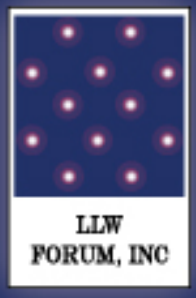
REPORT OF THE DISUSED SOURCES WORKING GROUP

A Study of the Management and Disposition of Sealed Sources from a National Security Perspective



Low-Level Radioactive Waste Forum, Inc.
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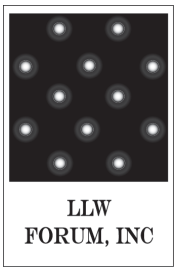

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ACKNOWLEDGEMENTS

This report was produced by the Disused Sources Working Group (DSWG or working group) on behalf of the Low-Level Radioactive Waste Forum, Inc. (LLW Forum)—an organization established to facilitate state and compact implementation of the Low-Level Radioactive Waste Policy Act of 1980 and its 1985 Amendments (LLRWPAA) and to promote the objectives of low-level radioactive waste regional compacts. The LLW Forum is dedicated to the goals of educating policy makers and the public about the management and disposal of low-level radioactive wastes and fostering information sharing and the exchange of views between state and compact policy makers, federal officials, industry representatives and other interested stakeholders. Directors that serve on the Board of the LLW Forum are appointed by Governors and compact commissions.

Eight members of the LLW Forum participated in the DSWG, including representatives of all four sited states/compacts, as follows:

- **Leonard Slosky**, Rocky Mountain Low-Level Radioactive Waste Board (DSWG Chair and LLW Forum Past-Chair)
- **Max Batavia**, Atlantic Interstate Low-Level Radioactive Waste Commission
- **Brad Broussard**, Texas Commission on Environmental Quality
- **Mike Garner**, Northwest Interstate Compact on Low-Level Radioactive Waste Management (LLW Forum Chair)
- **Kathryn Haynes**, Southeast Compact Commission for Low-Level Radioactive Waste Management
- **Rusty Lundberg**, Utah Division of Radiation Control, Department of Environmental Quality (LLW Forum Chair-Elect)
- **Alyse Peterson**, New York State Energy Research and Development Authority
- **Stan York**, Midwest Interstate Low-Level Radioactive Waste Compact Commission

Four staff members contributed to this project including Todd Lovinger, LLW Forum Executive Director and DSWG Project Director; Gary Robertson, DSWG Technical Consultant; Sebastian Christian, DSWG Outreach Consultant; and Cecilia Snyder, DSWG Communications Consultant.

The DSWG and LLW Forum acknowledge the time and input of many stakeholder groups that contributed feedback and perspectives for the development of this report including, but not limited to, manufacturers; distributors; recyclers; brokers and processors; users; state and compact officials; federal agencies including the U.S. Department of Defense (DoD), U.S. Department of Energy (DOE) National Nuclear Security Administration/Global Threat Reduction Initiative (NNSA/GTRI), U.S. Department of Transportation (DOT), and U.S. Nuclear Regulatory Commission; the federal interagency Radiation Source Protection & Security Task Force (Task Force); organizations including the Conference of Radiation Control

Program Directors (CRCPD), Organization of Agreement States (OAS), and Health Physics Society (HPS); and disposal facility operators.

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This paper was prepared by the Low-Level Radioactive Waste Forum's (LLW Forum's) Disused Sources Working Group (DSWG) at the behest of the National Nuclear Security Administration (NNSA)/Global Threat Reduction Initiative (GTRI). The opinions expressed in it are solely those of the DSWG and do not necessarily reflect the official policy or positions of any agency of the U.S. government, including NNSA/GTRI or the U.S. Department of Transportation (DOT) or the U.S. Nuclear Regulatory Commission (NRC), nor any organization with which the members of the DSWG are affiliated. NNSA/GTRI reviewed a draft of this paper for factual accuracy only.

EXECUTIVE SUMMARY

At the request of the U.S. Department of Energy (DOE) National Nuclear Security Administration/Global Threat Reduction Initiative (NNSA/GTRI), the Low-Level Radioactive Waste Forum (LLW Forum)—a national association of states, radioactive waste compacts, federal agencies, and industry representatives—formed the Disused Sources Work Group (DSWG or working group) in September 2011 to develop recommendations for improving the management of disused sealed sources that pose a threat to national security.[1] The DSWG, which is comprised of eight Directors of the LLW Forum, has solicited input from a broad range of stakeholders at 19 meetings over the past 30 months. This is the final report of the working group.

While society derives many benefits from the use of sealed sources, the national security threats posed by certain sealed sources requires that the nation reexamine the way in which such sources are managed. The current paradigm for the management of sealed sources does not fully reflect the reality of the post-9/11 threat environment. The magnitude of the disused source problem is large. There are approximately two million sealed sources and tens of thousands of disused sources in the United States; however, the exact number and location of the disused sources are unknown.[2] The existing data systems do not inventory all sealed sources or track all disused sources in the U.S. that pose a threat to national security. While most licensees manage their disused sources in a responsible manner, there remains a national security concern because of the potential for malevolent use.

Since the formation of the DSWG, significant advancements have been made regarding the disposal of sealed sources. The Texas Low-Level Radioactive Waste Disposal Compact (Texas Compact) commercial low-level radioactive waste disposal facility began operation in 2012, including the disposal of sealed sources from within and outside the Texas Compact region. With this facility, licensees in all states now have the ability to dispose of most disused sources. In September 2013, the Clive facility began accepting certain Class A sealed sources under a State of Utah approved limited one-year variance. The Branch Technical Position on Concentration Averaging and Encapsulation (CA BTP) being developed by the U.S. Nuclear Regulatory Commission (NRC) may provide for the acceptance of additional high activity sealed

[1] The Disused Sources Working Group (DSWG or working group) did not address Greater Than Class C (GTCC) sealed sources, transuranic (TRU) sealed sources, or other sources that are the responsibility of the federal government.

[2] Report to the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials,"* U.S. Government Accountability Office (GAO) Report 08-598, June 2008, page 1. The National Nuclear Security Administration (NNSA) sealed source registry contains approximately 23,000 sources. The NNSA registry allows users to voluntarily register in-use and disused sources for potential recovery by the Off-Site Source Recovery Project (OSRP) or the Conference of Radiation Control Program Directors (CRCPD) Source Collection and Threat Reduction (SCATR) program. The U.S. Nuclear Regulatory Commission's (NRC's) National Source Tracking System (NSTS) includes over 81,000 sources. The NSTS is a mandatory system that tracks Category 1 and Category 2 sources during the life cycle of the source from manufacture through shipment, use, decay, and disposal.

sources at the South Carolina, Texas, and Washington state disposal sites. While disposal is now possible for most disused sources, there has not been a dramatic increase in disposal activity.

Once used for their original purpose, many sources are stored indefinitely. Contributing to the accumulation of disused sources is the fact that the cost of the eventual shipment and disposal of sources is not included in the purchase price; and in most states, financial assurance is not required. Therefore, some users are unaware of these costs. When considering the purchase of a new sealed source, the buyer is not required to consider the overall life-cycle cost of properly managing the source—which can sometimes be in the hundreds of thousands of dollars—and most do not budget for its ultimate disposal. Thus, as currently configured, the economics of sealed source ownership do not motivate owners toward prompt end-of-life disposition, resulting in thousands of sealed sources being stored indefinitely. Since the purchase price of sources does not reflect the full life-cycle costs, users purchase more sources than they would if the total life-cycle costs were internalized.

Six major factors contributing to the disused source problem have been identified:

- the life-cycle costs of managing and ultimately disposing of sealed sources are not internalized;
- the practices of the NRC and the NNSA do not fully reflect a consistent view of what sources pose a threat to national security;
- the regulatory system is not adequate for the post-9/11 threat environment;
- there are no financial incentives for disused sources to be reused, recycled, or disposed in a timely manner;
- the opportunities for recycling and reusing sealed sources are being underutilized; and
- Type B shipping containers needed to transport certain high activity sealed sources are in short supply and are very expensive.

The NRC considers only Category 1 and Category 2 sealed sources to present a national security risk.[3] However, the DSWG received input from NNSA that some Category 3 sealed sources pose a threat to national security.[4] The U.S. Government should reach an agreement across agencies regarding which sealed sources pose a threat to national security.

[3] International Atomic Energy Agency (IAEA) *Code of Conduct* and IAEA *Safety Guide #RS-G-1.9, "Categorization of Radioactive Sources"* establishes sealed sources Categories 1 through 5, with Category 1 being the greatest risk and Category 5 being the lowest risk. Categories 1, 2, and 3 are all classified as "dangerous" sources.

[4] "Sources that fall into Category 3 and lower can be assembled into Category 2 or 1 quantities of radioactive material. Further, it may be the case that some radiation sources near the upper threshold for Category 3 pose more serious risks than other sources that fall near the lower threshold of Category 2 in scenarios other than those used to create the source categorization system." *Radiation Source Use and Replacement,* National Research Council, National Academies of Sciences (NAS), page 43, note 1, 2008. See also *Ensuring the Security of Radioactive Sources: National and Global Responsibilities,* Charles Ferguson, President of the Federation of American Scientists, 2012.

Licensees should be informed about alternative technologies and the actual costs of reusing, recycling, or disposing of sources when they are no longer needed. Research on alternative technologies to replace sealed sources should be a priority of the federal government and the private sector.

The current regulatory system was developed to primarily protect health and safety. The NRC and the Agreement States should enhance the regulatory system to fully address the national security threat of sealed sources. A Specific License (SL) should be required for all Category 1 through 3 sources and all such sources should be tracked in the NRC's National Source Tracking System (NSTS). The regulatory system should be restructured to provide economic incentives for the prompt reuse, recycle, or disposal of disused sources. Financial assurance requirements should be broadened to cover all Category 1 through 3 sources and increased to cover the full cost of transportation and disposal. Licensees should be required to pay an annual possession fee for each sealed source in inventory.

The NRC and the Agreement States should develop a comprehensive regulation to limit the storage of disused sources to two years and authorize regulators to require the disposition of sources in storage for more than two years unless there is a demonstrated future use. The inventories of disused sources at sealed source manufacturers, suppliers, and waste brokers should be reduced. The NRC should reconsider its decision to allow foreign sources that may not have a commercial disposal pathway to be imported. The financial needs of the Agreement States should also be addressed.

Federal and private research funding organizations should require grantees to budget for the disposal of sealed sources when they no longer are needed by the grantee.

The reuse and recycling of sealed sources should be promoted. A study on measures to promote the reuse and recycling of sealed sources should be conducted by an agency such as the U.S. Environmental Protection Agency (EPA). A sealed source "exchange" program should be established to facilitate the transfer of sources between those no longer needing sources and those looking to acquire sources.

NNSA should undertake a market analysis of the demand for Type B shipping containers and take additional steps to encourage the private sector to increase the supply of commercially available Type B shipping containers. NNSA should identify several internationally-certified Type B shipping containers that would have widespread applicability to disused sources in the U.S. and submit applications to have these packages certified by NRC for domestic use. The NRC should continue to expeditiously review applications for Type B shipping containers. The NRC should aggressively notify licensees and the Agreement States well in advance of the expiration of shipping container certifications.

An outreach program should be established to assist licensees in identifying resources to assist with packaging, transport, and disposal of disused sources.

States with disposal facilities licensed to accept Class B and Class C low-level radioactive waste should examine their waste acceptance criteria and policies, including the alternative approaches provision in the revised CA BTP to facilitate the disposal of certain high activity sealed sources. The existing NRC-Conference of Radiation Control Program Directors (CRCPD) program should be adequately funded to address orphaned and abandoned sources and individual states should retain the ability to operate their own orphaned and abandoned source programs. The Texas Compact should continue to allow the disposal of sealed sources from outside the Texas Compact region.

NNSA needs to maintain the ability to recover orphaned and abandoned sources that present a national security threat for the foreseeable future. It is also recognized that the CRCPD Source Collection and Threat Reduction (SCATR) program has been effective in collecting and disposing of thousands of disused sources over the last seven years.

However, the long-term solution to the disused source problem is to hold the licensees who have purchased and obtained the economic benefit from the sources responsible for the proper reuse, recycling, or disposal of the sources when they become disused. To this end, the NNSA should ensure that its programs do not provide a disincentive for licensees to properly reuse, recycle, or dispose of disused sources in a timely manner.

INTRODUCTION TO WORKING GROUP AND SCOPE OF STUDY

Background

The Low-Level Radioactive Waste Forum (LLW Forum) is an organization established to facilitate state and compact implementation of the Low-Level Radioactive Waste Policy Act of 1980 and its 1985 Amendments (LLRWPAA) and to promote the objectives of low-level radioactive waste regional compacts. The LLW Forum is dedicated to the goals of educating policy makers and the public about the management and disposal of low-level radioactive wastes and fostering information sharing and the exchange of views between state and compact policy makers, federal officials, industry representatives and other interested stakeholders.

The LLW Forum's objectives include:

- facilitating state and interstate compact implementation of federal law governing low-level radioactive waste management;
- educating policy makers, government and industry officials, and the public about technical, regulatory, and policy matters associated with the management and disposal of low-level radioactive waste as well as key legislative objectives;
- fostering information sharing and professional networking among state and interstate compact officials;
- providing opportunities for state and interstate compact officials to exchange views with federal officials, industry, and other interested parties; and
- supporting the goals of low-level radioactive waste interstate compacts and states.

At the fall 2010 meeting of the LLW Forum, officials from the National Nuclear Security Administration/Global Threat Reduction Initiative (NNSA/GTRI)[5] approached the LLW Forum for assistance in seeking solutions for the disposition of non-U.S. Department of Energy (DOE) owned disused sources which the agency believes to pose a threat to national security.[6]

[5] The Global Threat Reduction Initiative (GTRI) was established in 2004, with a mission to reduce and protect high-risk nuclear and radiological materials located at civilian sites worldwide.

[6] The federal interagency Radiation Source Protection and Security Task Force (Task Force) uses the term "risk-significant" to describe such sources. In order to provide clarity, the Disused Sources Working Group (DSWG or working group) developed the term "sources that pose a threat to national security" to describe those sources which are the subject of this report in accordance with the National Nuclear Security Administration (NNSA) mandate. (See the *Glossary of Terms* for specific definitions of terms used in this report including definitions of "risk-significant," "sources that pose a threat to national security," "sealed sources," and "disused sources.")

As a first-step, the LLW Forum created a Steering Committee that met with officials from the NNSA/GTRI, the DOE Office of Environmental Management, the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Department of Homeland Security (DHS) in January 2011 to gather information regarding the nature and extent of the various issues associated with disused sealed sources. During the course of the meeting, Steering Committee members emphasized the need to evaluate and address both key front-end issues and considerations (e.g., support national security, improve regulation, explore potential options for recycle and reuse, examine existing and emerging production technologies, consider marketing and distribution systems) as well as the back-end (e.g., identify and address traditional and/or innovative disposition pathways).

Consequently, during the May 2011 LLW Forum meeting, a resolution was unanimously passed by LLW Forum members authorizing the creation of the Disused Sources Working Group (DSWG or working group).[7] Members of the working group were appointed by the LLW Forum Chair and approved by the Executive Committee and included representatives from selected states and compacts and all four sited states/compacts. Following its formation, the working group moved forward to establish the overall course of action, set the scope of the study, and conduct its assessment.

Scope of Study

The potential for disused sealed sources to pose a national security concern is an important factor in framing the scope of this study. The LLW Forum's participation serves to provide a balanced examination of the various issues throughout the entire life cycle of radioactive sealed sources, rather than simply addressing the matter from a final disposition point of view. Accordingly, the DSWG has not limited its study to a cursory examination of issues related to the disposal of disused sealed sources. Nor did the working group consider its sole measure of success in meeting its objective to be limited to back-end solutions. Rather, the DSWG endeavored to clarify the problem, explore challenges associated with the management of disused sealed sources, and develop both front-end and back-end recommendations. The working group determined to limit the scope of the study to commercial sources and federal sources for which the states and compacts are responsible and exclude sealed sources that are under DOE's control and responsibility, including sealed sources with radionuclide concentrations that are Greater Than Class C (GTCC) as well as transuranic (TRU) sources.[8] Additionally, sources that present a low security concern, such as tritium exit signs, were also excluded from the scope of this study.

[7] Appendix B contains a copy of the Low-Level Radioactive Waste Forum (LLW Forum) resolution.

[8] The Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA), Public Law 99-240, establishes state and federal government low-level radioactive waste disposal responsibilities. Specifically, the federal government is responsible for the disposal of the following: (a) low-level radioactive waste owned or generated by the U.S. Department of Energy (DOE); (b) low-level radioactive waste owned or generated by the U.S. Navy as a result of the decommissioning of vessels of the U.S. Navy; (c) low-level radioactive waste owned or generated by the federal government as a result of any research, development, testing, or production of any atomic weapon; and (d) any other low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the U.S. Nuclear Regulatory Commission (NRC) for Class C radioactive waste. The scope of this study excludes the preceding wastes.

The working group pursued the following objectives:

- review existing information on those sources currently identified as being disused, as well as information related to where the sources were last put to practical use and associated disposal pathway availability;

- examine what can be done at the front-end to help ensure that licensees that purchase or use sources have the means to safely store, on a time-limited basis, and properly dispose of the sources once spent;

- explore the ability to reuse and recycle sealed sources;

- consider potential disposition options due to greater availability of commercial disposal capacity; and

- discuss potential contributions by unaffiliated states and interstate compacts that currently do not have disposal facilities in terms of policies or program requirements that foster final disposition options.

Due to the absence of comprehensive data and information and in consideration of the scope and limitations of the national radioactive source databases, the DSWG did not evaluate all aspects of the sealed source management life-cycle. Such data deficiencies limited the working group's ability to project anticipated future problem sources annually by quantity, radioactivity, waste type, origin, and state or compact of last use, as originally envisioned by the LLW Forum resolution.

Additionally, the DSWG recognized that it was unnecessary to pursue secured storage options due to the added availability of disposal capacity with the opening of the Texas Low-Level Radioactive Waste Disposal Compact (Texas Compact) low-level radioactive waste disposal facility. It was also not within the scope of this study to address the physical security of sealed sources (e.g., regulatory requirements for increased controls). For national security purposes, the reuse, recycling or disposal of disused sealed sources are the preferred alternatives.

Study Approach

In preparing this report, the working group first undertook a significant effort to seek and receive input from key stakeholders—such as source manufacturers, users, waste generators, recyclers, brokers, processors, disposal facility operators, regulatory organizations, federal and state agencies, interstate compact officials, and federal interagency Radiation Source Protection and Security Task Force (Task Force) representatives. Over the course of a number of meetings, beginning in October 2011 and concluding in February 2014, the DSWG invited select representatives of these key stakeholders[9] to present their perspectives, provide critical input, offer recommendations, and identify important issues associated with the life cycle of sealed sources. Stakeholders also offered information in response to data and information requests from

[9] Appendix C lists the various stakeholder meetings and the stakeholder participants.

the working group. For example, both the NNSA and the Conference of Radiation Control Program Directors (CRCPD) provided the working group with essential information about the GTRI/Off-Site Source Recovery Program (OSRP) and the Source Collection and Threat Reduction (SCATR) program, respectively.

The interactive nature of this level of participation by stakeholders afforded the DSWG the ability to gain direct insight into and more fully evaluate the following:

- strengths and limitations of the existing databases related to sealed sources in the United States;
- regulatory framework associated with radioactive materials licensing;
- nature of any critical restrictions, constraints, or limitations (regulatory, financial, market, management options, etc.) that stakeholders face throughout the life cycle of radioactive sealed sources;
- stakeholders' views regarding possible options and opportunities for improvement to address these issues;
- pertinent actions and efforts by regulatory agencies to address long-term storage of sealed sources;
- scope and purpose of existing national sealed source collection and recovery programs; and
- work of the Task Force.[10]

First, in developing its findings and recommendations, the DSWG reviewed and evaluated an extensive amount of data and information from stakeholders.[11] The working group also recognized the roles and relationship of the NRC and Agreement States in establishing and implementing regulations and standards associated with radioactive materials, including sealed sources.

The NRC is the primary federal agency responsible for establishing regulatory programs that protect the public health and safety regarding nuclear energy, radiation, and radioactive materials. States can enter into an agreement with the NRC to assume regulatory authority and responsibility to administer certain radioactive materials programs, including sealed sources and

[10] Under the Energy Policy Act of 2005 (EPAct), Public Law 109-58, the Task Force is charged with evaluating and providing recommendations to Congress and the President relating to the security of radiation sources in the United States from potential terrorist threats, including acts of sabotage, theft, or use of a radiological source in a radiological dispersal device (RDD or dirty bomb) or a radiological exposure device (RED). The NNSA/GTRI participates on this Task Force, which includes membership from 14 federal agencies and two state organizations. The initial Task Force report was completed in 2006 and in 2010 an updated report was published. Following the quadrennial cycle, the next report is due in 2014.

[11] See Appendix C for a complete list of working group meetings and participating stakeholders.

devices. Accordingly, some of the working group's findings and recommendations focus on the NRC in recognition of their lead role in establishing national requirements, standards, and guidance for radioactive materials that Agreement States can in turn adopt and implement as the authorized regulatory agencies. States may have the authority to establish rules that are more stringent to account for state needs and circumstances, particularly for security risks and concerns associated with disused sources, and these recommendations are not intended to preclude Agreement States from doing so.

Second, the DSWG discussed what it had learned from the stakeholders and formulated its initial findings and recommendations.

Third, the working group briefed the LLW Forum's Board of Directors on its initial findings and recommendations.

Fourth, stakeholders were re-contacted in order to give them an opportunity to review the draft findings and recommendations. In response, stakeholders provided comments that the working group considered and incorporated into a subsequent revision of the report.

Finally, before finalizing the report, the DSWG considered the suggestions offered by the LLW Forum's Board of Directors and the stakeholders in making revisions to the draft report.

The fact that certain disused sealed sources pose a threat to national security and consequently require secure disposition is integral to the development of the findings and recommendations of this report. In addition, many of the working group's recommendations have health and safety benefits as well.

PROBLEM STATEMENT

There are approximately two million sealed sources that are licensed for use in the United States.[12] Of those, thousands become disused sources each year.[13] Users are reluctant to declare their sources as disused or to reuse, recycle, or dispose of their sources for a variety of reasons such as future use, disposal cost, transportation restrictions, and the relative ease and low cost of long-term storage. Some of these sources pose a threat to national security as they could be used individually or in aggregate in radiological dispersal devices (RDD or dirty bombs) or radiation exposure devices (RED). Such an attack could contaminate a vast area. Liberty Rad Ex, a full-scale simulated RDD recovery exercise conducted in Philadelphia during April 2010, was the largest drill of its kind to test the country's capability to clean up and help communities recover from an RDD terrorist attack.[14] The U.S. Environmental Protection Agency (EPA) has estimated that an RDD incident in a major metropolitan area could result in 39 million cubic feet and 10 billion gallons of radioactively contaminated waste requiring disposal.[15]

Although two federal agencies maintain databases concerning sealed sources, sufficient data is not collected to show how many sealed sources exist in the U.S., nor how many of these may be disused. The NRC's National Source Tracking System (NSTS) currently tracks the possession and transfer of more than 81,000 sources.[16] The NSTS inventory includes only International Atomic Energy Agency (IAEA) Category 1 and 2 sources and does not include Category 3 through 5 sources.[17] The voluntary GTRI/OSRP registry contains an inventory of about 23,000 sources that pose a threat to national security. These inventories do not represent all sources that are currently in use and contain duplication. No comprehensive data system exists to track all sealed sources or disused sources in the United States.

The task of reducing the threat to national security from disused sources is complicated for a variety of reasons, such as:

- the regulatory system is currently not sufficient to address certain national security risks:

[12] Report to the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials,"* U.S. Government Accountability Office (GAO) Report 08-598, June 2008.
[13] 2006 Task Force and 2010 Task Force, *2006 Task Force Report and 2010 Task Force Report.*
[14] *Liberty Rad Ex National Tier 2 Exercise: After Action Report,* U.S. Environmental Protection Agency (EPA), dated March 30, 2011.
[15] Boe, T., et. al., *A Planning Tool for Estimating Waste Generation of a Radiological Incident and Subsequent Decontamination Efforts,* Proceedings of the Waste Management 2013 Conference, Phoenix, Arizona.
[16] "Total number of Cat 1 and 2 sources in NSTS in 7/2013 – 81,078," email from the Office of Federal and State Materials and Environmental Management Programs (FSME), Division of Materials Safety and State Agreements (DMSSA), NRC, dated August 21, 2013.
[17] NRC uses International Atomic Energy Agency (IAEA) Categories 1 through 5 as explained in Appendix A.

- some sources that pose a national security threat are inadequately licensed with minimal requirements;[18]
- some sources that pose a national security threat are not tracked;
- many sources that pose a national security threat are allowed to be possessed without financial assurance requirements; and
- some sources that do not pose a national security threat individually can be aggregated in quantities that will result in a threat to national security;

- practices of NRC and NNSA do not fully reflect a consistent classification of what sources pose a national security threat;

- devices in long-term storage are more likely to be subject to loss of control and accountability; and

- while disposal access is available for most sources, disused sources are not being disposed in a timely manner:

    - the current regulatory system and federal/state programs do not promote prompt reuse, recycle, or disposal, and in some cases actually provide incentives for users to delay disposal of disused sources; and as a result, existing opportunities for reuse, recycle, and disposal are being underutilized;
    - while at times providing a necessary safety net, the CRCPD SCATR and GTRI/OSRP—programs which collect and dispose of sources at a reduced cost to licensees—may provide an unintended disincentive for licensees to routinely plan and budget for disposal;
    - some licensees lack technical and administrative expertise to package, transport, and dispose of their disused sources;
    - the lack of and high costs of Type B containers required for the transportation of higher activity sources impedes the prompt disposition of such sources; and
    - some imported foreign disused sources may not have a commercial disposal pathway.

The 2005 Energy Policy Act (EPAct), Public Law 109-58, tasked the federal government to provide recommendations relating to the security of radiation sources in the U.S. from potential terrorist threats. Two reports[19] regarding the security of sources have been issued, but adequate follow-up has not been implemented. In this report, the DSWG endeavors to explore each of the stated issues and provide recommendations to decision makers and stakeholders on ways to address needed improvements. The DSWG believes that all facets of the industry contribute in some way to the problems and encourages all stakeholders to effectively implement their individual contributions towards a timely and comprehensive solution.

[18] For an explanation of the differences between Specific License (SL) and General License (GL) requirements, please see "Inadequate Licensing Requirements" section of *Issues, Findings and Recommendations* chapter of this report.
[19] 2006 Task Force and 2010 Task Force, *2006 Task Force Report and 2010 Task Force Report.*

ISSUES, FINDINGS, AND RECOMMENDATIONS

The following issues, findings, and recommendations are presented in the order of the life cycle of a sealed source. Issues related to the acquisition of sources, consideration of alternative technologies, and knowledge about the costs and responsibilities for properly managing sources are presented first. The next section focuses on the regulatory system including such issues as licensing, tracking, financial assurance, long-term storage, manufacturer inventories, and the importation of foreign disused sources. Issues related to reuse, recycle and disposal at commercial facilities—including the availability and cost of Type B shipping containers and future transition of the GTRI OSRP and CRCPD SCATR programs—are described toward the end of the chapter.

During the course of this project, the DSWG found that most licensees manage their sources in a responsible manner; however, despite the best intentions of licensees, the large number of disused sources still presents a risk to national security. The DSWG found that the state regulatory agencies are doing a good job at implementing the regulatory system as it now exists. However, the DSWG believes that enhancements to the regulatory system are needed to fully address the national security threats posed by disused sources. The DSWG acknowledges that some of the recommendations may pose additional resource demands on the Agreement States.[20] As such, the DSWG encourages NNSA to examine potential ways to address financial needs of the Agreement States when national security concerns are at issue.

The Growing Problem: The Acquisition and Accumulation of Sealed Sources

The number of disused sealed sources in the U.S. is growing, as the current system encourages the widespread possession and use of sealed sources. Since the beginning of the atomic age, it has been the policy of the U.S. to promote the use of atomic energy and its byproducts. The Atomic Energy Act (AEA) of 1946 declared as a purpose a program of assisting and fostering private research and development to encourage maximum scientific progress. The AEA was amended in 1954 to add as a purpose a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes. These two policy declarations remain in the AEA today.[21]

However, the national security threat posed by sealed sources now requires us to evaluate their widespread availability and accumulation. The current regulatory environment does not promote the use of alternative technologies or the reuse, recycling, or disposal of sources. Rather, the

[20] An Agreement State is a state that has signed an agreement with the NRC under which the state regulates the use of byproduct, source, and small quantities of special nuclear material within that state. There are currently 37 Agreement States.
[21] Public Law 79-585 and Public Law 83-703.

regulatory environment promotes the acquisition of new sources and the storage of disused sources, thereby increasing the inventory and perpetuating the problem.

With expanding uses of sealed sources, the total number of sources produced, purchased, and used in the U.S. is increasing. Consequently, sealed sources are relatively easy to obtain. Owners of sealed sources are not required to demonstrate the need for a new source before purchasing that source. Neither are they required to consider the use of alternative technologies. Further, owners of sealed sources are allowed to purchase new sources without disposing of their disused sources.

In some cases, alternative technologies do exist that could be used for the same purposes now filled by sealed sources. According to the 2010 Radiation Source Protection and Security Task Force Report (Task Force Report),[22] three types of alternative technologies could serve as replacements for certain risk-significant radioactive sources: (1) technologies that use the same radionuclide with a different chemical or physical form (e.g., replacing cesium-137 salt with less dispersible cesium-137 ceramic), (2) technologies that use a different radionuclide (e.g., replacement of cesium-137 salt with cobalt-60 metal), and (3) technologies that do not use a radionuclide (e.g., x-ray technology).

Contributing to the accumulation of disused sources is the fact that some users are unaware of and/or fail to adequately budget for the eventual disposition of sources. When considering the purchase of a new sealed source, the buyer does not often consider the overall life-cycle cost of properly managing the source—which can range from a few thousand to hundreds of thousands of dollars—and is not required to budget for its ultimate disposition. Thus, as currently configured, the economics of sealed source ownership do not compel owners toward prompt end-of-life disposition.

In the case of sealed sources purchased with grant funds, the cost of acquiring a new source is usually absorbed in the budget of the project or grant, so the user has little reason to question whether a source in their existing inventory would be adequate for the proposed use. However, the eventual cost of management and disposal of the source used in a project is rarely included in the grant request and thus there are no funds budgeted for the ultimate disposal of the source.

Failure to Reuse Sealed Sources in Inventory and to Consider Alternative Technologies

Issues and Findings:

The current system does not provide incentives for users purchasing new sources to consider whether sources in their existing inventory or an alternative technology would serve the proposed purpose.

The DSWG agrees with the Key Recommendation contained in the 2010 Task Force Report calling for the federal government to enhance support of research and development of alternative technologies to replace the use of risk-significant radioactive sources, as well as its

[22] 2010 Task Force, *2010 Task Force Report,* pp. iv-v, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

recommendation for a government-incentivized program for the replacement of risk-significant devices with effective alternatives.[23]

Recommendation:

1. To promote the reuse of sources already in a user's inventory and to promote the use of other technologies as an alternative to the use of sealed sources:

    - NRC and Agreement States should encourage potential buyers of sealed sources that pose a threat to national security to reuse sources already in inventory;

    - the federal government should continue to develop and promote technologies as alternatives to the use of sealed sources that pose a threat to national security;[24] and

    - the federal government should develop incentives to encourage potential buyers of sealed sources that pose a threat to national security to consider the use of alternative technologies to serve the purpose of a new source.[25]

Lack of Awareness of the Life-Cycle Costs of Managing Sealed Sources

Issues and Findings:

The purchase price of sealed sources does not include the cost of eventual disposition as it does for some consumer goods such as large household appliances. In addition, certain potential buyers are not well informed regarding the costs for the management and disposition of sealed sources. Some buyers are completely unaware that the cost of transportation and disposal may be exponentially higher than the purchase price of the source.[26]

In the case of sealed sources purchased with grant funds, the eventual cost of disposition of the source is rarely included in the grant request and thus there are no funds budgeted for the ultimate disposition of the source. Purchasers of sealed sources need to understand and budget for the associated life-cycle costs and responsibilities prior to acquisition.

Recommendations:

2. Create a program, possibly through the CRCPD, to educate proposed buyers of sealed sources about the life-cycle costs of sealed sources, including information about the cost of storage, transportation, and disposal.[27] *(See also DSWG Recommendation 24.)* The NRC

[23] Key Recommendation 2, 2010 Task Force, *2010 Task Force Report,* p. v, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.
[24] *Ibid.*
[25] *Ibid.*
[26] For example, a source costing $1,000 to purchase may cost from $800 to $10,000 or more to package, transport, and dispose. (The actual disposal cost is dependent on the isotope and condition of the source and source housing.)
[27] Conference of Radiation Control Program Directors (CRCPD) programs currently offer assistance only after a source becomes unwanted or disused including "identify[ing] contacts at government agencies and commercial services for on-scene assistance with securing and assessing radioactive material," as well as "finding, and in some

and Agreement States should require licensees to sign an acknowledgment that they have received and read the information prior to acquiring additional sources.

3. Federal research agencies should:

   - encourage grantors to give preference to applicants proposing to use sealed sources from their existing inventories or alternative technologies; and

   - require applicants to budget for the full life-cycle cost of use and disposition in grant applications.

Inadequate Regulatory Controls to Manage the Threat to National Security

The current regulatory system was developed primarily to protect health and safety and thus does not fully address the current post-9/11 threat environment from disused sealed sources. One of the main reasons for the national security threat from disused sealed sources is the lack of adequate regulatory controls. To ensure that regulators have the proper authority to adequately enforce cradle-to-grave management of sealed sources, the NRC and Agreement States need to revise their standards to establish a minimum set of requirements that fully address the national security threat from sources.

Under the current system, some sources that are considered to pose a public health threat by the IAEA or a national security threat by others are not tracked or licensed in a manner that ensures adequate control.[28] The licensing system should be enhanced so that all sources potentially

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cases funding, an outlet for radioactive material or related equipment …" Pamphlet titled, "CRCPD Assistance with Disposition of Unwanted Radioactive Material," CRCPD, Revised August 2010. The CRCPD is a non-profit organization of individuals that regulate and control the use of radioactive material and radiation sources. *For additional information on services offered by CRCPD, please go to www.crcpd.org.*

[28] IAEA *Code of Conduct* and IAEA *Safety Guide #RS-G-1.9 (Categorization of Radioactive Sources)* includes a system for categorizing radioactive sources based on their potential to cause harm to people. The system categorizes sources into five categories, Categories 1 through 5, with Category 1 being the greatest risk and Category 5 being the lowest risk. Categories 1, 2, and 3 are all classified as "dangerous" sources.
"Sources that fall into Category 3 and lower can be assembled into Category 2 or 1 quantities of radioactive material. Further, it may be the case that some radiation sources near the upper threshold for Category 3 pose more serious risks than other sources that fall near the lower threshold of Category 2 in scenarios other than those used to create the source categorization system." *Radiation Source Use and Replacement,* National Research Council, National Academies of Sciences (NAS), page 43, note 1, 2008. See also *Ensuring the Security of Radioactive Sources: National and Global Responsibilities,* Charles Ferguson, President of the Federation of American Scientists, 2012. In addition, a 2012 classified Sandia National Laboratory study found that certain Category 3 sources used maliciously could contaminate an area of approximately eight city blocks with radiation levels 20 times the NRC annual dose limit for a member of the public. GTRI has indicated to the DSWG that, according to NNSA protection and sustainability criteria, it would certainly consider such an incident to be a national security, public health, and safety concern and that it accordingly considers such Category 3 sources to be such a concern as well. In 2008, NRC staff proposed to amend the agency's regulations to expand the National Source Tracking System (NSTS) to include Category 3 sources including fixed industrial gauges (e.g., level gauges, conveyor gauges, thickness gauges, blast furnace gauges, dredger gauges, and pipe gauges); well-logging devices; medium and low-dose-range brachytherapy devices; and certain radiography devices. Staff also recommended inclusion in the NSTS

posing a national security threat are required to have a Specific License (SL) rather than a less stringently controlled General License (GL).

Moreover, existing source databases collect only limited information, and the provision of information by licensees in some cases is not mandatory. To assist regulators in reducing potential threats, these systems need to be enhanced to track the number and location of all sources that pose a threat to national security and identify which sources are disused.

Another regulatory concern is the lack of financial planning by licensees for the cost of eventual disposition of the source and the limitations of existing financial assurance requirements. The development of more stringent financial assurance requirements by the NRC and the Agreement States is crucial to ensuring that licensees properly manage and promptly dispose of disused sources.

After using a source for its original purpose, most licensees place it in storage or return it to the manufacturer. Often, the disused source is not reused by the licensee and is stored indefinitely. This is a problem because sources in long-term storage are more likely to be subject to loss of control and accountability.[29] In addition, users of sealed sources have little or no incentive to

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of "sources below the Category 3 threshold, but greater than or equal to a 10th of the Category 3 threshold," based on "…the nature of the sources at 1/10 of Category 3, their potential to aggregate to Category 2, and the costs to the licensed industry and the NRC." 71 *Federal Register* 19,749 (April 11, 2008). On June 30, 2009, by a 2-2 vote, NRC announced that the Commission "was unable to reach a decision on the staff's recommendation to issue a final rule expanding the number and type of radioactive sources" covered under the NSTS. Press Release 09-121 titled, *"NRC Commission Split 2-2 on Expansion of National Radioactive Source Tracking System,"* NRC, June 30, 2009. Health Physics Society (HPS) comments on Docket NRC-2008-0272, *"Limiting the Quantity of Byproduct Material in a General Licensed Device."* Their comments established the HPS position that all Category 3 sources and greater should be subject to a SL.

GAO completed the following two audits of the security aspects of NRC's licensing process that raised concerns about the relative ease with which lower activity sources can be purchased and potentially aggregated to higher activity levels: (1) Testimony Before the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective,"* GAO Report 07-1038T, July 12, 2007, and (2) Report to the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials,"* GAO Report 08-598, June 2008.

The Organization of Agreement States (OAS), Petition for Rulemaking Regarding 10 *Code of Federal Regulations* (CFR) 31.5 and 31.6; Comment on Draft Proposed Rule 10 CFR Parts 30, 31, 32 and 150. The purpose of this petition is to strengthen the regulation of radioactive materials by requiring an SL for higher-activity devices that are currently available under the General License (GL) in 10 CFR 31.5.

[29] "The NRC should evaluate requiring licensees to review and document the reasons for storage of risk-significant sources longer than 24 months and the feasibility of establishing a maximum time limit on the long-term storage of risk-significant sources not in use." As recommended in Action 7-1, 2006 Task Force, *2006 Task Force Report.* "The NRC incorporated this action into its evaluation for 2006 Recommendation 9-2 in consultation with Federal and State partners. The evaluations will factor into the NRC's decision whether to pursue rulemaking and the public consultation process." 2010 Task Force, *2010 Task Force Report,* p. 37, at http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

NUREG-1551, Final Report of the NRC-Agreement State Working Group (NRC-AS Working Group) to Evaluate Control and Accountability of Licensed Devices, October 1996. The NRC-AS Working Group examined the information provided by NRC and determined that there is a lack of licensee oversight by the regulators. According to the NRC-AS Working Group, regulators have not had an active role in ensuring that licensees maintain

dispose of disused sealed sources. Most sources are small and require very little space to store, so users incur very little cost or other negative consequences in storing disused sources. By comparison, disposal can be very costly. As disposal was not available for many states for some years, users are also not accustomed to including funds for disposal in their annual budgets.

Import of disused sources that were last used in foreign countries present two significant regulatory considerations. First, some sources being returned to the manufacturer in the U.S. by a foreign entity under a one-for-one exchange may not have a commercial disposal pathway. Second, the NRC allows foreign sources to come into the U.S. for recycling, but some of these sources are not recycled and then have no commercial disposal pathway.

Several Agreement States have taken the lead in developing more stringent and comprehensive regulations to address gaps in the current NRC source regulation program. Some which have been identified by the DSWG include: Oregon's comprehensive GL requirements and possession fees for each source in a licensee's possession;[30] Texas' fees on licensees to cover the cost of orphaned and abandoned source recovery;[31] Illinois' financial assurance requirement for most sources;[32] Florida's radiation protection trust fund covering all costs associated with licensee bankruptcy and orphaned sources;[33] and Colorado's comprehensive GL registration and annual self-certification program and requirement for SLs for certain Category 3 sources that are normally generally licensed. The NRC could expedite the development of revised regulations by incorporating the best practices already in use by the states. Revised regulations initiated by the NRC will also help states with regulatory reform[34] to adopt compatible regulations by streamlining the economic impact review process.

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control over and accountability for devices, and in ensuring that licensees possess, use, and transfer devices in accordance with the regulations. The NRC-AS Working Group further determined that both GLs and SLs have demonstrated loss of control over and accountability for devices.

[30]Oregon comprehensive GL rule to ensure accountability Rules (Oregon Rules for the Control of Radiation in GL Devices, OAR 333-102-0115).

[31]Texas Financial Provisions for orphan sources (Health & Safety Code: Subtitle D, Nuclear and Radioactive Materials: Chapter 401, Radioactive Materials and Other Sources of Radiation: Subchapter H, Financial Provisions).

[32]Illinois has strict Financial Assurance Requirements for sources (Title 32: Energy Chapter ii: Emergency Management Agency Subchapter B: Radiation Protection Part 326. Title 32).

[33]Florida has a Radiation Protection Trust Fund of 5 percent of the annual licensing and inspection fee to cover the cost for abandonment of radioactive materials, default on lawful obligations and insolvency (64E-5.206 Section 404.122 and 404.131(2)).

[34]State and Federal Regulatory Reform: A Comparative Analysis, Robert W. Hahn, AEI-Brookings Joint Center for Regulatory Studies, November 1998; IDEA: Regulatory Reform, State Government Performance Review, March 2011, www.sao.wa.gov/EN/Audits/SGPR/Documents/RegReform_Final_Report.pdf.

Inadequate Licensing Requirements

Issues and Findings:

The current NRC licensing structure provides for sources to either be Specifically Licensed (SL) or Generally Licensed (GL).[35] In order to possess a GL source, the user has only to file limited registration information with the NRC or Agreement State after obtaining the source. The DSWG believes that this provides a window of opportunity for aggregation or misuse of higher activity GL sources prior to the required reporting to regulatory agencies. In many instances, there is no significant evaluation by a regulatory agency prior to or during the possession of a GL source.

In contrast, possession of an SL source requires the user to submit a license application and undergo a facility inspection in advance of obtaining the source. Additional requirements for SL sources include adherence to license conditions, periodic renewals, state approved radiation safety training and procedures, and periodic inspections by the NRC or Agreement State. It seems unsound to have a regulatory system that allows users to possess sources that pose a threat to national security without an SL.

In 2010, the Organization of Agreement States (OAS) petitioned NRC to increase the regulatory control over certain GL sources.[36] When this came before the Commission, the additional controls failed upon a tie vote, resulting in a non-decision. However, the NRC did authorize Agreement States to increase controls on GL sources at their own discretion. As a result of this, few states enacted increased controls.

A previous NRC-Agreement State Working Group (NRC-AS Working Group) determined that there is a lack of oversight of GL licensees by the regulators.[37] The NRC-AS Working Group also found that regulators have not taken an active role in ensuring that GL licensees maintain control over and accountability for GL sources and in ensuring that licensees possess, use, and transfer GL devices in accordance with the regulations. This has led to a loss of control and sometimes to improper disposal or even to orphaned or abandoned sources.[38] Subsequently,

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[35] Section 11e.(1) byproduct material is regulated by the NRC under 10 CFR Part 30.31—Rules of General Applicability to Domestic Licensing of Byproduct Material. "Licenses for byproduct material are of two types: General and specific. (a) The Commission issues a specific license to a named person who has filed an application for the license under the provisions of this part and parts 32 through 36, and 39, (b) A general license is provided by regulation, grants authority to a person for certain activities involving byproduct material, and is effective without the filing of an application with the Commission or the issuance of a licensing document to a particular person. However, registration with the Commission may be required by the particular general license."

[36] OAS Petition for Rulemaking (PRM) 31-5 as found at http://www.regulations.gov/#!documentDetail;D=NRC-2008-0272-0059 and http://www.regulations.gov/#!documentDetail;D=NRC-2008-0272-0001; SECY 10-10-0105, *Limiting the Quantity of Byproduct Material in a Generally Licensed Device*; Commission Voting Record Decision Item: SECY-10-0105, Final Rule: *Limiting the Quantity of Byproduct Material in a Generally Licensed Device* (RIN 3150-Al 33), December 2, 2010. In addition to OAS, nine Agreement States also supported this position.

[37] Final Report of the NRC-AS Working Group to evaluate Control and Accountability of Licensed Devices (NUREG-1551).

[38] In response to an inquiry regarding information about missing nuclear materials over a five year period, the NRC documented 18 instances of Reportable Licensed Lost, Abandoned or Stolen Material (LAS) Events from 1997 to July 7, 2002. *Response to Freedom of Information Act (FOIA)/Privacy Act (PA) Request,* NRC Form 464 Part I, FOI/PA 2003-0082, December 18, 2002.

registration and annual reporting requirements for GL sources have been implemented by NRC and Agreement States. The DSWG is concerned, however, that because of the time lag in reporting information and the lack of regulatory oversight of GL sources, there is a potential window of opportunity for higher activity GL sources to be aggregated and used maliciously. For this reason, the DSWG concludes that it would enhance security if an SL was required for all sources that pose a threat to national security. The DSWG recognizes that additional regulation will be costly. However, due to the small number of Category 3 GL sources in the U.S., the DSWG believes that the reduction in threats to national security from increased regulation outweighs the anticipated socio-economic impact that would result from an RDD or RED event.

Recommendation:

4. The NRC should fully address the national security threat posed by sealed sources by amending its regulations to require an SL for all Category 3 sources.

Lack of an Adequate Source Tracking System

Issues and Findings:

An adequate source tracking system does not exist in the U.S. to identify the number and location of all sources that pose a national security threat and public health hazard[39] and which of these sources are disused. Several stakeholders have considered the issue and, at times, recommended that Category 3 sources be tracked.[40]

[39] IAEA *Code of Conduct* and IAEA *Safety Guide #RS-G-1.9,* "Categorization of Radioactive Sources," includes a system for categorizing radioactive sources based on their potential to cause harm to people. The system categorizes sources into five categories, Categories 1 through 5, with Category 1 being the greatest risk and Category 5 being the lowest risk. Categories 1, 2, and 3 are all classified as "dangerous" sources.

[40] In 2008, NRC staff proposed to amend NRC regulations to expand the NSTS to include Category 3 sources including fixed industrial gauges (e.g., level gauges, conveyor gauges, thickness gauges, blast furnace gauges, dredger gauges, and pipe gauges); well-logging devices; medium and low-dose-range brachytherapy devices; and certain radiography devices. Staff also recommended inclusion in the NSTS of "sources below the Category 3 threshold, but greater than or equal to a 10^{th} of the Category 3 threshold," based on "…the nature of the sources at 1/10 of Category 3, their potential to aggregate to Category 2, and the costs to the licensed industry and the NRC." 71 *Federal Register* 19,749 (April 11, 2008). On June 30, 2009, by a 2-2 vote, NRC announced that the Commission "was unable to reach a decision on the staff's recommendation to issue a final rule expanding the number and type of radioactive sources" covered under the NSTS. Press Release 09-121 titled, *"NRC Commission Split 2-2 on Expansion of National Radioactive Source Tracking System,"* NRC, June 30, 2009.
HPS comments on Docket NRC-2008-0272, *"Limiting the Quantity of Byproduct Material in a General Licensed Device."* Their comments established the HPS position that all Category 3 sources and greater should be subject to a specific license.
GAO completed the following two audits of the security aspects of NRC's licensing process that raised concerns about the relative ease with which lower activity sources can be purchased and potentially aggregated to higher activity levels: (1) Testimony Before the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective,"* GAO Report 07-1038T, July 12, 2007, and (2) Report to the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials,"* GAO Report 08-598, June 2008.

The NRC's NSTS is a secure, web-based database designed to enhance the accountability of radioactive sources. The NSTS is designed to help the NRC and Agreement States track certain radioactive sources from the time they are manufactured or imported through the time of their disposal, decay, or exportation. The NSTS contains information on only approximately 81,000 Category 1 and 2 radioactive sources[41] possessed by NRC and Agreement State licensees. There are approximately 2 million Category 1 through 5 sources.[42] The NSTS captures approximately four percent of the total sealed sources licensed in the U.S. The NSTS contains a voluntary data field for licensees to identify sources that are in long-term storage including the date and reason. Due to the optional nature of the data field, however, not all licensees provide a response.

The GTRI/OSRP maintains a voluntary registry of sealed sources in support of source collection activities. However, the registry is not comprehensive as it does not include all sources and it does not distinguish between sources that are in use and disused.

The NSTS and GTRI/OSRP registries are limited and not intended to identify and track all sources that pose a threat to national security. A comprehensive, mandatory system is needed for tracking the number, type, location, and date last used of all such sealed sources.

Recommendations:

5. The NRC should expand the NSTS to track Category 3 sources.[43]

6. The NRC and Agreement States should enhance the NSTS to include as a required field the date last used of all sealed sources that pose a threat to national security.[44] These data should be validated during routine inspections.

OAS Petition for Rulemaking Regarding 10 CFR 31.5 and 31.6; Comment on Draft Proposed Rule 10 CFR Parts 30, 31, 32 and 150. The purpose of this petition is to strengthen the regulation of radioactive materials by requiring an SL for higher-activity devices that are currently available under the GL in 10 CFR 31.5.

[41] "Total number of Cat 1 and 2 sources in NSTS in 7/2013 – 81,078," Email from FSME/DMSSA, NRC, dated August 21, 2013.

[42] Report to the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, *"Nuclear Security: NRC and DHS Need to Take Additional Steps to Better Track and Detect Radioactive Materials,"* GAO Report 08-598, June 2008, page 1.

[43] The 2010 Task Force Report recognizes that Category 3 sources can be aggregated into a "risk significant quantity." 2010 Task Force, *2010 Task Force Report,* p. 9, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

In response to an inquiry regarding the total number of Category 3 GLs in the U.S., NRC staff responded as follows: "As of 2012, the NRC has 13 generally licensed Cat 3 licensees … We do not know the number in Agreement States since we do not track that information. Each State tracks their own info." In response to an inquiry regarding how many Category 3 sources are at 60% of the Category 3 limit for upper activity, NRC staff state as follows: "We do not have an answer to the second question as we are not tracking Category 3 sources." Email from FSME/Division of Waste Management and Environmental Protection (DWMEP)/Environmental Protection and Performance Assessment Directorate (EPPAD)/Low-Level Waste Branch, NRC, dated December 18, 2013.

[44] In its comments, the NRC stated: "The NSTS has the functionality to track sources in long-term storage. However, the field is not mandatory. To make it mandatory, we need to have a strong basis to require licensees to report that information as it adds to the reporting burden." Comments from FSME/DMSSA/Licensing Branch, NRC, December 4, 2013. The DSWG, however, has determined that the entry of this data as a required field would not constitute an undue burden.

Inadequate Financial Assurance Requirements

Issues and Findings:

The economics of sealed source possession do not motivate licensees to plan or budget for the management and disposal of sources they possess or plan to purchase. Although the NRC has established limited financial assurance regulations,[45] they do not apply to the vast majority of sealed source users since the regulations only apply to licensees who possess a very large quantity of radioactive material (greater than 100,000 curies). Current NRC financial assurance requirements for sealed sources—including those for Category 1 and 2 sources—do not reflect the full cost of packaging, transport, and disposal.

The 2006 Task Force Report recommended financial assurance for Category 1 and 2 sources.[46] The 2010 Task Force Report closed this recommendation by turning the issue over to NRC, which subsequently decided against revised financial assurance requirements.

Recommendation:

7. To encourage timely disposal, the NRC should develop robust financial assurance requirements for all licensees with sources that pose a threat to national security (Categories 1 through 3).[47] The financial assurance requirements should be adequate to cover the entire cost of packaging, transport, and disposal.

Inadequate Funding for Orphaned and Abandoned Source Disposition

Issues and Findings:

An issue that needs to be addressed is the funding required for the disposition of orphaned and abandoned sources, which can present a significant risk to national security as well as public health.[48] When orphaned and abandoned sources are found, the cost of dispositioning them often falls on the state or federal government. NRC has an orphaned and abandoned source funding agreement with the CRCPD, but it is limited in scope ($50,000 per year for five years).[49] The existing program is insufficient to address the orphaned and abandoned source disposition needs of the nation.[50]

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[45] NRC regulations on financial assurance are found in 10 CFR Part 30.35, *Financial Assurance and Recordkeeping for Decommissioning*. For example, $113,000 in financial surety is required for licensees that possess 100,000 Ci of Cs-137 or 10,000 Ci of Co-60 while disposal of these quantities may cost significantly more.

[46] Recommendation 9-2, 2006 Task Force, *2006 Task Force Report,* p. 27 and Summary Table of 2006 Recommendations and Actions and 2010 Recommendations, 2010 Task Force, *2010 Task Force Report*, p. 46, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

[47] Some NRC Agreement States, such as Illinois, require financial assurance for sources. Title 32: Energy Chapter ii: Emergency Management Agency Subchapter B: Radiation Protection Part 326: Financial Assurance Requirements.

[48] See "State and Federal Action is Needed for Better Control of Orphan Sources," HPS Position Statement, Adopted April 2002, at http://www.hps.org/documents/orphansourcesposition.pdf.

[49] *NRC Takes Action on Orphan Radioactive Sources,* News Release No. 99-128, NRC, June 21. 1999.

[50] As an example, the estimated cost to dispose at the Richland facility in Washington of a large radium source (approximately 1 Ci) that was recently found in Pennsylvania was $180,000.

Recommendation:

8. The existing NRC-CRCPD program should be adequately funded to address orphaned and abandoned sources throughout the U.S. Individual states should retain the ability to operate their own orphaned and abandoned source programs, such as is currently done in Texas.[51]

Extended Storage of Sources

Issues and Findings:

Many source users are choosing to store their disused sources indefinitely rather than pay for the cost of disposal. This is a concern because sources in long-term storage are more likely to be subject to loss of control and accountability.[52] The continued increase in the number of disused sources being stored rather than safely reused, recycled, or disposed presents a national security concern.

The main reasons for disused sources not being reused, recycled, or disposed in a timely manner are the cost of disposition and a lack of regulatory drivers to encourage disposition. The current system provides no incentives to remove sources from storage for reuse, recycling or disposal, nor does it provide any disincentives to storage.

Since 2008, the State of Oregon has imposed an annual possession fee on each source that a licensee possesses.[53] The annual fee is based on the license type, use, and the number of sources possessed. Such a fee can provide an economic incentive for users to dispose of sources in storage.

NRC and Agreement State regulators also lack adequate authority to require licensees to dispose of sources that have been stored for an extended period of time. Currently, the NRC and Agreement State regulations limit storage for two years only for GLs and in the case of licensee inactivity,[54] but enforcement of this requirement is less certain when licensees claim a potential future use of the source. Additionally, in the past it has been difficult to enforce license storage limits due to a lack of disposal access. This is no longer a constraint as disposal is now available for most sources throughout the U.S. However, the existing regulations do not provide adequate enforcement authority to prevent the indefinite storage of disused sources.

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[51] Title 2: Texas Health & Safety Code (HSC): Subtitle D, Nuclear and Radioactive Materials: Chapter 401, Radioactive Materials and Other Sources of Radiation: Subchapter H, Financial Provisions.

[52] The DSWG recognizes, however, that storage for decay may be an appropriate waste management method for some sources with a short half-life.

[53] Despite concerns about the imposition of such a fee, the State of Oregon has not experienced a significant reduction in its number of licensees.

[54] "Any person who acquires, receives, possesses, uses or transfers byproduct material in a [GL] device … [m]ay not hold devices that are not in use for longer than 2 years … Devices kept in standby for future use are excluded from the two-year time limit if the general licensee performs quarterly physical inventories of these devices while they are in standby." 10 CFR Part 31.5(c)(15). See also 10 CFR Part 30.36 regarding decommissioning requirements when "[n]o principal activities under the [specific] license have been conducted for a period of 24 months."

Recommendations:

9. To provide a financial incentive for disposal and increase awareness of sources in inventory and especially in storage, the NRC and Agreement States should require licensees to pay an annual fee for each source in its possession, similar to what Oregon now has in place.[55] The fee should be sufficient to provide licensees with an incentive to promptly dispose of disused sources rather than store them.

10. Now that disposal access is available for most sources in the U.S., the NRC and the Agreement States should expand and make enforceable the GL storage limit regulation to address all Category 1 through 3 sources in storage for more than two years unless the licensee can make a clear demonstration of future use. There should be clear regulatory authority to direct the disposition (reuse, recycle, or disposal) of Category 1 through 3 sources after they have been stored for two years. *This was a 2006 Task Force Action Item.*[56]

11. The NRC and Agreement States should incorporate procedures in their current inspection programs to review the status of Category 1 through 3 sources in storage—including consideration of the length of, reason for, and location of storage.[57]

Large Inventories Held by Manufacturers and Suppliers

Issues and Findings:

There is no regulatory requirement that sources be returned to manufacturers and suppliers once their useful life is over. However, at their discretion, source and device manufacturers and suppliers will often accept the return of a disused source if the user is purchasing a new replacement source from the same manufacturer or supplier. This practice—commonly referred to as a "one-for-one exchange"—is not required by federal or state regulations and is not an option when the user chooses not to purchase a replacement source from the manufacturer or supplier.

The DSWG believes that the return of sources to manufacturers and suppliers reduces the security threat because it results in fewer storage locations and increases the likelihood of beneficial reuse or recycle, thereby reducing the number of new sources that need to be manufactured. In addition, manufacturers and suppliers often have greater institutional knowledge of the product, more comprehensive oversight, and increased physical security in place. Nonetheless, the DSWG is concerned that some source and device manufacturers and suppliers are accumulating large numbers of disused sources in storage with little possibility of reuse or recycle and believes that additional regulatory oversight is needed to minimize manufacturers' and suppliers' inventories.

[55] Oregon Health Authority, Public Health Division, 333-103-0001-0050, Fees.
[56] Action 7-1, 2006 Task Force, *2006 Task Force Report,* p. 37.
[57] As recommended in Recommendation 6, 2010 Task Force, *2010 Task Force Report,* p. 38, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

Recommendation:

12. To prevent the accumulation of an excessive number of sources by manufacturers and suppliers, the NRC and Agreement States should require manufacturers and suppliers to dispose of those sources that have no reuse or recycle value on an annual basis.

Need for Greater Controls on Import of Foreign Disused Sources

Issues and Findings:

Adding to the inventory of sources that pose a risk to national security are those sources that are imported to the U.S. from foreign countries.

The NRC's 10 CFR 110.2 regulation, "Export and Import of Nuclear Equipment and Material," provides exemptions to the definition of radioactive waste allowing the import of disused sources without an import license.[58] Under Exemption 1, sources that are manufactured in the U.S. but used in a foreign country may be returned to the domestic manufacturer following their useful life. Under Exemption 6, sources may be imported from foreign countries by U.S. entities, such as manufacturers and distributors, solely for the purpose of recycling.

Interstate low-level radioactive waste compacts with commercial disposal sites (sited compacts) determine disposal access to the facilities located within their compact. Access policies with regard to imported sources vary between compacts. As a result, some of the sources that are authorized for import from foreign countries under the NRC's exemptions may not have commercial disposal access in the United States.

Recommendation:

13. The NRC should work with the sited compacts to ensure that the agency's actions do not create orphaned waste as a result of allowing the importation of sealed sources from foreign countries. In particular, the NRC should reconsider its policy of allowing sources used in foreign countries to be imported unless it is determined that the sources have a commercial disposition pathway. With regard to sources that are imported for recycle purposes, NRC should establish stringent, enforceable criteria as to what constitutes legitimate recycling, including assurances that most of the imported radioactive material in sources is actually recycled in a timely manner.

The Need for Timely Reuse, Recycle, or Disposal of Disused Sources

The long-term storage of disused sources poses a threat to national security because of the potential for loss of control and accountability. Additional actions need to be taken to encourage the prompt disposition of disused sources following their useful life. By creating a regulatory framework that promotes the reuse and recycle of disused sources, as well as encouraging

[58] 10 CFR Part 110.2.

advanced planning and budgeting for the high costs of disposal, regulators will effectively reduce long-term storage and promote prompt disposition of disused sources.

Some disused sources are still valuable resources. One user's disused sources may be usable by another, or the disused sources may contain valuable radioisotopes that can be used in the manufacture of new sources. The current regulatory system does not encourage (and at times hinders) the reutilization of disused sources. Programs that encourage reuse and recycle in other areas of commerce (e.g., tires, computers, and large appliances) could provide beneficial examples to address the responsible disposition of disused sources.

In most cases, if a disused source cannot be recycled or reused, then it should be promptly sent to a licensed disposal facility. The dynamics of disposal access have changed significantly over the past few years. When the DSWG was formed, 36 states did not have access for disposal of Class B and C sealed sources. In April 2012, the Texas Compact facility began operation. The Texas Low-Level Radioactive Waste Disposal Compact Commission (Texas Compact Commission) and the State of Texas now provide for the receipt of out-of-compact low-level radioactive waste, including sealed sources. In addition, the State of Utah approved a one-year variance that allows Energy*Solutions* to accept Class A sealed sources gathered by the SCATR program at the Clive, Utah facility through September 30, 2014. As a result of these developments, disposal options are currently available for most disused sources manufactured and used within the U.S. Unfortunately, however, in most cases disposal access has not translated into actual disposal.

The necessity of Type B shipping containers for the transportation of many higher activity sources has emerged as a significant impediment to the use of newly available disposal opportunities. Regulatory changes and shipping container certificate expirations have resulted in a shortage of these containers, significantly increased their costs, delayed disposal, and caused some sources to be stranded in place.

The DSWG also reviewed government-subsidized programs[59] aimed at fostering disposal of sources that may present a national security threat. Although these programs provided significant benefits in the past, they should be reevaluated due to the availability of additional disposal access and their potential to provide an unintended disincentive to prompt disposal by licensees. The DSWG offers recommendations for transition of these programs to improve the long-term management of disused sources and reduce the impact on taxpayers.

Lack of Opportunities for Reuse and Recycling

Issues and Findings:

In some cases, a source no longer needed by a licensee constitutes a valuable resource in that it may be usable by another licensee, or the radioisotopes within the source can be recycled in the

[59] The NRC has signed a Memorandum of Understanding (MOU) with DOE "Concerning Coordination Relating to Sealed Source Recovery." The MOU addresses NRC requests to recover sources under extraordinary circumstances, GTRI/Off-Site Source Recovery Program (OSRP) collection and recovery, NRC-funded CRCPD's orphan source project, and GTRI-funded CRCPD Source Collection and Threat Reduction (SCATR) project.

manufacture of a new source. This could extend the benefits derived from the radioisotopes contained within the disused source.

The current regulatory system, however, does not promote reuse and recycling. Many licensees are not familiar with reuse and recycling options and no financial incentives are offered. As a result, reuse and recycling are underutilized. Even if a licensee is interested in offering a source it no longer needs to another licensee for reuse, information is not readily available for licensees to know who may be in need of that type of source.

Recommendations:

14. A detailed study should be conducted—possibly by the EPA due to their long history of working with reuse and recycling of resources—to identify measures to promote opportunities for the reuse and recycling of sources.[60]

15. A secure "source exchange" program should be created and administered via an intermediary—possibly by the EPA due to their experience in exchange programs for other resources such as hazardous materials—to work with licensees, source and device manufacturers, and recyclers to provide them with information about sources still having a useful life, with the goal of increasing beneficial reuse and recycle opportunities.[61] The program could identify sources meeting the specific application requirements being sought for reuse or recycling, identify sources containing radioisotopes that can be removed and used to manufacture new sources, and assist with paperwork required for source transfer.

Licensees Are Not Taking Advantage of Disposal Opportunities

Issues and Findings:

Access for disposal of most disused sources has been available to states throughout the U.S. since early 2012. However, licensees have not been taking full advantage of the current opportunities to dispose of disused sources.[62] Most users of sealed sources are storing their sources rather than disposing of them—probably because of the high cost of packaging, transport, and disposal. Storage of so many disused sources presents a significant national security risk.

Now that disposal access is available for most sources, regulatory requirements need to be revised to provide the licensee with strong incentives to take prompt action once a source is no

[60] As recommended in Key Recommendation 7, 2010 Task Force, *2010 Task Force Report,* p. 38, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

[61] CRCPD currently offers limited assistance "in finding the most affordable, legal disposition for radioactive material through: adoption by an individual; reuse by a device manufacturer; reprocessing of the material; acceptance by Federal or State government …" Pamphlet titled, "CRCPD Assistance with Disposition of Unwanted Radioactive Material," CRCPD, Revised August 2010. The CRCPD is a non-profit organization of individuals that regulate and control the use of radioactive material and radiation sources. *For additional information on services offered by CRCPD, please go to www.crcpd.org.*

[62] For the first year of operation, the DSWG estimates that approximately 500 sources (excluding tritium exit signs) totaling less than 100 curies were disposed at the Waste Control Specialists LLC (WCS) facility.

longer needed. The prompt disposition of disused sources is a key action needed to reduce the national security risk from such sources. Two mechanisms that could provide motivations for disposition include robust financial assurance requirements and an annual source possession fee. *(For additional information, see Recommendations 7 and 9 above.)*

The NRC is currently finalizing revisions to the Branch Technical Position on Concentration Averaging and Encapsulation (CA BTP), which provides guidance for waste generators, processors, disposal facility operators and regulators in complying with 10 CFR Part 61 regulations as they apply to classification of waste for disposal.[63] In particular, the document outlines acceptable methods to determine radionuclide concentrations in specific waste streams or mixtures of these waste streams and how the concentrations can be averaged over the volume or mass of the waste disposal container.

The revised draft CA BTP increases the allowed concentration and activity for certain isotopes, including some that pose a significant national security risk. The NRC's analysis shows that a 130 curie (Ci) cesium-137 sealed source can be safely encapsulated and disposed in a Class C low-level radioactive waste disposal facility where currently the limit on such a source is 30 Ci. The revised draft CA BTP also includes an alternative approaches section that allows the waste generators and waste processors to work with Agreement State regulators in the states with commercial disposal facilities to consider site-specific and waste-specific information that would allow the acceptance of wastes that would not otherwise be acceptable. This may allow for the disposal of certain higher activity sealed sources that pose a national security threat.

Recommendations:

16. The NRC, Agreement States, and compact commissions should encourage licensees to take advantage of both the Texas Compact disposal facility and SCATR's efforts to collect Class A sources for disposal at Energy*Solutions'* Clive facility in Utah under the one-year exemption currently scheduled to end on September 30, 2014.

17. States that host Class B and C low-level radioactive waste disposal facilities should review their policies, waste acceptance criteria, and the alternate approaches methodology provided in the NRC's revised CA BTP to potentially allow disposal of higher activity sources.

18. The Texas Compact should continue to allow the disposal of sealed sources from outside the compact.

Recommendations 7, 8, 9, 10, 11, and 12 in this report have also been designed to improve the disposition of disused sources.

[63] The Branch Technical Position on Concentration Averaging and Encapsulation (CA BTP) provides guidance for classifying waste for disposal. NRC-2011-0022; 77 *Federal Register* 34,411 (June 11, 2012).

Limited Availability and High Cost of Type B Shipping Containers Impedes Prompt Disposal

Issues and Findings:

Many higher activity sources are required to be transported in Type B shipping containers. The NRC and U.S. Department of Transportation (DOT) are the primary agencies responsible for setting standards and certifying shipping containers and share responsibility based upon a Memorandum of Understanding (MOU).[64] In general, DOT regulations (49 CFR) are more encompassing. They cover all aspects of transportation, including packaging, shipper and carrier responsibilities, documentation, and all levels of radioactive material from exempt quantities to very high levels. The NRC regulations (10 CFR Part 71) are primarily concerned with packaging requirements for Type B packages and Type A fissile packages. Type B packages are subjected to a number of rigorous tests designed to demonstrate the package's ability to withstand transport accidents and must show that criticality safety, containment, and dose rates meet regulatory requirements before the NRC issues a Certificate of Compliance. The process for developing, testing, certifying, and manufacturing a Type B shipping container can take a number of years, and can cost $1 million or more.

In 2004, U.S. regulations concerning Type B package design and test standards were made mandatory for all packages transported into, out of, or through the U.S. to be consistent with the IAEA standards.[65] As a result of this rulemaking, specification packages (packages built to specifications and not subject to performance testing) were no longer authorized for use. In the past 20 years, DOT has discontinued approval for use of several Type B containers. These changes and the fact that a very small number of new packages have been developed have resulted in a shortage of Type B containers for the transport of high activity sources, such that the rental cost is now very high ($25,000 to over $100,000 per shipment).[66]

The NRC routinely notifies certificate holders prior to the expiration of a shipping container certificate. In at least one instance in 2013, the NRC issued an Information Notice (IN) to alert source users that a certification was going to expire.[67] The DSWG finds this broader notification to be beneficial in that it allows source users advanced notice of certificate expiration. Such notification would allow source users to take action to encourage the certificate holder to file for renewal or pursue renewal for their specific device for purposes of disposition.

Currently, Energy*Solutions* has three Type B containers for non-exclusive use and has four new Type B containers that are in fabrication. Waste Control Specialists LLC (WCS) is having three Type B containers developed. The new WCS containers are expected to be primarily used by

[64] Under the MOU, NRC is responsible for the design and testing of a Type B package and the U.S. Department of Transportation (DOT) is responsible for the hazard communication and radiation levels required during transport of the package. *For additional information on the MOU between NRC and DOT, see www.nrc.gov/about-nrc/regulatory/enforcement/moudot.pdf.*

[65] Packages that were grandfathered into the new regulations, including Type B ( )—called Type B "open parenthesis" packages—and DOT specification packages, were no longer authorized for use under the regulations after October 2008.

[66] This estimate is based upon communications with four industry stakeholders.

[67] See http://pbadupws.nrc.gov/docs/ML1312/ML13129A363.html.

utilities for waste other than sealed sources. As such, the new containers are not expected to resolve the current shortage of Type B containers for the shipment of high-activity disused sources. In addition, NNSA is designing, certifying, and manufacturing two new Type B containers for their own use. Once the new containers are certified, NNSA intends to make the certified designs available to others. However, this does not guarantee that the private sector will choose to manufacture additional Type B containers.

Internationally certified shipping containers (with a U.S. certificate of competent authority issued by DOT revalidating the international certification) may be authorized to be used for the import (to final destination) and export (from point of origin to port of exit) of sealed sources into and out of the U.S. in a single shipment. For example, a foreign source can be imported into a port in New Jersey and then shipped to Los Angeles in a container meeting IAEA standards and not reviewed for compliance with U.S. standards. However, such containers cannot be used to ship a source from New Jersey to Texas for disposal. It appears to the DSWG that if these containers meet international safety standards for the import and export of foreign sources, they should be suitable for transport of domestic sources.

The shortage and high costs of Type B shipping containers impede the prompt disposal of high activity disused sources.

Recommendations:

19. NNSA should identify several foreign package designs for Type B shipping containers that would have widespread applicability to a number of disused sources in the U.S. NNSA should submit applications to have these packages certified by the NRC for domestic use.

20. The NRC and Agreement States should develop a process that will provide licensees and Agreement States at least one year advance notice of container certificate expiration and should encourage licensees to reuse, recycle, or dispose of the affected sources before the certificate expires.

21. The NRC and DOT should continue to work together to increase the availability of Type B shipping containers by expediting the review and approval of new Type B NNSA package designs, NNSA applications for certification of foreign package designs, and packages developed by industry, as recommended in part in the 2010 Task Force Report, Recommendation 8.

22. The DOE should contract for a market study for Type B containers to determine their market demand. The purpose of the study would be to determine if there is sufficient profit potential for the private sector to produce additional containers.

Future Transition of Programs That Provide Unintended Disincentives for Disposal

Issues and Findings:

By focusing the majority of its efforts on sources that pose a threat to national security but at the time had no commercial disposal pathway, GTRI/OSRP has effectively reduced the threat posed by higher activity disused sources. There continues to be a need for the GTRI/OSRP program to use a portion of its resources for collection of orphaned and abandoned sources, GTCC sources, TRU sources, and other sources that do not meet the waste acceptance criteria of the commercial disposal facilities. However, with the opening of the Texas Compact facility, most domestic sources other than GTCC and TRU sources now have a disposal pathway to a licensed commercial disposal facility. Nonetheless, certain sources between 30 Ci and the Class C limit do not have a clear commercial disposal pathway and continue to be a significant concern.

The SCATR program has focused its efforts on lower activity sources that have a commercial disposal pathway. These sources generally do not pose a threat to national security unless a significant number of these sources are aggregated.

However, an unintended consequence of both the GTRI/OSRP and SCATR programs is that they may provide a disincentive for licensees to promptly reuse, recycle, or dispose of their disused sources. Licensees have gained the economic benefit of using the sealed sources, but through the SCATR and GTRI/OSRP programs they may not bear the full cost of disposal as these programs may subsidize the packaging, transport, and disposal of sources. This may result in several adverse consequences.

First, since the life-cycle cost of using sealed sources is being artificially lowered through government subsidies, licensees may be obtaining more sources than they otherwise would. Second, these programs provide an economic incentive for the licensee to store sources waiting for the next "roundup" program to avoid having to pay the full cost of packaging, transport and disposal of their disused sources.

Recommendations:

23. Congress should continue to fund NNSA activities for the collection of orphaned and abandoned sources and sources that do not meet the waste acceptance criteria of commercial disposal facilities. In providing these services, NNSA should ensure its actions continue to be in compliance with state and compact requirements.

24. NNSA should consider shifting a portion of the resources currently used for SCATR and GTRI/OSRP from the collection of non-orphaned or abandoned sources that have commercial disposal pathways to the creation of an outreach program to educate licensees on life-cycle obligations related to sealed sources *(see DSWG Recommendation 2)* including actively assisting licensees with identifying resources (e.g., brokers and processors) for packaging, transport, and disposal of disused sources.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

At the request of the U.S. Department of Energy (DOE) National Nuclear Security Administration/Global Threat Reduction Initiative (NNSA/GTRI), the Low-Level Radioactive Waste Forum (LLW Forum)—a national association of states, radioactive waste compacts, federal agencies, and industry representatives—formed the Disused Sources Working Group (DSWG or working group) in September 2011 to develop recommendations for improving the management of disused sealed sources that pose a threat to national security.

In the time since the working group began this study, additional disposal access has become available for most disused sources. However, the availability of increased disposal options has not resulted in a major increase in disposal activity. High costs of disposal and limitations regarding the cost and availability of Type B shipping containers often act as barriers to disposal, while the relative ease of long-term storage acts as a perverse incentive to hold onto sources. The current system promotes new source acquisition, further exacerbating the problem, and the existing regulatory framework is inadequate to protect national security.

A comprehensive approach is needed to address all stages in the life cycle of a sealed source. We cannot look just to licensing or disposal for solutions. All facets of the industry contribute in some way to the problems and they all should contribute to the solutions. There are roles for many stakeholders in the DSWG's recommendations.

A summary of the working group's findings and recommendations is presented below. It should be noted that a number of recommendations in this report have been previously recommended by the federal interagency Task Force on Radiation Source Protection and Security (Task Force), but not yet implemented.

Findings

The following is a summary of findings of the working group. *For further explanation of these findings, see the "Issues, Findings and Recommendations" chapter of this report.*

- The current sealed source management system presents multiple opportunities for the malicious use of sealed sources.
- Studies by the federal government have shown the potential for dramatic socio-economic impacts from a radiological dispersal device (RDD) or radiological exposure device (RED) event.
- Disused sealed sources are not being reused, recycled, or disposed in a timely way. Licensees are not taking full advantage of disposal opportunities and there is a lack of opportunities for reuse and recycling.

- Lack of awareness of the life-cycle costs of managing sealed sources, coupled with failure to reuse sealed sources in inventory and failure to consider alternative technologies, have contributed to the continued acquisition and accumulation of sealed sources.
- Regulatory controls to address the threat to national security are insufficient due to inadequate licensing requirements, inadequate financial assurance requirements, the lack of an adequate source tracking system, and the need for greater controls on import of foreign disused sources.
- Inadequate regulatory controls have resulted in extended storage of sources and large inventories being held by manufacturers, suppliers, and users.
- Limited availability and high cost of Type B shipping containers impedes prompt disposal.
- While government-funded source collection programs have been successful in disposing of a number of sealed sources, these programs now provide unintended disincentives for users to promptly dispose of disused sources.
- The long-term solution to the disused source problem is to hold the licensees who have purchased and obtained the economic benefit from the sources responsible for the proper reuse, recycling, or disposal of the sources when they become disused.

Recommendations

The following is a list of all of the recommendations of the working group that are contained in the *Issues, Findings and Recommendations* chapter of this report.

Failure to Reuse Sealed Sources in Inventory and to Consider Alternative Technologies

1. To promote the reuse of sources already in a user's inventory and to promote the use of other technologies as an alternative to the use of sealed sources:

    - the U.S. Nuclear Regulatory Commission (NRC) and Agreement States should encourage potential buyers of sealed sources that pose a threat to national security to reuse sources already in inventory;

    - the federal government should continue to develop and promote technologies as alternatives to the use of sealed sources that pose a threat to national security;[68] and

    - the federal government should develop incentives to encourage potential buyers of sealed sources that pose a threat to national security to consider the use of alternative technologies to serve the purpose of a new source.[69]

[68] As recommended in Key Recommendation 2, Radiation Source Protection and Security Task Force (Task Force), *2010 Radiation Source Protection and Security Task Force Report (Task Force Report),* p. v, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.
[69] *Ibid*.

Lack of Awareness of the Life-Cycle Costs of Managing Sealed Sources

2. Create a program, possibly through the Conference of Radiation Control Program Directors (CRCPD), to educate proposed buyers of sealed sources about the life-cycle costs of sealed sources, including information about the cost of storage, transportation, and disposal.[70] *(See also DSWG Recommendation 24.)* The NRC and Agreement States should require licensees to sign an acknowledgment that they have received and read the information prior to acquiring additional sources.

3. Federal research agencies should:

   - encourage grantors to give preference to applicants proposing to use sealed sources from their existing inventories or alternative technologies; and

   - require applicants to budget for the full life-cycle cost of use and disposition in grant applications.

Inadequate Licensing Requirements

4. The NRC should fully address the national security threat posed by sealed sources by amending its regulations to require a Specific License (SL) for all Category 3 sources.

Lack of an Adequate Source Tracking System

5. The NRC should expand the National Source Tracking System (NSTS) to track Category 3 sources.[71]

6. The NRC and Agreement States should enhance the NSTS to include as a required field the date last used of all sealed sources that pose a threat to national security.[72] These data should be validated during routine inspections.

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[70] Conference of Radiation Control Program Directors (CRCPD) programs currently offer assistance only after a source becomes unwanted or disused including "identify[ing] contacts at government agencies and commercial services for on-scene assistance with securing and assessing radioactive material," as well as "finding, and in some cases funding, an outlet for radioactive material or related equipment …" Pamphlet titled, "CRCPD Assistance with Disposition of Unwanted Radioactive Material," CRCPD, Revised August 2010. The CRCPD is a non-profit organization of individuals that regulate and control the use of radioactive material and radiation sources. *For additional information on services offered by CRCPD, please go to www.crcpd.org.*

[71] The 2010 Task Force Report recognizes that Category 3 sources can be aggregated into a "risk significant quantity." 2010 Task Force, *2010 Task Force Report,* p. 9, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

[72] In its comments, the U.S. Nuclear Regulatory Commission (NRC) stated: "The [National Source Tracking System] NSTS has the functionality to track sources in long-term storage. However, the field is not mandatory. To make it mandatory, we need to have a strong basis to require licensees to report that information as it adds to the reporting burden." Comments from Office of Federal and State Materials and Environmental Management Programs (FSME)/ Division of Materials Safety and State Agreements (DMSSA)/Licensing Branch, NRC,

Inadequate Financial Assurance Requirements

7. To encourage timely disposal, the NRC should develop robust financial assurance requirements for all licensees with sources that pose a threat to national security (Categories 1 through 3).[73] The financial assurance requirements should be adequate to cover the entire cost of packaging, transport, and disposal.

Inadequate Funding for Orphaned and Abandoned Source Disposition

8. The existing NRC-CRCPD program should be adequately funded to address orphaned and abandoned sources throughout the U.S. Individual states should retain the ability to operate their own orphaned and abandoned source programs, such as is currently done in Texas.[74]

Extended Storage of Sources

9. To provide a financial incentive for disposal and increase awareness of sources in inventory and especially in storage, the NRC and Agreement States should require licensees to pay an annual fee for each source in its possession, similar to what Oregon now has in place.[75] The fee should be sufficient to provide licensees with an incentive to promptly dispose of disused sources rather than store them.

10. Now that disposal access is available for most sources in the U.S., the NRC and the Agreement States should expand and make enforceable the General License (GL) storage limit regulation to address all Category 1 through 3 sources in storage for more than two years unless the licensee can make a clear demonstration of future use. There should be clear regulatory authority to direct the disposition (reuse, recycle, or disposal) of Category 1 through 3 sources after they have been stored for two years. *This was a 2006 Task Force Action Item.*[76]

11. The NRC and Agreement States should incorporate procedures in their current inspection programs to review the status of Category 1 through 3 sources in storage—including consideration of the length of, reason for, and location of storage.[77]

December 4, 2013. The Disused Sources Working Group (DSWG or working group), however, has determined that the entry of this data as a required field would not constitute an undue burden.

[73] Some NRC Agreement States, such as Illinois, require financial assurance for sources. Title 32: Energy Chapter ii: Emergency Management Agency Subchapter B: Radiation Protection Part 326: Financial Assurance Requirements.

[74] Title 2: Texas Health & Safety Code (HSC): Subtitle D, Nuclear and Radioactive Materials: Chapter 401, Radioactive Materials and Other Sources of Radiation: Subchapter H, Financial Provisions.

[75] Oregon Health Authority, Public Health Division, 333-103-0001-0050, Fees.

[76] Action 7-1, 2006 Task Force, *2006 Task Force Report,* p. 37.

[77] As recommended in Recommendation 6, 2010 Task Force, *2010 Task Force Report,* p. 38, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

Large Inventories Held by Manufacturers and Suppliers

12. To prevent the accumulation of an excessive number of sources by manufacturers and suppliers, the NRC and Agreement States should require manufacturers and suppliers to dispose of those sources that have no recycle or reuse value on an annual basis.

Need for Greater Controls on Import of Foreign Disused Sources

13. The NRC should work with the sited compacts to ensure that the agency's actions do not create orphaned waste as a result of allowing the importation of sealed sources from foreign countries. In particular, the NRC should reconsider its policy of allowing sources used in foreign countries to be imported unless it is determined that the sources have a commercial disposition pathway. With regard to sources that are imported for recycle purposes, NRC should establish stringent, enforceable criteria as to what constitutes legitimate recycling, including assurances that most of the imported radioactive material in sources is actually recycled in a timely manner.

Lack of Opportunities for Reuse and Recycling

14. A detailed study should be conducted—possibly by the U.S. Environmental Protection Agency (EPA) due to their long history of working with reuse and recycling of resources—to identify measures to promote opportunities for the reuse and recycling of sources.[78]

15. A secure "source exchange" program should be created and administered via an intermediary—possibly by the EPA due to their experience in exchange programs for other resources such as hazardous materials—to work with licensees, source and device manufacturers, and recyclers to provide them with information about sources still having a useful life, with the goal of increasing beneficial reuse and recycle opportunities.[79] The program could identify sources meeting the specific application requirements being sought for reuse or recycling, identify sources containing radioisotopes that can be removed and used to manufacture new sources, and assist with paperwork required for source transfer.

[78] As recommended in Key Recommendation 7, 2010 Task Force, *2010 Task Force Report,* p. 38, http://www.nrc.gov/security/byproduct/2010-task-force-report.pdf.

[79] CRCPD currently offers limited assistance "in finding the most affordable, legal disposition for radioactive material through: adoption by an individual; reuse by a device manufacturer; reprocessing of the material; acceptance by Federal or State government …" Pamphlet titled, "CRCPD Assistance with Disposition of Unwanted Radioactive Material," CRCPD, Revised August 2010. The CRCPD is a non-profit organization of individuals that regulate and control the use of radioactive material and radiation sources. *For additional information on services offered by CRCPD, please go to www.crcpd.org.*

Licensees Are Not Taking Advantage of Disposal Opportunities

16. The NRC, Agreement States, and compact commissions should encourage licensees to take advantage of both the Texas Low-Level Radioactive Waste Disposal Compact (Texas Compact) disposal facility and the Source Collection and Threat Reduction (SCATR) program's efforts to collect Class A sources for disposal at Energy*Solutions'* Clive facility in Utah under the one-year exemption currently scheduled to end on September 30, 2014.

17. States that host Class B and C low-level radioactive waste disposal facilities should review their policies, waste acceptance criteria, and the alternate approaches methodology provided in the NRC's revised Branch Technical Position on Concentration Averaging and Encapsulation (CA BTP) to potentially allow disposal of higher activity sources.

18. The Texas Compact should continue to allow the disposal of sealed sources from outside the compact.

Recommendations 7, 8, 9, 10, 11, and 12 in this report have also been designed to improve the disposition of disused sources.

Limited Availability and High Cost of Type B Shipping Containers Impedes Prompt Disposal

19. NNSA should identify several foreign package designs for Type B shipping containers that would have widespread applicability to a number of disused sources in the U.S. NNSA should submit applications to have these packages certified by the NRC for domestic use.

20. The NRC and Agreement States should develop a process that will provide licensees and Agreement States at least one year advance notice of container certificate expiration and should encourage licensees to reuse, recycle, or dispose of the affected sources before the certificate expires.

21. The NRC and U.S. Department of Transportation (DOT) should continue to work together to increase the availability of Type B shipping containers by expediting the review and approval of new Type B NNSA package designs, NNSA applications for certification of foreign package designs, and packages developed by industry, as recommended in part in the 2010 Radiation Source Protection and Security Task Force Report (Task Force Report), Recommendation 8.

22. The DOE should contract for a market study for Type B containers to determine their market demand. The purpose of the study would be to determine if there is sufficient profit potential for the private sector to produce additional containers.

Future Transition of Programs That Provide Unintended Disincentives for Disposal

23. Congress should continue to fund NNSA activities for the collection of orphaned and abandoned sources and sources that do not meet the waste acceptance criteria of commercial disposal facilities. In providing these services, NNSA should ensure its actions continue to be in compliance with state and compact requirements.

24. NNSA should consider shifting a portion of the resources currently used for SCATR and GTRI/Off-Site Source Recovery Project (OSRP) from the collection of non-orphaned or abandoned sources that have commercial disposal pathways to the creation of an outreach program to educate licensees on life-cycle obligations related to sealed sources *(see DSWG Recommendation 2)* including actively assisting licensees with identifying resources (e.g., brokers and processors) for packaging, transport, and disposal of disused sources.

ABBREVIATIONS, ACRONYMS, AND GLOSSARY OF TERMS

Abbreviations and Acronyms

Am—Americium
AEA—Atomic Energy Act
CA BTP—Branch Technical Position on Concentration Averaging and Encapsulation
Ci—Curie
CFR—Code of Federal Regulations
CRCPD—Conference of Radiation Control Program Directors
Cs—Cesium
CsCI—Cesium chloride
DHS—U.S. Department of Homeland Security
DMSSA—Division of Materials Safety and State Agreements
DoD—U.S. Department of Defense
DOE—U.S. Department of Energy
DOT—U.S. Department of Transportation
DSWG—Disused Sources Working Group
EPA—U.S. Environmental Protection Agency
EPAct—Energy Policy Act of 2005
FOIA/PA—Freedom of Information Act/Privacy Act
FR—Federal Register
FSME—Office of Federal and State Materials and Environmental Management Programs
GAO—Government Accountability Office
GL—General License
GTCC—Greater than Class C
GTRI—Global Threat Reduction Initiative
HPS—Health Physics Society
HSC—Health and Safety Code
IAEA—International Atomic Energy Agency
IN—Information Notice
ISSPA—International Source Suppliers and Producers Association
LANL—Los Alamos National Laboratory
LAS—Lost, Abandoned or Stolen
LLRW—Low-Level Radioactive Waste
LLRWPAA—Low-Level Radioactive Waste Policy Amendments Act of 1985
LLW Forum—Low-Level Radioactive Waste Forum
MOU—Memorandum of Understanding
NAS—National Academies of Sciences
NGCC—Nuclear Government Coordinating Council
NNSA—National Nuclear Security Administration
NRC—U.S. Nuclear Regulatory Commission

NRC-AS Working Group—U.S. Nuclear Regulatory Commission-Agreement State Working Group
NSCC—Nuclear Sector Coordinating Council
NSTS—National Source Tracking System
OAS—Organization of Agreement States
OSRP—Offsite Source Recovery Project
PRM—Petition for Rulemaking
RDD—Radiological Dispersal Device
RED—Radiological Exposure Device
SCATR—Source Collection and Threat Reduction Program
SL—Specific License
Task Force—Task Force on Radiation Source Protection and Security
Task Force Report—Task Force on Radiation Source Protection and Security Report
Texas Compact—Texas Low-Level Radioactive Waste Disposal Compact
Texas Compact Commission—Texas Low-Level Radioactive Waste Disposal Compact Commission
TRU—Transuranic Waste
Type B ( )—Type B "open parenthesis" package
U.S.—United States
U.S.C.—United States Code
WCS—Waste Control Specialists LLC

Glossary of Terms

Aggregation—Storage or co-location of two or more sources that when their activities are combined could potentially result in Category 1, 2, or 3 and pose a threat to national security.

Agreement State—A state that has signed an agreement with the NRC under which the state regulates the use of byproduct, source, and small quantities of special nuclear material within that state. There are currently 37 Agreement States.

Byproduct Material (AEA, Section 11e.(1))—Radioactive material (except special nuclear material and source material) yielded in or made radioactive by exposure to the radiation incidental to the process of producing or using special nuclear material.

Cask—A heavily shielded container used for the dry storage or shipment (or both) of radioactive materials such as spent nuclear fuel or other high-level radioactive waste. Casks are often made from lead, concrete, or steel. Casks must meet regulatory requirements and are not intended for long-term disposal in a repository.

Code of Conduct—The IAEA Code of Conduct prescribes an infrastructure in terms of legislative elements and regulatory programs to be developed and promulgated by regulatory agencies within all Member States, ranging from developing countries to those with mature programs. The Code is divided into 23 general principles, 13 principles for legislation and regulations, 36 principles that apply to the regulatory body, and 7 principles for the import and export of radioactive sources. All principles are directed toward ensuring that an adequate legislative program exists to support a regulatory program that ensures that sealed sources are managed and controlled in a manner to minimize the potential for unsafe management and malevolent use.

Compact—A group of two or more states that have enacted a legal agreement to work cooperatively to fulfill their responsibilities under the LLRWPAA.

Conference of Radiation Control Program Directors, Inc. (CRCPD)—A non-profit, non-governmental professional organization dedicated to radiation protection. CRCPD's mission is "to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education." CRCPD's primary goal is to assure that radiation exposure to individuals is kept to the lowest practical level, while not restricting its beneficial uses.

Curie (Ci)—One of three units used to measure the intensity of radioactivity in a sample of material. This value refers to the amount of ionizing radiation released when an element (such as uranium) spontaneously emits energy as a result of the radioactive decay (or disintegration) of an unstable atom. Radioactivity is also the term used to describe the rate at which radioactive material emits radiation, or how many atoms in the material decay (or disintegrate) in a given time period. As such, 1 Ci is equal to 37 billion (3.7 x 1010) disintegrations per second, so 1 Ci also equals 37 billion (3.7 x 1010) Bq. A curie is also a quantity of any radionuclide that decays

at a rate of 37 billion disintegrations per second—1 gram of radium (Ra-226), for example. The curie is named after Marie and Pierre Curie, who discovered radium in 1898.

Disposal—The emplacement of radioactive sources in an appropriate facility without the intention of retrieval.

Disposition—Includes the reuse, recycle or disposal of disused sources.

Disused Source—A radioactive source that is no longer used, and is not intended to be used, for the practice for which an authorization has been granted.

General License (GL)—A regulatory acknowledgement that grants authority to a person for certain activities involving byproduct material without filing an application for an SL. The general license allows the person to receive and use the source. Certain general licenses may require registration with the NRC or an Agreement State.

Global Threat Reduction Initiative (GTRI)—A division of NNSA whose mission is to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide. GTRI achieves its mission via three initiatives which provide a comprehensive approach to preventing terrorists' access to nuclear and radiological materials. As part of its mission, GTRI's Domestic Protect Program, works with U.S. partner sites like hospitals, universities and industry to provide voluntary security enhancements to prevent terrorists from acquiring in-use radiological materials. In addition GTRI works with U.S. partner sites that have radiological sources that are no longer being used and safely and securely recovers them. Taken together with NNSA's work to prevent proliferation and secure nuclear material, the Domestic Protect Program demonstrates GTRI's commitment to protecting the American people from nuclear and radiological terrorism. *For additional information, see http://nnsa.energy.gov/mediaroom/factsheets/gtri-protect.*

Greater than Class C Radioactive Waste (GTCC) —As defined in the LLRWPAA, low-level waste that exceeds the Class C limits in 10 CFR Part 61.55, "Waste Classification." This section classifies low-level radioactive waste as Classes A, B, or C, according to the concentration of specific short- and long-lived radionuclides. This section also sets varying requirements on waste forms for disposal. GTCC waste is generally unacceptable for near-surface disposal.

International Atomic Energy Agency (IAEA)—The center of worldwide cooperation in the nuclear field, through which member countries and multiple international partners work together to promote the safe, secure, and peaceful use of nuclear technologies. The United Nations established the IAEA in 1957 as "Atoms for Peace."

Licensee—A company, organization, institution, person, or other entity to which the NRC or an Agreement State has granted a GL or SL to construct or operate a nuclear facility, or to receive, possess, use, transfer, or dispose of source material, byproduct material, or special nuclear material.

Life-Cycle Cost—Sum of all recurring and non-recurring costs over the full life span, or a specified period, of a sealed source or device. This includes purchase price, installation cost, operating costs, maintenance and upgrade costs, residual value, and disposal costs at the end of ownership or its useful life.

Long-Term Storage—Storage with little or no limits on its duration. This type of disposition mechanism can be used while arrangements are made for final disposition because of a (1) lack of a final disposal option, (2) lack of available funds, (3) need for time to complete an amended or new authorization, or (4) need for time to establish a new disposition pathway. It can also be used while the availability of transportation to a new disposition location is pending. Long-term storage can be an effective mechanism to alleviate a health and safety concern or security risk posed by a source. However, long-term storage may not permanently alleviate the risk associated with the source.

Low-Level Radioactive Waste (LLRW)—Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material.

Low-Level Radioactive Waste Disposal—The emplacement of low-level radioactive waste in an appropriate licensed facility without the intention of retrieval.

National Nuclear Security Administration (NNSA)—A government agency that is responsible for the management and security of the nation's nuclear weapons, nuclear nonproliferation, and naval reactor programs. Program support is divided into several key program areas including Defense, Nuclear Nonproliferation, Naval Reactors, Emergency Operations, Infrastructure and Environment, Nuclear Security, Management and Administration and the Office of the Administrator. Each program area is focused on specific challenges. *For additional information, see http://nnsa.energy.gov/ourmission.*

National Source Tracking System (NSTS)—A secure, web-based data system that helps the NRC and its Agreement States to track and regulate the medical, industrial, and academic uses of certain nuclear materials, from the time they are manufactured or imported to the time of their disposal or exportation. This information enhances the ability of the NRC and Agreement States to conduct inspections and investigations, communicate information to other government agencies, and verify the ownership and use of nationally tracked sources.

Off-Site Source Recovery Project (OSRP)—A federal government activity sponsored by the NNSA/GTRI and that is managed at the LANL through the Nuclear Engineering & Nonproliferation Division. OSRP has an NNSA-sponsored mission to remove excess, unwanted, abandoned, or orphaned radioactive sealed sources that pose a potential risk to health, safety, and national security.

Organization of Agreement States (OAS)—A nonprofit, voluntary, scientific and professional society incorporated in the District of Columbia. The membership of OAS consists of state radiation control program directors and staff from the 37 Agreement States who are responsible for implementation of their respective Agreement State programs. The purpose of the OAS is to

provide a mechanism for these Agreement States to work with each other and with the NRC on regulatory issues associated with their respective agreements.

Orphaned Source—A radioactive source that is not under regulatory control, either because it has never been under regulatory control, or because it has been abandoned, lost, misplaced, stolen, or transferred without proper authorization.

Radioactivity—The process by which a nucleus of an unstable atom loses energy by emitting particles of ionizing radiation. A material that spontaneously emits this kind of radiation—which includes the emission of energetic alpha particles, beta particles, and gamma rays—is considered radioactive.

Radiological Dispersal Device (RDD)—The combination of radioactive material and the means (whether active or passive) to disperse that material with malicious intent without a nuclear explosion.

Radiological Exposure Device (RED)—An object used to maliciously expose people, equipment, and/or the environment to ionizing radiation without dispersal of radioactive material.

Recycle—To recondition and adapt to a new use or function.

Risk-Significant Quantity—Aggregated radioactive material that together meets or exceeds the Category 1 or 2 thresholds from the IAEA Code of Conduct.

Risk-Significant Source—Category 1 and 2 sources as defined in the IAEA Code of Conduct.

Sealed Source—A radioactive material or byproduct that is specifically manufactured or obtained for the purpose of using the emitted radiation. Such sources are commonly used in teletherapy or industrial radiography; in various types of industrial gauges, irradiators, and gamma knives; and as power sources for batteries (such as those used in spacecraft). These sources usually consist of a known quantity of radioactive material, which is encased in a man-made capsule, sealed between layers of non-radioactive material, or firmly bonded to a non-radioactive substrate to prevent radiation leakage.

Source Collection and Threat Reduction (SCATR) Program—A program begun by the CRCPD in 2006, based on funding from DOE. This program is designed to reduce the amount of unused radioactive material stored by radioactive material licensees. SCATR provides a financial incentive for licensees to remove unwanted radioactive material from long-term storage for proper disposal to reduce the threat of these sources being used for malicious intent.

Sources That Pose a Threat to National Security—A term used in this report to refer to Category 1, 2, and 3 sources as defined in the IAEA Code of Conduct. *(For additional information, see Appendix A.)*

Specific License (SL)—A regulatory document granted by an appropriate governmental body, allowing an entity to carry on some activities subject to regulation by the governmental body. The NRC issues licenses subject to Title 10 of the *Code of Federal Regulations* or an Agreement State issues a license under its equivalent regulations.

Storage—The holding of radioactive sources in a facility that provides for their containment with the intention of retrieval.

Transuranic Waste (TRU)—Artificially made, radioactive elements, such as neptunium, plutonium, americium, and others—that have atomic numbers higher than uranium in the periodic table of elements. TRU is primarily produced from recycling spent fuel or using plutonium to fabricate nuclear weapons and is contaminated with alpha emitting transuranic radionuclides possessing half-lives greater than 20 years and in concentrations greater than 100 nCi/g.

Type B Package—A package specifically designed and engineered to transport a higher activity of radioactive material. These packages must meet all Type A package requirements and successfully pass a series of sequential tests simulating worst-case accident conditions (e.g., free drop, puncture, thermal, and immersion).

Waste Classification (Classes of Waste)— A classification system developed by the NRC for low-level radioactive waste according to its radiological hazard. The classes include Class A, B, and C, with Class A being the least hazardous and accounting for 96 percent of low-level radioactive waste. As the waste classes and hazards increase to Class B and C, the regulations established by the NRC require progressively greater controls to protect the health and safety of the public and the environment.

APPENDIX A

Source Categories

The International Atomic Energy Agency (IAEA) has developed a ranking of radioactive sources according to their relative potential to cause immediate harmful health effects if not safely managed or securely protected.[80] Individual sealed sources are ranked from highest potential (Category 1) to lowest potential (Category 5).

Category 1
These sources could lead to the death or permanent injury of individuals who are in close proximity to the source for a short period of time (e.g., minutes to hours).

Examples: radioisotope thermoelectric generators, irradiators, teletherapy machines, and fixed multi-beam teletherapy machines.

Category 2
These sources could lead to the death or permanent injury of individuals who are in close proximity to the source for a longer period of time than Category 1 sources.

Examples: industrial gamma radiography equipment and high/medium close-rate brachytheraphy devices.

Category 3
These sources could lead to the permanent injury of individuals who are in close proximity to the source for a longer period of time than Category 2 sources. Sources in Category 3 could, but are unlikely to, lead to fatalities.

Examples: fixed industrial gauges (e.g., level gauges, dredger gauges, conveyor gauges, and spinning pipe gauges) and well logging gauges.

Category 4
These sources could lead to the temporary injury of individuals who may be in close proximity to the source for a longer period of time than Category 3 sources. Permanent injuries are unlikely.

Examples: low dose-rate brachytherapy sources, thickness gauges, portable gauges, and bone densitometers.

Category 5
These sources could, but are unlikely to, cause minor temporary injury of individuals.

Examples: x-ray fluorescence devices, static eliminators and electron capture devices.

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[80] The International Atomic Energy Agency (IAEA) Categorization of Radioactive Sources is found in Safety Guide No. RS-G-1.9 and can be found at http://www-pub.iaea.org/MTCD/publications/PDF/Pub1227_web.pdf. *For additional information, see http://www.iaea.org.*

APPENDIX B: LLW FORUM RESOLUTION

Re: Creation of a Formal Working Group on Disused Sources

Orange Beach, Alabama
March 25, 2011

As the Nuclear Government Coordinating Council (NGCC) and the Nuclear Sector Coordinating Council (NSCC) created in December 2008 the Removal and Disposition of Disused Sources Focus Group (the "focus group") with a mission to:

1. fully characterize the sealed source disposal challenge,
2. develop a consensus problem statement,
3. investigate and recommend immediate- and long-term options, and
4. recommend to the NSCC and NGCC a messaging strategy for communicating with the appropriate stakeholders to implement a solution;

As the focus group published two deliverables that incorporated the following recommendations:

1. support ongoing DOE efforts to develop a disposal capacity for GTCC LLRW,
2. concentration averaging of sealed sources for disposal at existing commercial facilities (including revisiting the Branch Technical Position),
3. case by case exemption by existing compacts for disposal of discrete numbers of high-risk sealed sources,
4. physical destruction of Class A sources for disposal as Class A LLRW, and
5. co-disposal of sources containing foreign-origin americium-241, plutonium-238 and plutonium-239 sources with sources containing domestic material (federal and state governments provide secure storage of sources so that sources can be recovered while simultaneously increasing efforts to investigate disposal options);

As, at the Fall 2010 meeting of the Low-Level Radioactive Waste Forum, Inc. ("LLW Forum") in Saratoga Springs, New York, officials from the National Nuclear Security Administration ("NNSA") requested that the LLW Forum create a formal working group to work with them and other interested stakeholders on a path forward;

As the LLW Forum thereafter created a Steering Committee to gather data and make a recommendation to the LLW Forum Board of Directors;

As the Steering Committee met with officials from NNSA, the U.S. Department of Energy ("DOE"), the U.S. Nuclear Regulatory Commission ("NRC") and the U.S. Department of Homeland Security ("DHS") in Washington, DC in mid-January to gather additional information, during which meeting Steering Committee members: 1) expressed concern that

front-end considerations (i.e., improved regulation, exploring potential options for recycle and reuse, examining existing and emerging processing technologies, etc.) need to be addressed in addition to focusing on the back-end (i.e., identifying potential disposition pathways); 2) emphasized that NNSA needs to consult and communicate more fully with the State of Texas regarding the potential disposition of unwanted sources at the planned federal facility in Andrews County, Texas; and 3) noted that addressing front-end issues first is crucial to any consideration by host states to potential exemptions for problem sources;

As the Steering Committee members unanimously voted to recommend that the LLW Forum's Board of Directors establish a formal working group to study the issue more fully and report back to the LLW Forum's Board of Directors and NNSA with their findings and recommendations, with the caveat that any such working group may not be able to identify ultimate disposal solutions, but rather may simply identify issues for further consideration and make recommendations for a path forward;

Now Wherefore Be it Resolved that, upon formal approval of grant funding from NNSA, the LLW Forum will create a working group, that will use a holistic approach that considers both the front-end and back-end, to study the issue of disused sources and report back to the LLW Forum's Board of Directors and NNSA with its findings including but not limited to potential action items and recommendations;

Now Wherefore Be it Further Resolved that the working group will be 100 percent funded by NNSA including, but not limited to, reimbursement for travel expenses for working group members and LLW Forum staff, hourly rate for LLW Forum staff time, and hourly rate for contract support such that no LLW Forum funds or resources will be expended on working group activities without the express authorization of the organization's Executive Committee;

Now Wherefore Be it Further Resolved that, although the working group may identify potential disposition options for disused sources, this is not the only goal, nor is it to be considered the measure of success; rather, the working group will seek to clarify the problem, explore challenges associated with management of sealed sources, and develop both front-end and back-end recommendations to address the issue;

Now Wherefore Be it Further Resolved that the following items constitute the preliminary work scope for the working group:

1. Compile information on those sources currently identified as being part of this problem including, but not limited to, the last state or compact in which the sources were put to practical use; LLRW or NARM; disposal pathway available; the waste class (A, B, C or GTCC); and for what purpose the sealed source was used.
2. Project anticipated future problem sources annually by quantity, radioactivity, waste type, origin and state or compact of last use, and other useful information.
3. Examine what can be done at the front-end to help ensure that organizations that manufacture and purchase/use sources have the means to properly manage/dispose of and/or safely store the sources once used.

4. Explore the ability to reuse/recycle sealed sources including, but not limited to, identifying existing and emerging technologies and limitations thereon.
5. Discuss potential contributions by unaffiliated states and interstate compacts that do not currently have disposal access including, but not limited to, willingness and interest in hosting a secured storage facility.
6. Consider potential disposition options.

Now Wherefore Be it Further Resolved that the working group will seek to complete its work and produce a final report in a 12- to 18-month time frame;

Now Wherefore Be it Further Resolved that the working group may seek input from other stakeholders including, but not limited to the NRC, DOE, NNSA, DHS, the Conference of Radiation Control Program Directors (CRCPD), International Association of Source Suppliers and Providers, brokers and processors, waste disposal facility operators, and generators and users of sealed sources ... although the LLW Forum's Board of Directors (state and compact officials designated by governors and LLRW compact commissions) will retain ultimate control over decision making and the final end-product; and

Now Wherefore Be it Further Resolved that the working group will produce a final report to be delivered to the LLW Forum's Board of Directors and NNSA that may include, among other things, a problem statement, explanation of issues, and recommendations for a path forward.

APPENDIX C: LIST OF DSWG MEETING DATES, LOCATIONS, AND STAKEHOLDER ATTENDANCE

Santa Fe, New Mexico
October 19, 2011

- Abigail Cuthbertson: Off-Site Source Recovery Project (OSRP), National Nuclear Security Administration/Global Threat Reduction Initiative (NNSA/GTRI), U.S. Department of Energy (DOE)
- Meaghan Jennison: NNSA/GTRI
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- John O'Donnell: Materials Licensing Division, U.S. Nuclear Regulatory Commission (NRC)
- Jennifer Opila: Department of Public Health and Environment (DPHE), State of Colorado, and Conference of Radiation Control Program Directors (CRCPD)

Austin, Texas
December 1-2, 2011

- Abigail Cuthbertson: NNSA/GTRI
- Richard Grondin: Perma-Fix Environmental Services, Inc.
- Meaghan Jennison: NNSA/GTRI
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- John Miller: International Isotopes
- Kate Roughan: QSA Global

Dallas, Texas
February 8-9, 2012

- Abigail Cuthbertson: NNSA/GTRI
- Earl Fordham: Department of Health Services (DHS), State of Washington
- John Hageman: Health Physics Society (HPS)
- Susan Jenkins: Department of Health & Environmental Control, State of South Carolina
- Meaghan Jennison: NNSA/GTRI
- James Kennedy: DWMEP/OFSMEMP, NRC

- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- Christianne Ridge: Division of Waste Management & Environmental Protection (DWMEP), Office of Federal & State Materials & Environmental Management Programs (OFSMEMP), NRC

Orlando, Florida

May 10-11, 2012

- David Allard: Bureau of Radiation Protection, Commonwealth of Pennsylvania
- Abigail Cuthbertson: NNSA/GTRI
- Meaghan Jennison: NNSA/GTRI
- Joseph Klinger: Division of Nuclear Safety, Emergency Management Agency, State of Illinois
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- Russ Meyers: CRCPD
- James Yusko: Bureau of Radiation Protection, Commonwealth of Pennsylvania and CRCPD

Washington, DC

July 17-18, 2012

- Curtis Anderson: NNSA/GTRI
- Reginald Augustus: DWMEP/OFSMEMP, NRC
- Frank Cocina: NNSA/GTRI
- Abigail Cuthbertson: NNSA/GTRI
- Adelaide Giantelli: NRC Representative to Radiation Source Protection & Security Task Force (Task Force)
- Maurice Heath: DWMEP/OFSMEMP, NRC
- Meaghan Jennison: NNSA/GTRI
- James Kennedy: DWMEP/OFSMEMP, NRC
- Kenneth Kline: DWMEP/OFSMEMP, NRC
- Dave Martin: Division of Planning and Analysis, Energetics Inc. (Consulting to NNSA/GTRI)
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- Christianne Ridge: DWMEP/OFSMEMP, NRC
- Jennifer Tobin: Office of International Programs, NRC
- Duncan White: Agreement State Programs Branch, Division of Materials Safety and State Agreements (DSMSSA), OFSMEMP, NRC

Salt Lake City, Utah
September 13-14, 2012

- Mike Ault: US Ecology
- Jeff Havlicak: Waste Control Specialists LLC (WCS)
- Craig Jones: Department of Environmental Quality (DEQ), State of Utah
- Tom Magette: Energy*Solutions*
- David Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Mary Shepherd: JL Shepherd & Associates
- Dan Shrum: Energy*Solutions*
- Temeka Taplin: NNSA/GTRI
- Joseph Weismann: US Ecology

Austin, Texas
November 28-29, 2012

- Abigail Cuthbertson: NNSA/GTRI
- Kayla Evans: Commission on Environmental Quality, State of Texas
- Ray Fleming: Department of State Health Services, State of Texas
- Charlie Gallagher, Gammatron, Inc.
- Richard Gallego: Thomas Grey & Associates, Inc.
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- John McCormick: Bionomics, Inc.
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- Sherrod Reavis, Waste Control Specialists LLC
- John Salsman: Texas A&M University

Austin, Texas
January 29-30, 2013

- *Disused Sources Working Group (DSWG) members only*

Charleston, South Carolina
March 26-27, 2013

- *DSWG members only*

Alexandria, Virginia and Washington, DC
May 15-17, 2013

- Frank Cocina: NNSA/GTRI
- Abigail Cuthbertson: NNSA/GTRI
- Meaghan Jennison: NNSA/GTRI
- Greg Komp: U.S. Department of Defense (DoD)
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- James Shaffner: DWMEP/OFSMEMP, NRC

Madison, Wisconsin
June 25-26, 2013

- *DSWG members only*

Portland, Oregon
August 27-28, 2013

- *DSWG members only*

Denver, Colorado
September 24-25, 2013

- *DSWG members only*

Park City, Utah
October 21, 2013

- Board of Directors, Low-Level Radioactive Waste Forum (LLW Forum)

Austin, Texas
November 19-20, 2013

- *DSWG members only*

Salt Lake City, Utah
December 10-11, 2013

- *DSWG members only*

Alexandria, Virginia and Washington, DC
January 14-16, 2014

- Rick Boyle: Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation (DOT)
- Frank Cocina: NNSA/GTRI
- Abigail Cuthbertson: NNSA/GTRI
- Theresa Kliczewski: Office of Environmental Management, U.S. Department of Energy (DOE)
- Dave Martin: Division of Planning and Analysis, Energetics Inc. *(consulting to NNSA/GTRI)*
- Larry McNamara: Oasis Services Inc. *(consulting to NNSA/GTRI)*
- Dan Schultheisz: Center for Waste Management and Regulation, Radiation Protection Division, U.S. Environmental Protection Agency (EPA)
- Temeka Taplin: NNSA/GTRI
- Mike Welling, Organization of Agreement States (OAS)
- Bernard White: Licensing Branch, Division of Spent Fuel Storage and Transport, Office of Nuclear Material Safety and Safeguards, NRC

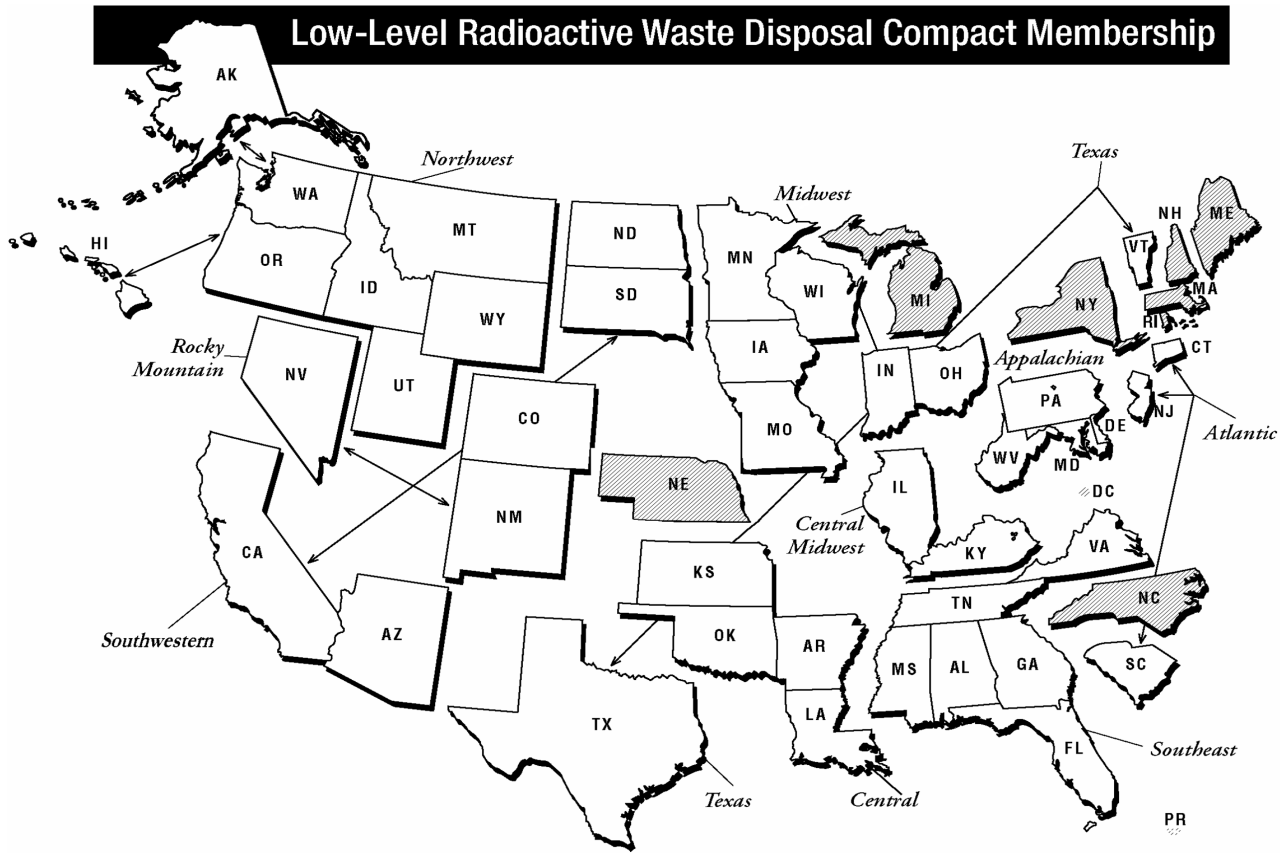
San Francisco, California
February 19-20, 2014

- *DSWG members only*

Austin, Texas
March 17-18, 2014

- LLW Forum meeting attendees

This paper was prepared by the Low-Level Radioactive Waste Forum's (LLW Forum's) Disused Sources Working Group (DSWG) at the behest of the National Nuclear Security Administration (NNSA)/Global Threat Reduction Initiative (GTRI). The opinions expressed in it are solely those of the DSWG and do not necessarily reflect the official policy or positions of any agency of the U.S. government, including NNSA/GTRI or the U.S. Department of Transportation (DOT) or the U.S. Nuclear Regulatory Commission (NRC), nor any organization with which the members of the DSWG are affiliated. NNSA/GTRI reviewed a draft of this paper for factual accuracy only.



Appalachian Compact
Delaware
Maryland
Pennsylvania
West Virginia

Atlantic Compact
Connecticut
New Jersey
South Carolina

Central Compact
Arkansas
Kansas
Louisiana
Oklahoma

Central Midwest Compact
Illinois
Kentucky

Northwest Compact
Alaska
Hawaii
Idaho
Montana
Oregon
Utah
Washington
Wyoming

Midwest Compact
Indiana
Iowa
Minnesota
Missouri
Ohio
Wisconsin

Rocky Mountain Compact
Colorado
Nevada
New Mexico

Northwest accepts Rocky Mountain waste as agreed between compacts

Southeast Compact
Alabama
Florida
Georgia
Mississippi
Tennessee
Virginia

Southwestern Compact
Arizona
California
North Dakota
South Dakota

Texas Compact
Texas
Vermont

Unaffiliated States
District of Columbia
Maine
Massachusetts
Michigan
Nebraska
New Hampshire
New York
North Carolina
Puerto Rico
Rhode Island