadvertent release of considerable amount of radioactivity to the environment. For the last years, the IAEA has been working on strengthening the control over radioactive sources to avoid these occurrences and to protect the public from the hazards of ionizing radiation. Some of the efforts are channeled through the IAEA Technical Cooperation Programme, with the objective of providing assistance to face this challenge.

INTRODUCTION

The Mediterranean Sea is characterized for an intense maritime traffic. Every year, millions of people and tons of goods move among seaside countries. From there, people and goods move farther into Europe, Asia, Africa and the rest of the world. Throughout the Mediterranean and other regions, radioactive sources are widely used for beneficial purposes in different branches of industry, medicine, agriculture and research. Sources are present in a very wide range of equipment – such as: radiotherapy machines and other equipment used for cancer treatment, measuring instruments such as gauges used to measure soil moisture and soil density and many other components, seed irradiators, lightning rods that protect buildings from lightning strikes and some smoke detectors. Once radioactive sources have reached the end of their useful life, they must be carefully managed, and require proper disposal processes to prevent them from becoming “orphans”. Orphan sources are disused radioactive sources that have fallen out of regulatory control, due to theft, loss or abandonment.

To protect the public from the hazards of ionizing radiation, and to prevent disused sources from becoming orphan sources, “cradle to grave” control of radioactive sources is essential. This requires a national policy and strategy, an adequate legal and regulatory framework, and adequate resources and infrastructure. A strong regulatory framework for the long-term management of radiation radioactive sources must cover the entire lifecycle, from production and use to disposal. For many years the IAEA has been helping Member States to strengthen their national management and regulatory infrastructures to ensure that the radioactive sources are properly regulated at all times, including accountancy, licensing, inspection procedures of practices involving the use of radiation sources, controlling export–import operations of sources

and training and equipping law enforcement and border control bodies.

CHALLENGES AND OPPORTUNITIES IN THE MEDITERRANEAN REGION

If lost or not properly controlled, disused sealed sources can be a threat to human health and the environment. Exposure to large doses of radiation from an unshielded high activity source can be lethal or cause severe radiation injury. If the source capsule is damaged the radioactive material can be released and dispersed, resulting in contamination to the environment. Orphan sources (those not under effective regulatory control) or malicious acts (illicit trafficking, terrorism) are different ways in which a source may pose a threat to human health and the environment.

As of today, a good deal of countries of the Mediterranean region have already in place a reasonable national infrastructure for the control of radioactive sources and are implementing the provisions of the Code of Conduct on the Safety and Security of Radioactive Sources [1]. Nevertheless, overall the situation cannot be considered fully satisfactory and there is wide room for improving the control of radioactive sources until comprehensive and harmonized “cradle to grave” management systems of radioactive sources will be achieved across the Mediterranean region. In particular, several countries are still in need of completing their national regulatory framework addressing all elements related to the use, storage and disposal of radioactive sources. Moreover, while much attention has been paid to the safe and secure utilization of the sources while in use, prominent gaps and/or weaknesses have been identified in many areas of the back-end part of cycle, once the sources have reached the end of its usable life. At that stage of the cycle the sources cease to be assets and become a burden and a financial liability. The unavailability of a sound national policy for managing disused sources, including appropriate disposal routes, makes necessary to store spent sources in temporary locations, sometimes under poor safety and security conditions and supervision. Cases have been reported of radioactive sources accidentally or purposely eliminated through conventional disposal routes or simply abandoned in the environment.

Storing and disposing of radioactive sources is not only a matter of resources; it requires careful assessment and planning, including sound policy and strategy, effective institutional framework, comprehensive operational procedures and appropriate human and financial resources. Regrettably, at the present stage not all the countries of the Mediterranean region have developed and enforced national policies and strategies and corresponding capabilities for the long-term management of disused radioactive sources. In addition, there is wide room to improve international cooperation and exchanges among the seaside countries of the region to share experience in tackling common interest problems associated to regulated and unregulated movement of sources and radioactively contaminated materials, in matters including, but not limited to, notification, authorization and denial of shipments, import and export of sources, repatriation of radioactive sources and contaminated material detected at borders and conditions while in transit. Bearing in mind that there are multiple operations and shipments crossing on a daily basis the Mediterranean Sea, promoting the establishment of harmonized approaches to deal with the management of disused sources from a region-wide perspective will definitely contribute to reinforce safety and security of trade across the Mediterranean region.

Prior to this point, the IAEA has contributed extensively in developing safe, secure and sustainable approaches and standards for the management of sealed radioactive sources, as well as technical solutions for the conditioning, storage and disposal of radioactive sources.

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Amongst these, the most relevant ones for this project are the Mobile Hot Cell (MHC) [2], used to condition high activity sources for long term storage in the country or for repatriation to a supplier country, the Borehole Disposal Concept (BDC) [3], a safe system for permanent disposal, and conditioning systems for preparing the disposal packages.

TECHNICAL COOPERATION EFFORTS TO STRENGTHEN “CRADLE TO GRAVE” CONTROL OF RADIOACTIVE SOURCES IN THE MEDITERRANEAN REGION

Project INT9176, Strengthening “cradle to grave” control of radioactive sources in the Mediterranean region, started its life in 2010 as a project concept proposed for design. During the design phase, the specific conditions and peculiarities of the targeted countries were taken into consideration. The design involved three different Departments within the IAEA (Department of Technical Cooperation, Department of Nuclear Safety and Security, and Department of Nuclear Energy), generating synergies between safety and security with a focus on development. The project was approved in November 2011 for a period of four years, and started on January 2012. INT9176 is intended to assist participating countries to set up appropriate national policies and strategies aimed to achieve sustainable “cradle to grave” control of radioactive sources by reinforcing the present regulatory and management capabilities and fostering international cooperation among the countries of region to address matter of common interest associated to the use of the Mediterranean Sea as a trade avenue. The project also contributes, to the possible extent, to define and put into place region-wide harmonized policies, strategies and practices for the safe and secure management of the radioactive sources at all stages including a well-defined end-point for Disused Sealed Radioactive Sources (DSRS) and improved technology (merging of the Borehole Disposal Concept and the Mobile Hot Cell) for implementing the disposal end-point for all DSRS. INT9176’s overall objective is to protect the public from the hazards of ionizing radiation resulting from accidents or other occurrences involving radioactive sources attributable to poor control over these sources, by supporting the development of a “cradle to grave” control of sources in the Mediterranean region.

Counterparts and Partnerships

Twenty countries participate in the project, namely: Albania, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, Ghana, Greece, Jordan, Lebanon, Libya, Malta, Montenegro, Morocco, Nigeria, Slovenia, South Africa, Former Yug.Rep. of Macedonia, Tunisia, Turkey, and United Republic of Tanzania. 13 countries from the Mediterranean Sea shore were part of the project in early 2012, including 4 EU countries (currently 5, since Croatia became an EU Member State in early 2013). The interest raised by the project resulted in later additions (Jordan, Ghana, Former Yug. Rep. of Macedonia, Nigeria, United Republic of Tanzania, Libya and South Africa, according to their date they joined the project). Some of these countries, for instance South Africa or Ghana, were proposed by the Technical Officers to act as asset countries for the Mediterranean region.

The European Union has provided a generous contribution of up to 1.3 million euros (about 45% of the total budget of the project as designed in 2010) under the Nuclear Safety Co-operation Instrument (NSCI). This contribution is primarily targeted to support the non-EU countries of the region and to further develop certain IAEA methodologies and tools. The IAEA contribution from the Technical Cooperation Fund will be focused on backbone critical activities designed to ensure sound implementation and balanced participation. Additional financial resources have been provided by Spain, through the Spanish Nuclear Safety Council, and the United States, through

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the Peaceful Uses Initiative (PUI). Besides financial support, the Spanish Nuclear Safety Council provides expert advice and support to the participating countries. The contribution made by the United States is targeted to repatriate French-origin sources from Morocco to France.

Participating countries also offer their expertise to other participating countries. With the support of the IAEA, those countries with more developed capacities and capabilities share their experiences and provide expertise to other countries, thus fomenting and fostering interregional cooperation and partnerships between Mediterranean countries.

Scope, Approach and Objectives

The project covers all possible aspects for a “cradle to grave” management of radioactive sources in a comprehensive way. Different stakeholders (policy makers, regulators and operators) are approached at different stages to tackle different challenges related to the management of SRS. At any moment, these stakeholders are fully aware of the steps being taken by the others together with the IAEA. One of the key aspects of the projects is its transparency and coordination. The approach followed is holistic and follows a logic based on progressive capacity-building. The project focuses first on policy and strategy in order to build a solid framework for regulators and operations to act and exercise their functions. Once this framework is established, the project targets in parallel both operators and regulators. Depending on each country’s needs, more attention is given to one or another group. This second part is propped by a sound capacity-building programme based on expert support, exchange of information, sharing of good practices and training.

INT9176 is divided in seven outputs, each covering different aspects of the management of radioactive sources:

1. Provide support to revise the national policy and strategy for Disused Sealed Radioactive Sources (DSRS) management, including the preparation of an action plan for its implementation, in the participating countries.
2. Improved and licensed source management system in operation.
3. Reinforcing human capabilities and capacities in managing DSRS.
4. Reinforcing capacities of national regulatory authorities to license and exercise regulatory control over facilities and activities, in view of the safe management of disused sealed sources.
5. Reinforcing the safety of all components of the management of disused sealed sources and national regulatory framework in accordance with the IAEA safety standards.
6. Technical support capacities upgraded to fulfill the requirements of the Joint Convention and the provisions of the Code of Conduct.
7. Regional collaboration ensured and project implemented in a coordinated fashion.

The activities of the project are:

1. Formulation of national DSRS management policy and strategy, including safety and technology.
2. Establishment of a national DSRS policy and strategy implementation plan, including safety and technology.
3. Establishment of DSRS tracking system.
4. Elaboration of a model system (formal and technical infrastructure) for managing DSRS in a country.

5. Verification of DSRS management practices and facilities, including safety and technology.
6. Formulation of recommendation for national strategy implementation.
7. Predisposal management of DSRS.
8. Selecting of a DSRS disposal options.
9. Managing high activity DSRS (including merging the MHC with the BDC).
10. Preparation of training materials for regulatory matters.
11. Completing regulatory framework.
12. Reinforcing safety assessment capabilities using SAFRAN and support to licensing installations.
13. Establishing and sustaining a management system.
14. Reinforcing capabilities to implement the Joint Convention.
15. Reinforcing capabilities to implement the Code of Conduct.
16. Introducing the project, ensuring regional approach, coordinating activities and following progress.

A Comprehensive Approach for a Cradle-to-Grave Control of Radioactive Sources

INT9176 follows a classic IAEA Technical Cooperation approach: the project must *increasingly promote the tangible socio-economic impact by contributing directly in a cost-effective manner to the achievement of the major sustainable development priorities of each country* [4]. By strengthening the control of radioactive sources in the Mediterranean region, the IAEA is contributing to foster the safe use of these sources according to different national development priorities, thus promoting the safe and peaceful use of nuclear technology and techniques for development.

The project is implementing according to the following approach: The IAEA provides expert support and assistance to cover specific needs at either national or regional levels; carries-out a comprehensive training and capacity-building programme to enable participating countries to carry out regulatory activities or safely handle sealed radioactive sources; and develops and makes available the necessary technological tools and means, so the Member States can perform different “cradle to grave” activities without being restricted by technological constraints. Ways to foster and enabling transnational cooperation are being sought in order to ensure project continuity and the sustainability of results achieved so far beyond the time frame of the project.

Regarding the expert support and assistance, the IAEA has provided, to date, 45 expert missions aimed at covering different aspects for a comprehensive control of DSRS in each country. These missions are country-based, and address specific needs. Through these missions, the national counterparts of 15 countries have been provided with support to, for instance, review, update or establish their national policy and strategy for the management of SRS, or to review and upgrade their national regulations related to the management of SRS. Different action plans have been drafted with the support of external experts for approving and implementing the upgraded policy and strategy drafts. 12 meetings and workshops focusing on presenting the latest thematic developments and providing support and guidance of different topical areas were implemented throughout the Mediterranean region.

Regarding training and capacity-building, several regional and national training events have been carried out. Through the project, national teams on conditioning sources and on search orphan

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sources have been trained in Turkey, Egypt and Morocco. The project also envisages a demonstration event for conditioning high activity radioactive sources, which is to be implemented in 2014.

As for developing the necessary technological tools and means, INT9176 focuses on two major areas: providing support to enhance safety aspects and providing a safe and sustainable technology for the disposal of sources. The first area is covered through the upgrade of the software SAFRAN (Safety Assessment Framework), a tool originally developed within IAEA Safety Assessment Driving Radioactive Waste Management Solutions (SADRWMS) Project. The new updates will allow the user to conduct a safety assessment with clear documentation of methodology, assumptions, input data and models. The second area refers to the merging of the MHC and BDC, thus creating a new technology for the immediate condition and disposal of high activity sources. An exploratory study was already conducted, and work is underway to manufacture the necessary modifications to the MHC to allow safe and direct disposal of conditioned packages into a borehole.

INTERNATIONAL COOPERATION

Developing and Improving Technologies and Tools to Support Member States

One of the goals of INT9176 is to provide participating countries with effective technologies for managing their radioactive sources and addressing matters of common interest. However, the use of these technologies is not limited to the participating countries, and any Member State can benefit of their use in the future.

The end-point for DSRS is one of the most challenging issues. Although the project covers and offers advice in all possible solutions (removal for recycling and reuse, repatriation), special focus is given to disposal. For countries with no access to existing or planned disposal facilities for radioactive wastes, the only options for managing disused sealed radioactive sources (DSRS) is to store them indefinitely or to find an alternative method of disposal, if they cannot be returned to the original supplier. Although collecting and conditioning DSRS is a key step in sound management and increased safety and security, indefinite storage is not a sustainable solution. The IAEA developed an effective and affordable technology for the final disposal of DSRS, the Borehole Disposal Concept (BDC). The BDC entails the emplacement of disused sealed radioactive sources in an engineered facility bored or drilled and operated directly from the surface. The use of this technology is recommended for countries where financial or human resources are limited or where the necessary infrastructure to safely manage DSRS in the long-term is inadequate. To be disposed, sources need to be conditioned. The IAEA also developed the Mobile Hot Cell (MHC) technology for the conditioning of sources of category 1 and 2. This technology allows the recovery, manipulation and conditioning of high-activity sources (Cat 1-2). The technology to transfer the encapsulated sources into a disposal canister and to emplace the canisters into the borehole has not been given attention so far. The IAEA, through the project INT9176, is merging these two new technologies to allow the safe and direct disposal of sources into a borehole.

Further to these efforts, the IAEA is improving the software SAFRAN. The objective is to improve this tool, so it allows the safety assessment for predisposal management and a generic safety case and safety assessment of the borehole disposal concept. Once these new features are

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implemented, SAFRAN may be used for operation safety assessment of a BDC, operational safety assessment of conditioning and storage, and screening calculations for the post-closure safety assessment. The Source Inventory Management for Borehole Disposal (SIMBOD) Database (inventory tracking) for implementation in the BDC was also reviewed and updated within the framework of this project.

A Comprehensive Training and Capacity-Building Programme

Training and capacity building are two major areas of project INT9176. Several training courses at the national and regional level have been carried out, training altogether more than 100 professionals of different aspects for the management of radioactive sources.

Whenever possible, hands-on training has been provided. For instance, a national team was trained in Turkey for the search and recovery of orphan sources, and a national team was trained in Egypt to condition low activity radioactive sources for safe and secure storage. At the regional level, a regional workshop held in Morocco provided actual hands-on experience to the participants in the conditioning of Cat 3-5 sources. However, not all training is operational. In 2012, the participating countries received training on practical aspects of information and records management for control of sealed radioactive sources. Further training is planned for 2014 and 2015, both at the operational and regulatory levels. For instance, one of the key activities for 2014 is a demonstration of the Mobile Hot Cell for the conditioning high activity sources.

Existing training materials, such as those on safety requirements and safety assessment of radioactive waste management activities and facilities, have been reviewed and updated. New training material has also been produced, for instance on DSRS record control and tracking systems.

Expert missions

Although the project addresses the topic of controlling radioactive sources at the regional level, its flexible design allows tailor-made activities at the national level aimed at addressing specific needs of each participating country. Thus, missions of international experts have been sent to each country to support different stages in the establishment or improvement of the national systems and infrastructure for controlling radioactive sources. These missions complement the group events and trainings, and offer specific assessment, evaluation and solutions based on international standards to unique problems at the national level. The support provided through these missions is fundamental to keep participating members states moving forward in improving cradle-to-grave control of radioactive sources, especially in countries where lack of resources or budgetary constraints may be pose significant challenges.

Project Meetings

In order to provide support to participating countries and to inform them on the latest developments, options, tools and means for managing radioactive sources, thematic workshops and meetings have been held throughout 2012 and 2013. Different aspects and themes related to the management of DSRS have been addressed, such as policy and strategy, elaborating and implementing a model system, design and application of management systems, management options for disused sealed radioactive sources of category 3-5, disposal options (including the

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BDC), regulatory requirements for a safe management of DSRS, regulatory control for the safe management of disused sealed radioactive sources, trans-boundary movement of scrap metal and other commodities that inadvertently contain radioactive sources.

These meetings are instrumental to discuss with counterparts challenges and solutions, and to bring together experts and counterparts. Furthermore, these events allow the transfer of knowledge and good practices, since participating counterparts and experts openly discuss the different approaches taken by different actors to tackle and face similar problems. This type of events will also take place in 2014 and 2015.

Project Coordination Meetings

Project coordination meetings are instrumental for planning and moving forward with the implementation of Technical Cooperation projects. These meetings are also essential to evaluate project progress and apply corrective measures, if needed, to ensure a proper implementation in line with the set objectives. Moreover, information gathered in these meetings is crucial to assess the impact that any given project has in the participating countries and their populations.

During the last coordination meeting, held in Vienna in October 2013, project participants discussed, shared and evaluated the project results achieved so far, as well as the implementation and programming strategies for 2014–2015. Other needs identified by Member States during the course of the project were also discussed. Opportunities for enhancing regional and interregional collaboration in the management of disused sealed radioactive sources (DSRSs), as well as transport issues associated with DSRSs, were examined. Opportunities for engaging with other projects and creating synergies were also discussed, with the objective of delivering a more efficient technical cooperation.

Out of these meetings, interesting initiatives have been proposed to be developed within the framework of the project. One of these is the creation of a network for facilitating the exchange of information and good practices related to radioactive sources. The name proposed for this network is SourceNet. A regional training hub for dealing with DSRS-related matters has been proposed too, and the IAEA will look into the different possibilities related to this proposal.

THE WAY FORWARD

The proper control of radioactive sources is fundamental to protect the public and the environment. The IAEA will continue its efforts to ensure that all countries have solid systems in place for the control of radioactive sources in line with the international standards. Project INT9176 is contributing to this goal by providing technical cooperation. It also serves as a pilot project for other regions and future projects. Together with the support by the European Union, the United States and Spain, this project is already achieving interesting and promising results.

An important goal of the project is to provide participating countries with effective technologies for managing their radioactive sources when they become disused. For both the predisposal operations, i.e. conditioning and packaging for disposal, and disposal in boreholes, technologies have been conceived and partially demonstrated including the assessment of operational safety and long term safety of the disposal concept. However, for high activity sources in particular, the detailed designs, manufacturing the necessary equipment, full size operational demonstration

and comprehensive safety assessment are still to be completed. A challenging objective of the Project INT9176 is that these technologies be fully developed, demonstrated, proved from both safety and technology points of view and implemented at least in one of the participating countries.

CONCLUSIONS

Radioactive sources are at the heart of the peaceful uses of nuclear technologies aimed at promoting tangible socio-economic impact and at contributing to the achievement of sustainable development priorities. The different applications for radioactive sources in agriculture, medicine industry or research contribute to the tangible impacts of nuclear technology in achieving the Millennium Development Goals in the areas of eradicating extreme poverty and hunger, reducing child mortality, and ensuring environmental sustainability. However, the use of these radioactive sources needs to be properly controlled, especially when they become disused or are no longer needed, in order to avoid potentially harmful situations involving orphan sources, malicious acts or other mishaps.

A proper, harmonized and comprehensive control of Disused Sealed Radioactive Sources is fundamental to ensure the safe use of radioactive sources for nuclear applications in the Mediterranean region. This control needs to include a sound policy and strategy, an adequate legal and regulatory framework, adequate resources and sufficient infrastructure. This cradle-to-grave approach needs to cover transport, conditioning, storage and disposal of radioactive sources to avoid harmful situations derived from poor or lack of appropriate management. Issues such as storage and final disposal need to be properly addressed in time in order to avoid mismanagement or undesired situations.

The IAEA, through its technical cooperation programme and the TC project INT9176, supports participating Member States in the Mediterranean Region in the establishment of such cradle-to-grave management of radioactive sources. The project INT9176 serves as a platform for international and regional cooperation, exchange of lessons-learned and good practices, and training as well as capacity building. The project also goes one step further, improving existing technology and developing a new one by merging the Mobile Hot Cell and the Borehole Disposal Concept, thus proving a cost-effective solution for conditioning and disposal of radioactive sources.

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