Looking Toward Sustainable Long-term Management of Disused Sealed Radioactive Sources – 14280

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ABSTRACT
Sealed radioactive sources are used in almost every country in the world in numerous beneficial applications, with thousands of sources distributed worldwide [1]. These sources contain radioactive material comprising various isotopic and chemical compositions, many of which are relatively long-lived (such as Cs-137, Am-241, and Ra-226). The disposition of these sources when they become disused or reach the end of their useful life is problematic from several perspectives, in both developing and developed countries. Acceptable disposition options include recycling or reuse, if available; conditioning and transfer from user sites to long-term storage facilities; return to manufacturer and/or country of origin; or disposal [2]. The International Atomic Energy Agency (IAEA) has developed safety standards and guidance documents for the management of sealed sources, including the Safety Standards “Regulatory Control of Radiation Sources” [3] and “Radiation Protection and Safety of Radiation Sources” [4], but these documents primarily address regulatory requirements for the management of sources and do not specifically address operational considerations, such as how to sustain DSRS management options over long time periods. As an example, IAEA documents contain requirements related to maintaining inventory information on DSRS and planning for their eventual generation, but these may be difficult for developing countries to sustain over the period of time for which many sources will continue to be radioactive and/or “dangerous.” The Source Management Unit in the IAEA NEFW Waste Technology Section assists countries by performing operations to condition DSRS for long term storage, transportation, or disposal; but unless a country has chosen a final option for their DSRS and can implement it independently without external assistance, such conditioning work may not be a final solution. It is worth noting that sources are considered to be “dangerous” under IAEA’s categorization scheme until they fall below Category 3 activity thresholds [5] (e.g., 0.03 TBq [0.8 Ci] for Co-60), which are also well above clearance levels in most national regulations for the release of radioactive material.

INTRODUCTION

This paper investigates end-of-life management options for DSRS, summarizes the state of existing IAEA requirements and guidance regarding the implementation of those options, and presents example scenarios from IAEA operations in developing countries, including problems encountered and lessons learned, with possible solutions for sustainable management over the long term. It may benefit source owners and regulators by discussing present and future problems associated with long-term management of DSRS and suggesting possible solutions.

EXISTING END-OF-LIFE MANGEMENT OPTIONS

Short of curtailing the use of sealed radioactive sources, which could have adverse effects on numerous beneficial applications such as cancer treatment and industrial gauging, especially in developing countries, acceptable options must be found for the long-term management of disused sealed sources at the end of their useful life. In the ideal case, all requirements for the safe utilization of sources and management of DSRS should be available before they begin to be used [6], but experience has shown that this is not often the case in either developed or developing countries. For some sources with long half-lives, the radioactive material continues to maintain its "strength" or activity for long periods of time, such that the material can be re-used or placed in new encapsulation to accomplish the construction of new sealed sources. For others, such reuse is not feasible, usually due to radioactive decay of the nuclide.

It is generally accepted that current disposition options for the long term include recycling or reuse, if available; conditioning and long-term storage; return to manufacturer and/or country of origin; or disposal in a licensed facility with a safety assessment that addressed sealed sources and was used to develop waste acceptance criteria for disposal (with interim secure storage) [2].

SUMMARIES OF EXISTING REQUIREMENTS FOR DISUSED SEALED SOURCES

The IAEA has developed safety standards and technical guidance documents that address various aspects of the management of disused sealed sources. They cover general regulatory requirements and the responsibilities of different stakeholders, as well as describing various technical options for all stages of disused source management, including characterization, conditioning, storage, and disposal. Export of disused sources for repatriation or recycling is also discussed as a management option. This set of publications provides a useful basis for most countries to develop their policies and strategies for the management of their disused sources. However, countries with limited nuclear regulatory and technical infrastructure may need more detailed guidance when they start implementing their disused source management programs, especially for common longer-lived isotopes such as Cs-137 (half-life [t 1/2] about 30 years), Am-241 (t ½ = 432 yrs.), and Ra-226 (t ½ = 1,601 yrs.).

Some more general IAEA publications regarding radioactive waste management also contain provisions also applicable to disused sealed source management at a high level. However, they are not discussed here, in lieu of documents more specific to sealed sources.

Source Owner Responsibilities

Source owner responsibilities are defined in several standards and technical documents [4, 6, 7]. Source owners have the primary responsibility for their sealed sources, including at the end of the useful life of the sources. Owner responsibilities include developing a plan for the sources' control and disposition "prior to its import," and implementing (with the regulator) "a plan for safe management of the source after it has become spent," including making financial provisions to pay for disposition [4,6,7]. Experience shows that many source owners do not develop such plans, although more countries are now requiring contractual agreements for return as conditions of operating or import licenses. Even fewer source owners make full financial provisions to support such plans, nor are they routinely required to do so as conditions of their licenses.

Other source owner responsibilities include onsite storage of DSRS until they can be transferred to other owners or facilities [7], establishing a record-keeping system [6], and maintaining high-activity DSRS with interlocking systems or safety features retaining the source within its shield and in the unexposed position [7]. As institutional knowledge of the DSRS (or the device that contains it) weakens over long periods of storage, the maintenance and understanding of such safety features also degrades. High-activity DSRS users "should maintain periodic contact with the Source manufacturer" and "keep an accurate registry of the sources in its possession," including all available technical information regarding safe removal, handling, and storage procedures [7]; but this provision also is only sporadically implemented.

If an SRS licensee "is incapable of the appropriate management of the source when it becomes spent or if the license is revoked or the licensee no longer exists," the country needs a radioactive waste organization to "take responsibility for the management of the source." [6]

Regulator Responsibilities

The responsibilities of national regulators for DSRS are well documented and include licensing and regulating storage facilities, maintaining a record-keeping system for all DSRS in the country [6, 7], application of a quality assurance (QA) system commensurate with potential DSRS hazards [8], and encouraging the return of DSRS to suppliers (possibly through license conditions) [2, 3, 9, 10]. Other required or recommended responsibilities include the following:

- Gather information on the status of at least all Category 1-3 sources in each operating organization's inventory or the national register of sources, to assess whether the sources are disused and what provisions are made for their storage [10];.
- Set costs for acceptance of DSRS at national storage facilities "at a level to prevent the users from seeking unsafe options" for management [7, 8]
- Avoid designating DSRS as radioactive waste when they are being returned to a manufacturer or country of origin, especially if they will be reused or recycled [7]
- In countries with limited nuclear industry, administer a utilization plan for SRS that minimizes the number and activity of SRS purchased according to user needs.

Reuse/Recycling/Return to Manufacturer

IAEA standards and guidance suggest that MS should encourage the recycling or re-use of radioactive sources wherever possible [7]. This should be done according to established procedures and, as previously stated, the buyer of a SRS should include in the purchase contract a clause requiring the return of the source when it becomes disused [6].

When sources are transferred, the following precautions should be taken [6, 7]:

- The sources should not be endangered by mechanical damage and the safety systems on the sources should be checked for their functionality (e.g., locking mechanisms);
- For handling of bare sources, "proper shielding equipment should be provided" and staff exposures estimated using a dummy source;
- Transfer of high-activity sources from working shields should only be done according to approved procedures, by trained personnel with a transport container specifically designed for the equipment, so that the transfer can be completed without exposing the source;
- If no certified Type B containers exist in a country, the competent authority may allow a Special Arrangement transport of DSRS under certain conditions.

Financing

Although regulators are encouraged to set reasonable costs for DSRS management and ensure that financial provisions are made for their safe and secure management [2, 3, 9], the costs for returns to manufacturer or for disposal are difficult to predict into the future to a time when the sources may become disused and be either prohibitively expensive or greatly underestimated, such that insufficient funds are available when sources become disused. This is especially true for high-activity sources, for which IAEA has experienced costs in excess of 100,000 Euro for return to source suppliers. Lack of equipment availability and infrastructure to support some options is also problematic. The International Source Suppliers and Producers Association (ISSPA) has acknowledged cost and container availability as two of the major challenges to the successful exercise of management options for DSRS [15]. Countries should be prepared to provide public funds to manage DSRS in some situations such as where serious public safety concerns exist [8].

Conditioning and Storage

"Storage is by definition an interim measure" and refers only to configurations that allow for retrieval [16]. For most sources that cannot be returned to manufacturers or recycled, especially long-lived DSRS, "controlled long term storage is the only practicable option …" [6]. However, IAEA standards and guidance largely do not explicitly address factors that may impact safety or security during long storage periods and they recommend limiting temporary storage (particularly of high-activity DSRS) to as short a period as possible when no other options are available [7]. In spite of the requirement that DSRS owners must transfer sources to "another party" such as a storage facility within a reasonable period of time [7], "temporary" storage of DSRS at user facilities is the norm in many countries due to lack of safe and secure centralized storage facilities or transportation problems. "The choice of how best to manage the period of storage while awaiting final decommissioning and disposal should be made by the principal party, with the approval of the regulatory body" [2].

IAEA documents contain guidance on basic requirements for radioactive waste management infrastructure relevant to DSRS, which include [6]: identification of all parties involved in management of DSRS (including users/owners) and delineation of their responsibilities; identification of existing and anticipated DSRS and control of generation of new disused SRS; regulatory requirements addressing "source characterization, financing, technical ability and qualification of personnel, records management system, and radiation safety" [8]; and a safe and secure centralized interim storage facility [7]. Most developing countries lack at least some of these basics, although IAEA attempts to support MS in developing regulatory requirements and inventories of sources including DSRS. Many countries also lack storage facilities for radioactive waste, including DSRS.

Some important features for storage are recognized as responsibilities for operators of a DSRS-management organization or facility, including [6]:

- Conditioning and storage of DSRS until disposal is available; and
- Establishing and maintaining detailed record-keeping for all DSRS in a facility.

<u>Conditioning</u>

Conditioning is defined by IAEA as "operations that produce a waste package suitable for handling, transport, storage and/or disposal" and may include encapsulation or overpacking. It is required as soon as possible for DSRS that cannot decay to clearance levels in a reasonable period of time, especially high activity and long-lived sources, and ideally prior to storage. Storage of unconditioned high activity and long-lived sources such as Cs-137 and Am-241 "is not judged appropriate" [6, 8]. Source conditioning should accommodate future waste acceptance criteria and allow for future retrieval of the sources [7, 6, 8], as well as segregating types of sources that may have different disposal routes in the future (for example, alpha/neutron sources versus beta-gamma-emitting sources). In addition, conditioning should account for gas generation potential and "eliminate any possibility of leakage," although this might require periodic repackaging/overpackaging, which are not addressed in IAEA documents. IAEA also recommends features for conditioning facilities [8], including radiation instrumentation, archives of source and container designs and applications, and data processing, storage and retrieval (possibly for many decades), with regular reviews to incorporate changes in recording technology.

High activity gamma sources are considered as a special case. They "should be retained in their shielding devices" [6] and be segregated by half-life, isotope, radiation and activity levels. When removed from original equipment, the receiving shield should be designed with sufficient shielding to allow an acceptable surface dose rate, protect the sources, prevent them from falling out, and allow for them to be retrieved with minimal exposure to personnel [7]. It should also be able to withstand operational accidents. If unshielded transfers of SHARS are attempted, technical procedures for innovative approaches must be developed, tested, and used by well-qualified personnel. Removal of SHARS from original shields or transport containers may require use of a hot cell [7]. IAEA has designed a mobile hot cell used for exactly this purpose [12].

One question not addressed in IAEA requirements or guidance is the period of time for which conditioning should ensure isolation from the environment during storage. Normally, waste operators would develop this during the process of performing a safety analysis and developing waste acceptance criteria for storage, but there is no IAEA guidance specific to DSRS on these topics. A an example of the existing guidance, one document states that the encapsulation used in conditioning should assure that "barriers are maintained between the radioactive material and the environment" [8], but does not specify over what period of time the assurance should extend or at what frequency such the integrity of the encapsulation should be re-verified. The choice of materials used for encapsulation should consider mechanical strength, material aging as compared with the expected storage period, radiation effects, corrosion and fire resistance, impermeability to water and humidity, interaction with radioactive decay products (especially gaseous), and source security [8]. But in a country with no nuclear energy program and no plans to develop radioactive waste disposal, what should be assumed as the expected storage period of a Ra-226 source with a half-life of 1,601 years?

Storage

As mentioned previously, storage is viewed as an "interim" measure along the path to disposal. However, in countries with small radioactive waste inventories (existing or expected) and no foreseeable plans to develop disposal facilities, an objective assessment suggests the prudence of planning for greater permanence.

The available guidance/requirements for storage of DSRS relevant to long storage periods include the following [6]:

- Consideration of the physical and chemical state of DSRS when developing conditioning, storage, and monitoring requirements [8];
- Assurance of storage package integrity "during the entire planned storage time" and retrievability [7]
- Maintenance of inventory data for each package;
- Marking of packages with radiation symbols, the word "radioactive", and an identification tag with the unique number for the package [7]. In the case of long term storage, labels "should be made to withstand storage conditions without undue degradation";
- Storage away from non-radioactive material and in-use sources;
- Regular inspections, especially of high-activity sources [7];
- For high-activity DSRS, reversible securing mechanisms that "guarantee" sources are maintained in an unexposed position, intrusion is eliminated, and environmental conditions don't affect the source [7]
- For storage of high-activity DSRS, the following additional features: 1. Checks of security systems; 2. Special tests to ensure integrity of the source holder; 3. Radiological protection; 4. Proper training for personnel who enter facilities; 6. Management responsibility that "does

not lapse with change of personnel or ownership"; 8. Segregation from other DSRS and personnel trained on the security significance of these types of sources [7]
- Development of container and facility limits for heat generation, activity, and dose rate [7]
- Security that ensures that unauthorized personnel are denied entry to facilities [13]
- A quality assurance (QA) system including written procedures (including any country-specific requirements) and a quality plan (statement of practices/controls that ensure that the quality requirements for specific operations are met). QA should be applied at a realistic level and consider the number of DSRS, complexity of the infrastructure, and available personnel [8]

Radiation protection is also an important topic for longer-duration storage. The storage areas should be designated and operated as controlled areas [8]. Radiation surveys must be conducted regularly during the entire period of storage [6, 7], including contamination surveys (wipe tests), before, during, and after every step of work to check for any leakage, with equipment appropriate for the type of source (e.g., gamma, alpha, or neutron emitters). If tests show that contamination is present, the source of contamination must be investigated and contained during the expected storage time period [7]. Area monitors for airborne activity and dose rates and personal dosimeters relevant to the radiation and contamination being handled are also important [8], and dose rates should be regularly measured to detect defective shields and packages. "The effectiveness of the ventilation system should also be part of the surveillance programme."

Design guidance for storage facilities that facilitates long-term safety and security includes [6]:
- Remote location away from workers and members of the public;
- Design that considers ease of transfer of sources to and from the store, minimization of source handling, shielding as needed for containers with high surface dose rates, appropriate ventilation where there is a risk for airborne activity (as with Ra-226 sources), and a floor loading capacity sufficient for heavy shields associated with high-activity DSRS
- Location above groundwater and potential flood levels, or designs to prevent access
- Physical protection facilitating source movement "without compromising radiation safety" [8, 13]
- Low-maintenance construction materials with smooth surfaces to facilitate decontamination
- For long-lived DSRS, a facility "…designed to store the conditioned sources safely for several decades" [8]
- Limited and controlled access to storage areas, from which losses or thefts may not be detected until long after a removal has occurred
- Minimal number of personnel with authorized access to storage facility
- "Other appropriate security measures in the interim storage (such as guards, barbed wire fencing, surveillance cameras, alarm systems, etc.) and regular stocktaking should be considered in the context of the prevailing security situation. The effectiveness of the security system should be regularly audited and updated."

Recordkeeping

Maintenance of documentation and records consistent with legal and QA requirements is essential to effective longer term storage [8]. They should be kept in a condition that will enable them to be consulted and understood later. Records designated as permanent must be stored in perpetuity using a designated method and long term archives should be maintained in at least two locations and on at least two media, such as hard copies, microfiche and/or magnetic media. Records should also be updated as technology changes." Records should include information about DSRS container physical locations, identification numbers, and technical data such as the radiation level on a given date, contamination, and package inventory.

Disposal

Disposal is considered to be a permanent endpoint for DSRS. Most high activity and long-lived sources, depending on their activity and half-life, will ultimately require disposal in either a near surface or deep geological repository [6, 11] or possibly a borehole-type facility [12]. Characteristics relevant to disposal include high activity (coupled with longer half-life), physical and chemical form, decay heat, elevated dose rate that may result in radiological damage near the source, gas generation due to radiolysis, decay products, and corrosion [7]. Additional factors such as cost, available geological settings, complexity of site characterization, resources required to demonstrate site- specific safety, public acceptance, transportation, occupational exposures," and others should be considered in choosing a disposal option [11].

Disposal package criteria relevant to long-term performance include the following [11]:

- Leak test after disposal package closure
- Sufficient strength to withstand loads if stacked
- Decontamination on the external surface of packages to levels that meet acceptable limits defined by waste acceptance criteria;
- Packaging material that is "stable under high radiation conditions."
- Effective sealing of the package considering: "Containment of gaseous and particulate radioactive material; Prevention of groundwater ingress and release of liquids; Avoidance of an elevated internal pressure due to gas generation or thermal effects; Avoidance of explosive gas mixtures in voids; Containment of radionuclides when emplaced in the disposal unit."

For disposal facilities, the following are important for sustainable management [11]:

- Require a safety assessment/evaluation that addresses "both operational and post-closure safety, gives reasonable assurance that compliance with the waste acceptance criteria (WAC) will allow the facility to meet the relevant safety standards at all stages." The maximum activity for a container promulgated in a WAC must be determined based on these safety assessments;
- The definition of safe limits depends on the facility's characteristics and the scenarios under consideration" [6];
- Develop WAC that consider the hazards of both radioactive and non-radioactive components on the basis of operational constraints, site characteristics (such as lithology, hydrogeology, geochemistry and depth of the disposal zone) and the engineering design";
- Establish the duration of site specific institutional control periods for disposal facility with authorities prior to choosing disposal options. For shallow disposal, the expected duration of institutional control is "particularly important" because it drives the determination of limits on the acceptable content and concentration of longer-lived radionuclides";
- The WAC for disused sources…"needs to be defined so that the results of the operational and post-closure safety assessments conform to the applicable safety targets (e.g. dose constraints)." Specific WAC also should consider normal operations and accidental situations, and the entire life cycle of repository;
- Address potential gas generation issues early in the design of a disposal concept.

EXAMPLES

The implementation of IAEA regulations and guidance varies widely from country to country. It is less likely to be robust in countries with very small inventories of radioactive waste or DSRS, although this depends on the resources available in a country and the political commitment of governments to make resources available. IAEA is working to provide training and guidance appropriate for Member States with small inventories and no nuclear programs, but it can be difficult for countries to sustain programs and facilities over the long periods of time for which many sources will continue to be dangerous according to IAEA definitions (i.e., Category 3 or higher) [5]. The examples below illustrate how some of the more important guidance and requirements relevant to long-term management of DSRS are being implemented.

End-of-Life Planning

DSRS owners have the responsibility to develop a plan for source control and disposition prior to import, and work with the regulator to implement the plan when the source has become disused, including making financial provisions. Many countries are now requiring sources owners to include contractual agreements for return to the manufacturer before approving operating or import licenses. However, the issue of financial provisions to support such plans continues to be poorly implemented for reasons previously described. For example, in one African country possessing high-activity French sources, despite the willingness of France to repatriate the two source-containing devices, the country does not have the funds reserved to pay for the return, which will cost in excess of 200,000 Euro. Also, the regulator in an eastern European country has requested IAEA assistance for the return of a French-origin high-activity teletherapy source at a public hospital, which plans to replace the device with a linear accelerator. By contrast, some private clinic high-activity source owners in a South American country have used their own funds to pay the cost of return to the Canadian manufacturer. One source owner of a now-closed clinic advised that he was not able to do so because the cost was as high as the purchase cost of the original device. <u>Lesson learned</u> – regulators should continue to require licensees to have plans in place for the management of sources when they become disused (including return to manufacturer wherever possible) and should either require financial assurance or develop their own funding mechanisms (for example by collection of license fees) for the implementation of such plans. Whatever funding mechanisms are used should plan for at least an equivalent amount of funding as the purchase price of a new source or device.

Maintenance of Safety Features for High-Activity DSRS

Source owners are required to maintain interlocking systems and/or safety features for high-activity DSRS that retain sources within working shields in the unexposed position. However, experience from several previous accidents involving DSRS [14] shows that over long periods of storage, the maintenance and understanding of the nature of the material in the device, and especially of such safety features, is gradually lost. In one example encountered in an African country, a private clinic was left with a DSRS in a teletherapy device following the retirement and then death of one its former physicians. Clinic personnel disassembled the device on their own and placed the shield containing the source into a pit in the garden of the clinic for temporary storage. Unfortunately, the drawer containing the source and the source movement mechanism appears to have rusted in place in the humid conditions of the pit, such that shipment of this device for further management and removal of the source are now likely greatly complicated. Also, the drawer containing the source could have moved during the transport of the shield and exposed personnel to high levels of radiation, as has occurred in previous accidents. <u>Lesson learned</u> – high-activity DSRS should be moved only by experienced and knowledgeable personnel who understand the device design, the hazards presented by the source, and the mechanisms or methods that can be used during movement of the device.

Limitations on Temporary Storage at User Facilities

Storage by users should be limited to as short a period as possible and should only be used when no other options are available. Although DSRS owners are recommended to transfer sources to other users or a storage facility “within a reasonable period of time” [7], “temporary“ storage of DSRS at user facilities is the norm in many countries due to lack of safe and secure centralized storage facilities or transportation problems. It is much easier for regulators to exercise adequate control over DSRS stored in a single facility than to have to perform inspections and measurements at many different locations, as IAEA has observed in many countries that lack centralized storage facilities. Also, some entities that have custody of DSRS in such cases have no capability or knowledge about how to manage them properly, perform the necessary surveys for contamination and dose. In one recent example in an African country, a university owner who was responsible for a source had stored it for many years in a room adjacent to his office, but expressed concern about how much exposure he was receiving, whether students should be congregating in the area, and when the source could be removed. In another case in an eastern European country, DSRS of unknown isotope and activity were stored on the campus of a large bankrupt former company in an unmarked shed, with only one former employee who knew of their location. These situations can be contrasted with the more proactive situation in Morocco, in which the national storage facility operator routinely moves disused sources to the storage facility if the source owner has not made other arrangements for their long-term care.

Conditioning

As previously mentioned, IAEA requirements and guidance do not recommend or suggest how to develop an assumption for the period of time over which conditioning should ensure isolation from the environment during storage. Requirements that the encapsulation used in conditioning remain intact around the radioactive material do not specify over what period of time the encapsulation should endure or at what frequency such it should be re-tested. While it is recommended that the choice of materials used for encapsulation should consider factors such as aging and corrosion resistance, the expected life of containers in which DSRS have been conditioned is largely unaddressed. This is true for the stainless steel capsules used by IAEA for the conditioning of Ra-226 sources, and it is also true in some developed countries that do not have existing facilities for disposal of high-activity or long-lived DSRS.

Conditioning problems fall into three categories: 1. DSRS conditioned irretrievably, excluding further management options. This has been observed in many countries, including some European countries, where bare sources have been conditioned in either molten lead (subsequently solidified) or concrete. Both configurations exclude both further source characterization (for example, to meet a WAC that has not yet been developed) and future management options, such as borehole disposal. 2. High-activity DSRS left unconditioned. During a recent conditioning operation, five of 22 shields containing high-activity DSRS were observed to be so badly corroded that the DSRS could no longer be removed from them, even using remote-handling equipment. As with the previously-cited device observed in Africa, this makes proper conditioning and compliant transport virtually impossible, which precludes options such as repatriation to country of origin and borehole disposal. 3. Conditioned sources in containers with an uncertain life expectancy under local storage conditions. This can lead to the need for repackaging at an undetermined future date. Lesson learned – DSRS should be conditioned retrievably as soon as possible after they become disused using materials that will survive expected storage conditions for the longest possible duration.

Storage Period

IAEA guidance is that storage facilities for long-lived sources should be designed to store sources safely for several decades [8], but the basis for this recommendation is not provided. Given that many DSRS will continue to be "dangerous" for hundreds or thousands of years, greater attention to assumptions about storage times is warranted, especially for countries that have no nuclear power programs and/or are not pursuing radioactive waste disposal. Planning and financial arrangements to sustain management efforts for longer storage times are also much needed.

CONCLUSIONS

The most sustainable solution for management of DSRS is disposal, because it is permanent. For that reason, IAEA is promoting borehole disposal of DSRS, especially for developing countries with small inventories and appropriate site conditions that ensure the long-term safety of this option. However, return to manufacturer, repatriation to country of origin, and reuse can also be good options, assuming that reused or refabricated sources are used under proper regulatory controls. In many cases, however, storage for long periods of time may be necessary. It is in the interest of IAEA and all countries in which sealed sources are being used to develop detailed requirements for DSRS storage and final management.

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