

August 14, 2014

The President
The White House
Washington, DC 20500

Dear Mr. President:

In accordance with Section 651(d) of the Energy Policy Act of 2005 (Public Law 109-58), I am providing the enclosed report documenting the efforts of the Radiation Source Protection and Security Task Force (Task Force). The Task Force is chaired by the U.S. Nuclear Regulatory Commission (NRC) and includes members from 14 Federal agencies and the Organization of Agreement States, which represents all State governments that regulate the use of radiation sources.

The Energy Policy Act charged the Task Force with 1) evaluating and providing recommendations relating to the security of radiation sources in the United States from potential terrorist threats, including acts of sabotage, theft, or diversion for use in a radiological dispersal device; and 2) providing, within one year of enactment of the Act and not less than every four years thereafter, reports to the President and Congress, with recommendations, including recommendations for appropriate regulatory and legislative changes.

On August 15, 2006, the Task Force submitted its first report. While the Task Force found no significant gaps that were not already being addressed, it did identify a number of near-term actions planned or underway to further strengthen regulatory controls and made several additional recommendations to enhance the overall security of risk-significant radioactive sources. On August 11, 2010, the Task Force submitted its second report, which provided an update on the progress made since the 2006 Task Force report and proposed additional recommendations for improving the security of risk-significant radioactive sources in the United States.

The 2014 Task Force report identifies important progress that continues to be made in fostering and tracking the completion and closeout of the remaining recommendations from previous Task Force reports. Eleven of the 2006 Task Force recommendations and actions and six of the 2010 recommendations have been completed and closed out over the last four years. This report describes the activities, accomplishments, and challenges related to securing Category 1 and 2 quantities of radioactive sources, the most risk-significant sources listed in the International Atomic Energy Agency's Code of Conduct (2004). Three new recommendations with regard to these risk-significant sources are introduced in the latest Task Force Report, including topics covering cybersecurity; disposition/disposal financial planning or other mechanisms; and the transition to effective alternative technologies.

Largely, the report reflects a consensus position from the Task Force. However, some Task Force member agencies differed on some limited text in the report, principally as a reflection of the variation in the missions of the agencies represented on the Task Force. The most notable difference is in the area of non-radioactive technologies as replacements for sealed sources. Several member agencies believe that public perception and cost represent the major challenges to a wider acceptance of alternative non-radioactive technologies. The NRC has concluded through its public policy-making process¹ that, in addition to the often higher cost of new technologies, the comparable efficacy of these replacement technologies has not yet been demonstrated. Regardless of this difference, all members support efforts to further reduce security risks by developing alternative technologies as replacements for, in particular, cesium chloride. The Task Force is confident that Chapter 3 of the report, "Progress in the Area of Alternative Technologies," provides a balanced discussion of this matter. The Task Force will continue to monitor developments and to address this important issue.

If you have any questions, please feel free to contact me. I may be reached by phone at (301) 415-1750.

Respectfully,

/RA/

Allison M. Macfarlane

Enclosure:
[Radiation Source Protection and
Security Task Force Report](#)

¹ See Chapter 3, page 49, for a discussion on the NRC's policy statement on protection of cesium-137 chloride sources.

Identical letter sent to:

The President
The White House
Washington, DC 20500

The Honorable Joseph R. Biden, Jr.
President of the United States Senate
Washington, DC 20510

The Honorable John Boehner
Speaker of the House of Representatives
Washington, DC 20515

The Honorable John Shimkus
Chairman, Subcommittee on Environment
and the Economy
Committee on Energy and Commerce
United States House of Representatives
Washington, DC 20515
cc: Representative Paul Tonko

The Honorable Barbara Boxer
Chairman, Committee on Environment
and Public Works
United States Senate
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cc: Senator David Vitter

The Honorable Fred Upton
Chairman, Committee on Energy
and Commerce
United States House of Representatives
Washington, DC 20515
cc: Representative Henry A. Waxman

The Honorable Ed Whitfield
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The Honorable Sheldon Whitehouse
Chairman, Subcommittee on Clean Air
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The Honorable Thomas R. Carper
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The Honorable Mike McCaul
Chairman, Committee on Homeland Security
United States House of Representatives
Washington, DC 20515
cc: Representative Bennie G. Thompson

The Honorable Mary L. Landrieu
Chairman, Committee on Energy
and Natural Resources
United States Senate
Washington, DC 20510
cc: Senator Lisa Murkowski

Report to the President
and the U.S. Congress
Under Public Law 109-58,
The Energy Policy Act of 2005

The 2014 Radiation Source Protection and Security Task Force Report



Submitted by:
The Chairman of the U.S.
Nuclear Regulatory Commission

On Behalf of:
Radiation Source Protection
and Security Task Force

Key Accomplishments, Challenges, and Recommendations

Established by the Energy Policy Act of 2005 (EPAAct) [EPAAct 2005], the Task Force on Radiation Source Protection and Security (Task Force) presented its initial report to the President and Congress in 2006 [NRC 2006]. The report detailed specific recommendations relating to the security of radioactive sources in the United States (U.S.) from potential terrorist threats, including acts of sabotage, theft, or use of a radiation source in a radiological dispersal device (RDD) or radioactive exposure device (RED). In 2010, the Task Force presented its second report to the President and Congress [NRC 2010b], noting many accomplishments achieved between 2006 and 2010, including the completion and closeout of a number of significant recommendations from the 2006 Task Force report. This third report to the President and Congress describes the activities and accomplishments of the Task Force since 2010, and follows the same general format as the 2010 Task Force report. As was the case with the previous reports, the scope of this report is limited to issues relating to the security of the Category 1 and 2 quantities of radioactive sources listed in the International Atomic Energy Agency (IAEA) Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct) [IAEA 2004], which are considered the most risk-significant and have been the focus of Federal and State efforts to place tighter controls for security. The report does not address issues relating to unsealed radioactive material, high-level radioactive waste, or spent nuclear fuel.

Key Accomplishments between 2010 - 2014

Since the 2010 Task Force report, a number of key accomplishments have been made in the area of radioactive source security:

- √ Expanded disposal capacity: The initiation of operations at the Waste Control Specialists commercial low-level radioactive waste (LLRW) disposal facility licensed by the State of Texas in 2012 has provided commercial disposal access to sealed source waste generators in the 36 States that had been without a commercial disposal pathway since 2008. Therefore, disposal options for many commercial Class A, B, and C sealed sources are now available to LLRW generators in all 50 States. Progress has been made in addressing ongoing challenges regarding the transportation of sealed sources that exceeds current commercial disposal activity limits. These efforts include public and private sector engagement on the revision of U.S. Nuclear Regulatory Commission (NRC) guidance regarding commercial disposal of sealed sources, development of new transportation containers to facilitate the recovery of high-activity sources and devices, and progress toward a final Environmental Impact Statement (EIS) for the disposal of greater-than-Class C (GTCC) LLRW.
- √ Increased physical protection: In March 2013, the NRC published a final rule in the *Federal Register* in which security requirements for the use and transport of Category 1 and 2 quantities of radioactive material were incorporated in a new Part of Title 10 of the

Code of Federal Regulations (10 CFR): 10 CFR Part 37, “Physical Protection of Byproduct Material” [NRC 2013f]. The rule sets revised requirements for: background investigations; access controls; security plans; immediate detection, assessment, and response to unauthorized access; tracking of shipments; security barriers; and other requirements. All NRC licensees subject to the rule were required to comply with the final rule by March 19, 2014, and the Agreement States¹ are required to adopt compatible requirements by March 19, 2016. Additionally, the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) continues to provide voluntary security enhancements and specialized training to holders of such sources through its Global Threat Reduction Initiative (GTRI) at sites that use Category 1 and 2 radioactive sources. Entities that participate in these programs must first meet all regulatory requirements. Both appropriate facility personnel and local law enforcement agencies are eligible for GTRI training programs.

- √ Enhanced tracking and accounting: In August 2012 and May 2013, the NRC deployed two key software systems, the Web-Based Licensing System (WBL) and the License Verification System (LVS), respectively. The WBL supports the entry of licensing information that enables the NRC and Agreement States to manage the licensing life cycle from initial application through license issuance, amendment, reporting, and termination. In addition to its use by the NRC, the WBL can be used as a licensing system by those Agreement States that choose to use it. The LVS is a web-based system designed to enable licensed users to electronically verify the validity of a license issued by the NRC or an Agreement State. Any licensee transferring Category 1 or 2 quantities of radioactive sources to another licensee, prior to conducting such transfer, must verify with the LVS or verify with the applicable regulatory agency that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred. The WBL and the LVS, along with the National Source Tracking System that was deployed in 2009, are the three key systems that make up the Integrated Source Management Portfolio, which support the Radioactive Materials Security Program and related radioactive materials licensing and tracking activities of the NRC.
- √ Increased preparedness and communication: Public education efforts and coordination amongst the Federal, State, and Tribal Government organizations in the area of radioactive source security made significant strides. For example, one of the seven projects within the Public Education Action Plan developed by the interagency Public Education Steering Committee for the 2010 Task Force report was completed in 2013 and can serve as a foundation for a guide for communicating with the public following RDD events. This would complete a triad of communications guides for radiological and

¹ Agreement States are those States that have entered into formal agreements with the NRC, pursuant to Section 274 of the Atomic Energy Act of 1954 (AEA) (Public Law 83 703), to regulate certain quantities of AEA material at facilities located within their borders. Under the Act, NRC relinquishes to the States portions of its regulatory authority to license and regulate byproduct materials (radioisotopes), source materials (uranium and thorium), and certain quantities of special nuclear materials. Currently, there are 37 Agreement States.

nuclear events: nuclear power plant accidents, improvised nuclear devices, and now the third, RDDs.

- √ Improved transportation security coordination: In 2014, a final draft of the Transport Security Memorandum of Understanding (MOU) between the NRC, the U.S. Department of Homeland Security, and the U.S. Department of Transportation, which serves as a foundation for cooperation in the establishment of a comprehensive and consistent transport security program for risk-significant sources, was completed and signature is expected in Calendar Year 2014. The MOU is aimed at ensuring that the transportation of radioactive sources in the U.S. and across U.S. borders is carried out in a manner that protects the public health and safety and does not impact the common defense and security of the U.S. The MOU addresses, among other things, issues relating to risk assessments, strategic planning, inspections and enforcement, technical support, coordination during an emergency response, information sharing, background investigations, and cooperative research programs.
- √ Heightened international activity and visibility: At the 2012 and 2014 Nuclear Security Summits, held in Seoul and The Hague, respectively, the security of radioactive sources received high-level attention. In particular, the U.S. sponsored a Joint Statement at the 2014 Summit that was signed by 22 other countries that expresses the countries' intent to secure Category 1 sources within their territories by 2016. In addition, the U.S. continued to support IAEA efforts to encourage nations to make a political commitment to work toward following the guidance in the Code of Conduct [IAEA 2004]. To date, 122 nations have made this political commitment, marking an increase of 22 nations since 2010. The U.S. also took an active role in assisting the IAEA with organizing the 2013 *International Conference on the Safety and Security of Radioactive Sources: Maintaining Continuous Control Throughout the Lifecycle* in Abu Dhabi, United Arab Emirates. Further, the U.S. was instrumental in periodically convening the 10-member *ad hoc* group of countries that are major suppliers of radioactive sources to continue a dialogue on ways to improve implementation of export controls for radioactive sources and develop best practices for the repatriation of legacy sources.

Key Challenges and Recommendations

In addition to the many accomplishments, the Task Force has identified the following three challenges that require additional attention and has developed the following recommendations to address them:

(1) Security and control of radioactive sources

Challenge: Cybersecurity is one of the most serious economic and security-related challenges facing the U.S. and the world today. Cybersecurity threats are becoming increasingly sophisticated, as evidenced by the number of attacks on industries and facilities each year. The NRC has used a risk-informed approach to assess cybersecurity vulnerabilities in its regulated community. In this approach, the NRC prioritized, by taking consequences into consideration, implementation of security assessments and has identified effective countermeasures and mitigation measures to protect specific targets or radioactive sources. With regard to Category 1 and 2 quantities of radioactive sources, current protective measures focus primarily on access control, detection, assessment, and response to unauthorized access events and work is ongoing to assess specific cybersecurity vulnerabilities. The cybersecurity landscape for

Category 1 and 2 radioactive source licensees varies greatly due to the diversity of operating environments. An NRC-led working group, including Agreement State representation, was formed in 2013 to examine the potential threats to information systems of Category 1 and 2 radioactive material licensees' facilities and control systems. To further address this challenge, the Task Force makes one new recommendation and is continuing its efforts on three previous recommendations.

New recommendation: The Task Force recommends that U.S. Government agencies assess the adequacy of and coordinate strategies for preventing and mitigating cybersecurity vulnerabilities related to Category 1 and 2 radioactive sources [2014 Recommendation 1].

Ongoing recommendations: The Task Force has made significant progress in the area of security and control of radioactive sources (see Chapter 1). It has completed 13 recommendations and actions and continues to work on recommendations that propose that (1) the U.S. Government agencies should reevaluate their protection and mitigation strategies to protect against significant RDD and RED attacks using both potential severe, immediate or short-term exposure and contamination consequences to public health, safety, and the environment as the consequences of concern [2010 Recommendation 2]; (2) a Transport Security MOU be developed to serve as the foundation for cooperation in the establishment of a comprehensive and consistent transport security program for risk-significant sources [2006 Recommendation 5-1]; and (3) the U.S. Government should encourage suppliers to provide arrangements for the return of disused sources and examine means to reduce regulatory impediments that currently make this option unavailable [2006 Action 10-2].

(2) Recovery and disposition of radioactive sealed sources

Challenge: Despite the development of new disposal capacity for radioactive sealed sources since 2010, challenges remain. Commercial disposal options are still unavailable for many Category 1 and 2 sources. In addition, the availability of certified Type B containers necessary for the transport of many of these disused sources is limited, and the design, testing, construction, and certification of new transportation containers is a lengthy and expensive process. Furthermore, LLRW generators currently lack significant incentive to dispose of sealed source waste rather than keeping the waste in storage. In addition, a disposal capability for GTCC LLRW still does not exist. DOE continues to work on a final EIS for the disposal of such waste. The Task Force makes one new recommendation and is continuing its efforts on four previous recommendations.

New recommendation: The Task Force recommends that the NRC evaluate the need for sealed source licensees to address the eventual disposition/disposal costs of Category 1 and 2 radioactive sources through source disposition/disposal financial planning or other mechanisms. Disposition costs should include the cost of packaging, transport, and disposal (when available) of these sources [2014 Recommendation 2].

Ongoing recommendations: The Task Force has made significant progress in the area of recovery and disposition of radioactive sealed sources (see Chapter 2). It has completed two recommendations and continues to work on recommendations and actions that propose that (1) the U.S. Government support short and long-term research and development of certified Type B containers for use in domestic and international source recovery efforts [2010 Recommendation 8]; (2) the U.S. Government and States continue to evaluate waste disposal options for disused radioactive sealed sources [2010 Recommendation 4]; (3) DOE continues its ongoing efforts to develop disposal capability for GTCC LLRW, subject to required Congressional action [2006

Action 9-1]; and (4) Federal and State Governments investigate options such as providing short-term secured storage of sources recovered from U.S. owners that contain foreign-origin americium-241 radioactive material so these sources can be recovered now and increase efforts to investigate options for disposal of these sources [2010 Recommendation 5].

(3) Alternative technologies

Challenge: While there have been advancements in the development and application of alternative technologies for several common sealed source devices since 2010, challenges in widespread application of alternative technologies remain. For example, blood irradiators using x-ray technologies instead of Category 1 and 2 radioactive sources are now commercially available in both domestic and international markets. Nonetheless, replacement of sealed sources with non-radioactive technologies continues on a case-by-case basis and the process is challenged by a lack of awareness by users, the often higher cost of new technologies and efficacy of replacement technologies. As efforts to develop and promote effective replacement technologies continue, Federal, State, and private sector organizations could play an important role in addressing the challenges that are hindering progress and setting an example for others to follow. With that in mind, the Task Force makes one new recommendation and is continuing its efforts on a previous recommendation.

New recommendation: The Task Force recommends that the U.S. Government, as appropriate,² investigate options such as voluntary, prioritized, incentivized, programs for the replacement of Category 1 and 2 radioactive sources with effective alternatives. The Task Force further recommends that U.S. Government agencies, where appropriate, lead by example in the consideration of and transition to alternative technologies that meet technical, operational, and cost requirements [2014 Recommendation 3].

Ongoing recommendation: The Task Force has made progress in the area of alternative technologies (see Chapter 3). It has completed two recommendations and continues to work on a recommendation that proposes that the U.S. Government enhances support for short-term and long-term research and development for alternative technologies [2010 Recommendation 9]. The Task Force's previous recommendations that focused on the replacement of cesium chloride (CsCl) radioactive sources with alternatives [2010 Recommendations 3, 10, and 11] are now considered complete with the publication of the "Policy Statement of the U.S. Nuclear Regulatory Commission on the Protection of Cesium-137 Chloride Sources" on July 25, 2011 (75 FR 44378) [NRC 2011a] that sets forth NRC's policy on the secure use of sealed sources containing CsCl. The Policy states that the NRC recognizes that near-term replacement of devices or CsCl sources in existing blood, research, and calibration irradiators is not practicable or necessary due to implementation of the additional security requirements and lack of a disposal capacity. In the event that changes in the threat environment necessitate regulatory action, the NRC, in partnership with the Agreement States, will be ready to issue additional security requirements to apply appropriate limitations for the use of CsCl, as necessary.

² NRC's statutory mandate precludes it from promoting one technology over another for non-safety or security reasons. The NRC would review in accordance with its procedures any new license application for new technologies.

The Task Force will continue to maintain and update an implementation plan for all of these recommendations and actions. The implementation plan was developed as a living document following the issuance of the first report. The implementation plan includes timelines for completion and tracks achievements towards completion of these activities. In its development of the first implementation plan update following the issuance of this report, the Task Force plans to outline its strategic plan to more effectively and efficiently track open recommendations and actions via other mechanisms. These other mechanisms, such as other routine interagency coordination groups or developments of agreements with applicable agencies that have the responsibility and authority to carry out the recommended initiatives, may better foster timely completion of some of the initiatives.

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Background

Sealed sources are used routinely for peaceful purposes in a wide variety of medical, industrial and research applications globally. Given the enduring threat of terrorists seeking radioactive sources for malicious purposes, the United States (U.S.) Government continues its efforts to enhance radioactive source protection and security. The ability of terrorists to carry out such an attack has been of particular concern because of the widespread availability of radioactive sources. The loss or theft of such materials could lead to their malicious use in a radiological dispersal device (RDD) or a radiation exposure device (RED).

The Energy Policy Act of 2005 (Public Law 109-58) [EPAAct 2005], hereafter called the EPAAct, established an interagency task force on radiation source protection and security (hereafter referred to as the “Task Force”) under the lead of the U.S. Nuclear Regulatory Commission (NRC) to evaluate and provide recommendations to the President and Congress relating to the security of radiation sources in the U.S. from potential terrorist threats, including acts of sabotage, theft, or use of a radiation source in an RDD or RED. The EPAAct named 12 Federal agencies to the Task Force and named the NRC Chairman (or designee) as its

chair. The NRC invited the U.S. Department of Health and Human Services and the Office of Science and Technology Policy to participate on the Task Force. A representative from the Organization of Agreement States³ was also asked to participate as a non-voting member. The EPAAct mandated that not later than 1 year after the date of the legislation’s enactment, and not less than once every 4 years thereafter, the Task Force shall submit to the President and

Members of the Task Force

- Chairman of the U.S. Nuclear Regulatory Commission (Chair)
- Secretary of Homeland Security
- Secretary of Defense
- Secretary of Energy
- Secretary of Transportation
- Attorney General
- Secretary of State
- Director of National Intelligence
- Director of the Central Intelligence Agency
- Administrator of the Federal Emergency Management Agency
- Director of the Federal Bureau of Investigation
- Administrator of the U.S. Environmental Protection Agency

Other Invited Agencies

- Department of Health and Human Services
- Office of Science and Technology Policy
- Organization of Agreement States (non-voting member)

³ Agreement States are those States that have entered into formal agreements with the NRC, pursuant to Section 274 of the Atomic Energy Act of 1954 (AEA) (Public Law 83 703), to regulate certain quantities of AEA material at facilities located within their borders. Under the Act, NRC relinquishes to the States portions of its regulatory authority to license and regulate byproduct materials (radioisotopes), source materials (uranium and thorium), and certain quantities of special nuclear materials. Currently, there are 37 Agreement States.

Congress a report providing recommendations, including possible regulatory and legislative changes, on several specific topics related to the protection and security of radiation sources.

The Task Force provided its first report to the President and Congress on August 15, 2006 (hereafter referred to as the “2006 Task Force report”) [NRC 2006]. The Task Force concluded in the 2006 Task Force report that there are no significant gaps in the area of radioactive source protection and security that are not already being addressed. However, it did identify areas that warranted focused attention. As a result, the Task Force proposed ten recommendations that would either require a policy, rule, or procedural change to implement, or require additional evaluation or study before a final recommendation could be made. The Task Force also identified 18 actions that did not rise to the level of recommendations because they were underway or planned in the near term, but that were important to track and complete.

Following the issuance of the 2006 Task Force report and in an effort to continue the cooperation and coordination among Federal and State partners, the Task Force met periodically to discuss topics of interest, receive updates on activities being conducted by member agencies, and obtain status reports on the implementation of the recommendations and the actions listed in the 2006 Task Force report. In addition, the Task Force formed specific subgroups to address a number of recommendations and actions outlined in the 2006 report, including five studies in the areas of public education, alternative technologies, financial assurance for disused sources, feasibility of phasing out cesium-137 chloride salt, and reevaluation of radionuclides and threshold levels warranting enhanced protection. These analyses were used to form the basis for many of the new recommendations and legislative changes proposed in the next quadrennial report to the President and Congress, which was published in 2010 (hereafter referred to as the “2010 Task Force report”) [NRC 2010b].

The 2006 Task Force report presented detailed background information providing the basis for efforts that were established to address and resolve the issues it raised. The 2010 Task Force report was developed to provide an update on the progress made since the 2006 Task Force report and to propose new recommendations, including possible legislative and regulatory changes, in an effort to continue to improve the security of radioactive sources in the U.S. Eleven new recommendations were proposed in the 2010 Task Force report. This 2014 Task Force report follows the same general format as the 2010 Task Force report, offering a concise summary of activities, accomplishments, and new recommendations since the Task Force began its activities. Similar to its process for developing the previous reports, the Task Force formed subgroups to evaluate progress made and to identify any new recommendations in each of the topic areas specified in the EPAct.

This 2014 Task Force report is divided into three main topical areas, which make up the report chapters: (1) advances in the security and control of radioactive sources, (2) status of the recovery and disposition of radioactive sealed sources, and (3) progress in the area of alternative technologies. Within each of the topical areas, accomplishments and/or challenges since 2010 are highlighted and a status of the recommendations and actions from the 2006 and 2010 Task Force reports for each of the ten topics identified in the EPAct are provided. Stakeholder interactions have played a key role in the Task Force’s analysis and development of certain recommendations and actions, and the report highlights them when applicable. Lastly, a summary table at the end of this report compiles the open and new recommendations and actions from all the Task Force reports. As the summary table indicates, 11 of the 2006 recommendations and actions and 6 of the 2010 recommendations have been completed these past 4 years. The Task Force intends to continue to meet to implement and

monitor the progress of the remaining recommendations and actions and to identify any additional gaps that may arise in the years to come.

Chapter 1

Advances in the Security and Control of Radioactive Sources

I. Coordination and Communication Improvements

Since 2006, coordination efforts among Federal agencies, State governments, and international partners have continued to improve in assessing security programs and making risk-significant radioactive sources⁴ more secure and less vulnerable for use by terrorists. A number of Federal and State agencies established forums or have bolstered their efforts in fostering communication and good working relationships on radioactive source security issues. The enhanced interagency relationships have allowed for the successful implementation of a number of activities.

Accomplishments

- √ The Task Force has been an important vehicle for advancing issues relating to the domestic security of radioactive sources from potential terrorist threats. Over the past 4 years, the Task Force has routinely met, at least twice a year, to monitor and discuss the progress made on the recommendations and actions presented in the 2006 and 2010 Task Force reports [NRC 2006, NRC 2010b].
- √ The Task Force continues to support progress and maintains awareness of developments in the area of public education, outreach, and communication initiatives related to radiation and other hazards. One significant achievement in this area is the completion of one of the seven projects within the Public Education Action Plan developed by the interagency Public Education Steering Committee for the 2010 Task Force report. It was completed in 2013 and can serve as a foundation for a guide for communicating with the public following radiological dispersal device (RDD) events. This would complete a triad of communication guides for radiological/nuclear events: nuclear power plant accidents, improvised nuclear devices, and now the third, RDDs. The purpose of this effort was to engage the public in a discussion of radiation and risk in the context of the U.S. Environmental Protection Agency (EPA) Protective Action Guides. The product of this effort is intended to increase readiness for the radiological terrorism threat and to reduce the impacts of an incident if one were to occur.

⁴ The Category 1 and 2 quantities of radioactive sources listed in the International Atomic Energy Agency (IAEA) Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct) [IAEA 2004] are considered the most risk-significant and have been the focus of Federal and State efforts to place tighter controls for security. Unless otherwise noted, throughout this report, the terms Category 1 and 2 sources refer to the 16 radionuclides listed in Table 1-1. Note that the table provides the associated Category 2 quantities for the radionuclides. The Category 1 quantities are 100 times the quantities listed in the table.

- √ The senior management of the “trilateral agencies” (U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Homeland Security (DHS), and the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA)), with additional support and participation from the Federal Bureau of Investigation (FBI), continue to meet periodically with the goal of enhancing coordination on overarching technical and policy issues related to source security.
- √ In cities and communities across the nation, U.S. Government agencies, Tribes, first responders, law enforcement personnel, and health agencies continue to coordinate and participate in exercises to test, evaluate, and improve their ability to investigate and respond to terrorist attacks, including those involving nuclear/radiological materials. Thousands of Federal, State, Tribal, territorial, and local responders engage in these types of exercises as part of a robust, full-scale, simulated response to a multifaceted threat. On a smaller scale, exercises at selected facilities, which are co-sponsored by the FBI and NNSA’s Global Threat Reduction Initiative (GTRI), provide no-fault, site-specific scenarios where senior managers from various Federal, State, and local organizations can practice their crisis and consequence management skills in response to a simulated terrorist incident.
- √ In coordination with the NRC and Agreement State regulatory bodies, the FBI has continued its visits across the Nation to certain possessors of Category 1 and 2 radioactive sources. These visits establish communications and give the FBI an understanding of the current security arrangements at licensee sites and how and when law enforcement should be engaged if there were to be a threat or event at these sites.
- √ Agencies have conducted public meetings and outreach efforts since 2006 on major topical areas addressed in this report, such as the Title 10 of the *Code of Federal Regulations* (CFR) Part 37 rulemaking and the Integrated Source Management Portfolio (ISMP).

Table 1-1: Radionuclides that Warrant Enhanced Security and Protection:

Radionuclide	IAEA Category 2 Threshold	
	(TBq)	(Ci)
Americium-241 (Am-241)	0.6	16
Am-241/Beryllium (Am/Be)	0.6	16
Californium-252 (Cf-252)	0.2	5
Curium-244 (Cm-244)	0.5	14
Cobalt-60 (Co-60)	0.3	8
Cesium-137 (Cs-137)	1.0	27
Gadolinium-153 (Gd-153)	10.0	270
Iridium-192 (Ir-192)	0.8	22
Promethium-147 (Pm-147)	400.0	11,000
Plutonium-238 (Pu-238)	0.6	16
Plutonium-239/Be (Pu/Be)	0.6	16
Radium-226 (Ra-226)	0.4	11
Selenium-75 (Se-75)	2.0	54
Strontium-90 (Yttrium-90) (Sr-90 (Y-90))	10.0	270
Thulium-170 (Tm-170)	200.0	5,400
Ytterbium-169 (Yb-169)	3.0	81

2006 Recommendation 4-2: The Task Force recommends that the Federal agencies and States continue efforts to improve coordination and communication of their ongoing activities in the area of radiation protection and security for Category 1 and 2 sources.

Status: Complete.

As stated above in the list of accomplishments, significant improvement in Federal, State, Tribal, and stakeholder communication and cooperation has been achieved. There are a number of groups that continue to meet and forums that are held in order to continue addressing policy and programmatic issues. Specifically, some of these groups and forums include:

- The Nuclear Government Coordinating Council and the Nuclear Sector Coordinating Council, established through the DHS under the auspices of the Critical Infrastructure Partnership Advisory Council, which provides a forum for Federal Government partners as well as public-private sector interactions on various issues, including those pertaining to sealed source security.
- The trilateral agencies which routinely meet to allow for senior management of respective agencies to discuss the status of their source security programs and high-level initiatives.
- The annual Organization of Agreement States (OAS) meeting which provides an opportunity to discuss topics that are of mutual interest to the Agreement States and the NRC, including programmatic issues related to source security.
- The Task Force continues to coordinate interagency issues and monitor other cooperative efforts, as previously mentioned. Specifically, as directed by the EPAct and its own charter, the Task Force is able to evaluate and provide recommendations on the security of

Category 1 and 2 radioactive sources from an overarching perspective, including manufacture, import/export use, transportation storage, and disposal. As a result, the Task Force is able to assess areas in which there may not be actions underway or programs in place that could benefit from further attention.

- The Federal Radiological Preparedness Coordinating Committee, an interagency body consisting of 20 departments and offices from various Federal agencies, meets regularly to develop and coordinate policy guidance for Federal radiological incident management activities. It also provides policy guidance for activities in support of State, Tribal, and local government radiological emergency planning and preparedness activities.
- The National Operations Center (NOC) provides real-time situational awareness and monitoring of the homeland, coordinates Federal incidents and response activities, and, in conjunction with the Office of Intelligence and Analysis, issues advisories and bulletins concerning threats to homeland security, as well as specific protective measures. The NOC – which operates 24 hours a day, 7 days a week, 365 days a year – coordinates information sharing to help deter, detect, and prevent terrorist acts and to manage domestic incidents.

In discussing communication and coordination efforts during this cycle of analysis, the Task Force focused on coordination specifically in relation to emergency response. As a way to improve upon communication amongst the Federal Government and State partners, the Task Force plans to utilize its current communication distribution method to inform and coordinate on emergency-response related events.

II. Reevaluation of Radioactive Source Lists

In the 2010 Task Force report, the Task Force reevaluated the list of sources and associated thresholds that are to be used by the U.S. Government as the appropriate framework for considering which sources warrant enhanced security and protection and concluded that no changes should be made to the list of existing 16 radionuclides and associated threshold quantities. For this 2014 Task Force report, the Task Force considered whether a full reevaluation was necessary based upon review of key factors such as: changes in the threat environment and gathered intelligence, changes in isotope production, changes in isotope usage, and changes in primary consequences of concern. Although the Task Force determined a full reevaluation was not necessary at this time, the Task Force formalized its review process by making changes to the Task Force and Radiation Sources Subgroup charters to document the above factors that will be considered for each subsequent reevaluation. Formalizing the reevaluation process for this and future work allowed the Task Force to close 2006 Recommendation 3-1, which recommended the periodic reassessment of the source list and threshold levels, as this requirement is now contained within, and directed by, the Task Force Charter.

Accomplishments

2006 Recommendation 3-1: The Task Force recommends that the U.S. Government periodically reevaluate the list of radioactive sources that warrant enhanced security and protection to assess their adequacy in light of the evolving threat environment [and consistent with current National consequences of concern in order to provide a consistent level of protection with other critical infrastructure].

Status: Complete; periodic reassessment of the source list and threshold levels will be directed by the Task Force, in accordance with the Task Force Charter.

In preparation for the 2014 Task Force report, the Task Force reviewed information from the intelligence community regarding the current threat of terrorist organizations using radioactive sources or other radioactive materials against the U.S., along with isotope production and usage information, in order to determine whether changes to the radioactive sources list or threshold levels were needed. Although the U.S. still faces a general, credible, threat of terrorism utilizing radioactive materials, the Task Force is not aware of any specific threat leveled against a specific target. In addition, the global use of radioactive sources has remained stable both in species and quantity such that the addition of novel radionuclides or changes in thresholds for the existing list is not justified at this time.

2010 Recommendation 1: The Task Force recommends that U.S. Government agencies use the radionuclides and the associated Category 2 threshold quantities in Table II, “Radionuclides that Warrant Enhanced Security and Protection” (as shown on page 11 of the 2010 Task Force report), as the appropriate framework for considering which sources warrant enhanced security* and that they adopt the definitions for a significant RED and a significant RDD (as shown on page 8 of the 2010 Task Force report) for prioritizing and allocating resources to eliminate, control, or mitigate risks of malevolent radiological incidents. *By warrants enhanced security and protection is meant enhanced in comparison to the security and protection applied to radioactive sealed sources before September 11, 2001.

Status: Complete; refer to Table 1-2 with respect to the individual agencies’ status in addressing the recommendation.

2010 Recommendation 2: The Task Force recommends that U.S. Government agencies should reevaluate their protection and mitigation strategies to protect against significant RED or RDD attack using both potential severe immediate or short-term exposure and contamination consequences to public health, safety, and the environment as the consequences of concern. Agencies should use the Task Force-endorsed definitions, radionuclides, and thresholds for a significant RED and RDD and the associated assumptions and parameters as common guidance in the assessment of risk and management of homeland security activities.

Status: Ongoing; refer to Table 1-2 with respect to the individual agencies’ status in addressing the recommendation.

For the 2010 Task Force report, the Task Force developed definitions of a “significant radiation exposure device (RED)” and “significant radiological dispersal device (RDD)” in order to better evaluate the source list and threshold levels consistently across U.S. agencies and carry out 2010 Recommendations 1 and 2. Each agency within the Task Force was then expected to determine how best to apply both recommendations to their respective missions. The results of this application to agencies with a specific mission or guidance are as follows:

Table 1-2: Applicable Agencies' Status in Addressing 2010 Recommendations 1 and 2

Agency/Office	2010 Recommendation 1	2010 Recommendation 2
NRC (and Agreement States that NRC has relinquished certain regulatory authority to)	<p>Complete - While the definitions of a significant RED and RDD are not used in NRC's regulatory framework, the Category 1 and 2 radionuclides and threshold quantities are used in:</p> <ul style="list-style-type: none"> • Security orders • 10 CFR Part 20 • 10 CFR Part 37 • 10 CFR Part 73 • 10 CFR Part 110 • NUREG-1556 and other guidance 	<p>Complete - The NRC reevaluated its protection and mitigation strategies. The NRC's Security Assessment decision-making framework designated prompt fatalities as the primary consequence of concern. Using land contamination or other economic consequences is a significant change in NRC's underpinning assumptions for safety and security. Accordingly, the agency has completed a preliminary study of potential vulnerabilities, actions, and impacts, and evaluated the results. It was concluded that the current protection and security framework and posture is also adequately protective against the consequences in the definitions adopted in 2010 Recommendation 1, based upon current available information.</p>
Department of State (DOS)	<p>Complete - In bilateral and multilateral forums, DOS urges countries to establish and maintain effective lifecycle controls for Category 1 and 2 radionuclides, consistent with the Code of Conduct [IAEA 2004].</p>	
DOE/Office of Environment, Health, Safety and Security	<p>Complete - The list of isotopes of greatest concern for potential use in an RDD or RED with associated threshold values, are utilized in the following DOE directives:</p> <ul style="list-style-type: none"> • DOE O 231.1B, Environment, Safety, and Health Reporting • DOE O 462, Import and Export of Category 1 and 2 Radioactive Sources Aggregated Quantities [DOE 2008b] • DOE 470 series (safeguards and security) <p>While the definitions of 'significant RDD' and 'significant RED' in the 2010 Task Force report are not</p>	<p>Ongoing - DOE's safeguards and security graded security protection policy framework designates prompt fatalities (lethality) as the primary consequence of concern. Using land contamination or other economic consequences for the DOE security policy framework would be a significant change for DOE's underlying assumptions and parameters for safeguards and security policy. DOE is reevaluating its current strategy for protecting against a 'significant RDD and RED' event, with consideration of a broad spectrum of controls and protection measures afforded radioactive materials.</p>

	specifically used within DOE directives, the agency would support, respond to, and participate in a National RDD or RED event, as appropriate.	
NNSA/GTRI	Complete - The list of radionuclides and associated Category 2 threshold quantities are used as a factor for considering which sources warrant enhanced security under NNSA/GTRI's voluntary security enhancement program. NNSA/GTRI also supports the definition of a 'significant RDD and RED' and encourages consideration of the significant economic consequences of an RDD.	Complete – NNSA/GTRI's voluntary security enhancement program mitigates the risk of a 'significant RDD or RED' by working with licensees to enhance their security posture beyond regulatory requirements. NNSA/GTRI does this by addressing the risk of an insider, by installing in-device delay kits that increase the amount of time needed to access the source, and by training alarm responders.
DHS/Domestic Nuclear Detection Office (DNDO)	Complete - The definitions and activity levels defined by the Task Force are used by DNDO to craft scenarios for operational models and risk analysis. They were used to specify threat objects used to build the U.S. Coast Guard Maritime Security Risk Analysis Model Radiological/Nuclear Enhancement module, and are also used in the standardization of threat objects for RDD activities for aviation pathways. Specifically, the definitions form the basis for the choice of RDD source activity level appropriate planning purposes.	
DHS/Infrastructure Protection	Complete – The radionuclides and associated threshold values are used to inform discussions, decision-making, and collaborations with the interagency DHS Nuclear Government Coordinating Council (NGCC) and DHS NGCC Radioisotope Subcouncil.	

FBI	Complete – As part of its Radiological Outreach Initiatives, the FBI utilizes the list of radionuclides and associated Category 2 threshold quantities of concern as one of the factors in determining which manufacturers, transporters, and licensed users of radionuclides should be prioritized for outreach to provide additional security awareness and establish lines of communication.	Complete – The FBI’s Radiological Outreach Initiatives were implemented with the goal of mitigating the risk of one of the radionuclides of concern being used as an RDD or RED in any type of malevolent incident. This is accomplished by providing security awareness briefings and material on both domestic and international threats and establishing local points of contact to ensure information is relayed to the affected FBI field office concerning any suspicious incidents.
EPA	Complete - While the definitions of ‘significant RDD’ and ‘significant RED’ in the 2010 Task Force report are not specifically used in EPA response policy, the agency would support, respond to, and participate in a National RDD or RED event, as appropriate.	

III. Security Measures and Initiatives

Radiological security efforts at the Federal and State Government levels have made significant progress in further enhancing the security of civilian Category 1 and 2 quantities of radioactive sources. The NRC continues to work with the Agreement States in regulating nearly 1,400 licensees that are authorized to possess at least Category 2 quantities of radioactive sources. The NRC and Agreement State regulators continue to routinely inspect licensees to ensure they are meeting security requirements that provide adequate protection against sabotage, theft, or diversion of these radioactive sources in the U.S. Today, these measures protect approximately 80,000 sources used in medical, commercial, and research activities. The NRC recently updated and expanded these security requirements, adding them to a new section of NRC regulations — 10 CFR Part 37, “Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material.”

The security requirements include:

- Background investigations and fingerprinting to ensure that people with access to radioactive materials are trustworthy and reliable;
- Controls on who can access areas where radioactive materials are stored or used;
- Security plans and procedures to monitor, detect, assess, and respond to unauthorized access attempts;
- Coordination and response planning between licensees and local law enforcement;
- Coordination and tracking of radioactive materials shipments; and
- Security barriers to discourage theft of portable devices.

NNSA/GTRI implements voluntary enhancements to augment the security posture of nuclear materials and radioactive sources beyond regulatory requirements. Licensees who meet NRC or Agreement State security requirements can voluntarily work with NNSA/GTRI to put additional security enhancements in place on a cost-share basis.

Accomplishments

- √ In 2010, the NRC initiated a security rulemaking to replace various security orders. In developing the proposed rule, the NRC considered the various security orders, lessons learned from implementation of the orders and inspection against the orders, recommendations from the NRC's Independent External Review Panel (IERP) and the Materials Program Working Group (MPWG), public comments on the proposed rule, and a petition for rulemaking filed by the State of Washington. The objective of the rule was to provide reasonable assurance of preventing theft or diversion of Category 1 and Category 2 quantities of radioactive sources. It also contains the security requirements for the transportation of small quantities of irradiated fuel (<100 grams). Conforming changes were made in other parts of the CFR as well. The final rule was published in the *Federal Register* on March 19, 2013 (78 FR 16922) [NRC 2013f]. The new 10 CFR Part 37 became effective on May 20, 2013; and NRC licensees had to comply with the requirements by March 19, 2014. Agreement States will have until March 19, 2016, to issue compatible requirements for their licensees. NRC published implementing guidance with the final rule [NRC 2013e].
- √ The 10 CFR Part 37 rule supersedes the Increased Controls, Fingerprinting orders [NRC 2005, NRC 2007a] and security orders (i.e., Irradiator, Manufacturing and Distribution, and Shipment of Radioactive Materials in Quantities of Concern) issued to NRC licensees. The NRC issued a letter to NRC licensees, dated April 10, 2014, rescinding these orders and the licenses that have license conditions to implement the orders will be amended through future license renewal or amendment processes. The NRC will rescind security orders issued to Agreement State licensees concurrent with the implementation of compatible Agreement State legally binding requirements. Additional information pertaining to these and other orders can be found at <http://www.nrc.gov/security/byproduct/orders.html> [NRC 2013g].

2006 Action 6-1: The NRC should expeditiously complete its implementation of the fingerprinting provisions of the EAct for those applicants for and licensees with Category 1 and 2 quantities of radioactive material. The NRC should place a high priority on completing the EAct Section 652 rulemaking. As part of the rulemaking, the NRC should require fingerprinting for any individual who could have access to Category 2 or above quantities of radioactive materials. The NRC should also require periodic reinvestigations of such persons.

Status: Complete.

The completion of 10 CFR Part 37 provides the fingerprinting requirements for Category 1 and 2 licensees. It requires that anyone with unescorted access to Category 1 or Category 2 quantities of radioactive sources undergo a background investigation that includes fingerprinting and a criminal history records check along with other elements. The background investigation must be complete before an individual may have unescorted access to the material. The initial background investigation must encompass at least the 7 years preceding the date of the

background investigation or since the individual's eighteenth birthday, whichever is shorter. The background investigation includes the following elements: fingerprinting and FBI criminal history records check; verification of true identity; verification of employment history; verification of education; and determination of character and reputation. A periodic re-investigation is required every 10 years and is limited to the fingerprints and an FBI identification verification and criminal history records check.

2006 Action 6-2: The NRC should evaluate the feasibility of establishing a national database for materials licensees that would contain information on pending applications and information on individuals cleared for unescorted access.

Status: Complete.

The NRC completed a two-part analysis to evaluate this recommendation. The analysis concluded that the first portion of the action related to pending applications was addressed by WBL, which was deployed by the NRC on August 31, 2012. WBL supports the entry of licensing information and license images that enables the NRC and Agreement States to manage the licensing life cycle from initial application through license issuance, amendment, reporting, and termination. WBL is used by the NRC and can be voluntarily used as a licensing system by any Agreement State. WBL provides a mechanism in which applicants for a license and authorized licensees can electronically apply for licenses, amend licenses, or track the status of their licensing actions.

The NRC conducted a feasibility assessment on the second portion of the action related to a system that would contain information on individuals cleared for unescorted access and determined that it is not feasible at this time to implement a National database for materials licensees that contains "information on individuals cleared for unescorted access." Staff involved in the development of the implementation guidance for the new 10 CFR Part 37 rulemaking conducted scoping activities with various interested industry groups to confirm that the development of such a database was not feasible at this time.

Overall, such a government-sponsored system that would contain information about individuals that is retrieved by the individual's name or other personal identifier (e.g., social security number) would be considered a Privacy Act system of records. Such a system would fall under this category due to the fact that the system would be at least searchable by individuals' names to determine their unescorted access privileges to Category 1 or Category 2 quantities of radioactive material. A significant challenge regarding developing such a system is that being a U.S. Government Privacy Act system of records there are requirements for protection of sensitive privacy information, which would defeat the purpose of such a system.

2014 Recommendation

2014 Recommendation 1: The Task Force recommends that U.S. Government agencies assess the adequacy of and coordinate strategies for preventing and mitigating cybersecurity vulnerabilities related to Category 1 and 2 radioactive sources.

Cybersecurity is one of the most serious economic and security-related challenges facing the U.S. and the world today. Cybersecurity threats are becoming increasingly sophisticated as evidenced by the increase in the number of attacks on industries and facilities each year. The increased access of the internet exposes vulnerabilities that allow adversaries to potentially

cause economic and physical harm to the U.S. As the nation increasingly relies on the internet to conduct business, ensuring the security of this component of the nation's critical infrastructure has become a very important issue for the Federal, State, and local Governments; Congress; and industry. On February 12, 2013, the President issued an Executive Order (EO) 13636, "Improving Critical Infrastructure Cybersecurity," and Presidential Policy Directive (PPD)-21, "Critical Infrastructure Security and Resilience," designed to enhance physical and cybersecurity and resilience for critical infrastructure.

Specifically, the EO directs improved cybersecurity information sharing between the Federal Government and the owners and operators of critical infrastructure – certain vital systems and assets to the U.S. – and the development by the Federal Government, in collaboration with critical infrastructure stakeholders, of a framework to reduce cyber risks to critical infrastructure. Under the PPD, the critical infrastructure-related functions, roles, and responsibilities across the Federal Government for implementing the EO are delineated. The PPD identifies 16 critical infrastructure sectors and designates "Sector-Specific Agencies" responsible for each sector.

- √ The NRC has used a risk-informed approach for assessing cybersecurity vulnerabilities of its regulated community. In this approach, the NRC prioritized, by taking consequences into consideration, implementation of security assessments and has identified effective countermeasures and mitigation measures to protect specific targets or materials. Specific to the nuclear materials sector and consistent with their risk significance, cybersecurity requirements have been in place for commercial reactors since 2009. Because cyber threats are dynamic and multidimensional due to the continuously evolving capabilities of potential adversaries and emerging technologies, the NRC continues to coordinate with Federal partners and international stakeholders on cybersecurity issues through a variety of technical meetings, working groups, workshops, and conferences. The NRC formed a cyber assessment team to provide a consistent process for evaluation and resolution of issues with cybersecurity-related implications for all NRC licensees. With regard to Category 1 and 2 quantities of radioactive sources, current protective measures focus primarily on access control, detection, assessment, and response to unauthorized access events and work is ongoing to assess specific cybersecurity vulnerabilities. The cybersecurity landscape for these licensees varies greatly due to diversity of operating environments. An NRC-led working group, including Agreement State membership, was formed in 2013 to examine the potential threats to information systems of Category 1 and 2 radioactive source licensees' facilities and control systems. The working group has developed a set of self-assessment tools to gather information from a sample group representing a variety of Category 1 and 2 radioactive source licensees. Cybersecurity assessments focus on the following areas:
 - Devices that use software-based control systems, such as irradiators and medical radiosurgery devices;
 - Access control, intrusion detection, and assessment systems that may allow an adversary to gain access to material and avoid detection; and
 - Computer systems that licensees use to track source inventories.

The overall goal of the working group is to assess potential vulnerabilities and identify the potential consequences that may occur from loss of control, or if the availability, integrity, or confidentiality of the data contained in the system were compromised.

The NRC will continue to coordinate this and similar NRC assessments with its Federal Government and State partners. The Task Force will leverage, as appropriate, and not be duplicative of the efforts of on-going Federal initiatives such as EO 13636 and PPD-21.

IV. Improvements to the Licensing Process

Since 2010, the NRC has worked with the Agreement States to ensure the continued implementation of actions to address identified vulnerabilities involving the licensing, possession, and use of radioactive materials. Vulnerabilities in the licensing process were initially identified in 2006-2007 when the U.S. Government Accountability Office (GAO) completed a covert operation, wherein GAO posed as a legitimate company and applied for and received an NRC materials license using falsified information [GAO 2007]. Following this event, the NRC undertook immediate corrective actions to address the vulnerabilities and developed a comprehensive action plan to address the recommendations made by GAO and the Permanent Subcommittee on Investigations regarding the needed changes in the process for issuing licenses for radioactive materials [NRC 2007b, NRC 2007c]. The NRC established three groups to assist in implementing the action plan and developing additional recommendations for improving the materials regulatory infrastructure: (1) the Pre-licensing Guidance Working Group (PLGWWG); (2) the IERP; and (3) the MPWG.

The PLGWWG concluded its effort in 2008 with the issuance of the revised pre-licensing guidance [NRC 2008c]. Efforts by NRC staff to ensure that the continued implementation of the revised pre-licensing guidance continues to provide a basis for confidence that radioactive materials will be used as intended and specified on the radioactive materials license. Agreement States must implement the essential objectives of the revised pre-licensing guidance. The performance of the Agreement States and NRC Regional offices is periodically evaluated using the Integrated Materials Performance Evaluation Program (IMPEP). Agreement State and NRC Regional office implementation of the pre-licensing guidance is reviewed during IMPEP.

The NRC has continued to make steady progress in addressing the recommendations of the IERP and MPWG. These recommendations included: eight recommendations made in March 2008 by the IERP regarding the licensing process and the need for security aspects to be further incorporated into NRC's radioactive materials program [NRC 2008b]; and several strategies identified in October 2008 by the MPWG to mitigate the identified security vulnerabilities [NRC 2008a].

Accomplishments

- √ Continued and ongoing implementation of the 2008 revised pre-licensing guidance by NRC and the Agreement States to: (1) provide a basis for confidence that radioactive materials will be used as intended and specified on the radioactive materials license; (2) perform site visits for "unknown" applicants and for all requests for authorization to possess Category 2 and above quantities of material; (3) investigate the legitimacy of all applicants through readily available means, such as internet searches and business

listings forwarding suspicious applications to the appropriate authority for follow-up; and (4) identify those licenses that require additional security requirements.

- √ The NRC developed and implemented the ISMP. The ISMP is a set of integrated information technology tools that supports the Radioactive Material Security Program and related radioactive materials licensing and source tracking activities of the NRC. The key systems that comprise the ISMP include the National Source Tracking System (NSTS), the WBL, and the License Verification System (LVS). Integrating these three systems provides the following benefits:
 - Making national radioactive source authorization, possession, and transaction information available, as appropriate, to other government agencies with a role in the protection of the Nation from nuclear and radiological threats.
 - Providing licensees with a secure automated means to verify license information and possession authorization prior to initiating radioactive source transfers.
 - Enabling users to monitor the location, possession, transfer, and disposal of their applicable Category 1 and 2 radioactive sources throughout the country. This information can also be utilized by NRC and Agreement State regulators to identify Category 1 and 2 radioactive sources possessed by licensees in their jurisdictions.
 - Improving source accountability and gives better information to decision-makers, and it will detect and alert regulators to tracking discrepancies.
 - Modernizing NRC licensing and inspection management and tracking systems.
- √ Based on a recommendation made by the IERP, in January 2012, the NRC completed actions to establish maximum possession limits on all licenses, with limited exceptions, that apply to short-lived unsealed radioactive materials used in diagnostic medicine. These possession limits serve several practical purposes with respect to the disposition of unwanted or unused radioactive sources and also help prevent unnecessary possession of radioactive sources that could lead to potential security vulnerabilities. The Agreement States were notified of the need to implement a policy for establishing maximum possession limits for radioactive materials on specific licenses. The implementation of this effort is being reviewed during the IMPEP reviews of the Agreement States and NRC Regions.
- √ In June 2010, the NRC began a significant effort to revise its licensing guidance contained in the NUREG-1556 series, "Consolidated Guidance About Materials Licensees" [NRC 2014a]. The 21-volume series of documents provides licensing guidance for applicants and license reviewers for various types of licensed activities (e.g., industrial radiography, well logging, manufacturers and distributors, service providers). Prior to the revision effort, a risk-informed analysis was performed to identify measures to improve the thoroughness and security of the licensing process. The revisions to the NUREG-1556 series of documents are being performed by a working group consisting of NRC and Agreement State representatives. Revisions are ongoing and scheduled to be completed in 2015.

- √ In 2012, the NRC revised its training course for license reviewers, “Licensing Practices and Procedures” (G-109), to include additional focus on the risk-informed aspects of licensing, more discussion of security as it relates to licensing, and additional practical training on the 2008 revised Pre-licensing Guidance.
- √ Revisions were made to the comprehensive training programs for NRC license reviewers and inspectors. Several IERP and MPWG recommendations involved the incorporation of security into the training requirements for NRC materials licensing and inspection staff. The revised NRC Inspection Manual Chapter 1248, “Formal Qualifications Program for Federal and State Materials and Environmental Management Programs” [NRC 2013b] and revised qualification journals for Materials Health Physics License Reviewers [NRC 2013c] and Materials Health Physics Inspectors [NRC 2013d] were published in April 2013. The revisions to the training programs incorporate security into the NRC’s licensing and inspection culture by providing training on the available tools for use by the NRC staff to make risk-informed inspection and licensing decisions that address security, as well as health and safety, and environmental protection. In addition, the revised qualification program requires that individuals with involvement in the materials security program must take focused training on the NRC’s security requirements or be able to demonstrate that they have the equivalent training or experience. To achieve qualification as an NRC license reviewer or inspector, individuals must demonstrate that they master the techniques and skills needed to collect, analyze, and integrate information using a safety and security focus to develop supportable regulatory conclusions. The revised qualification journals are a matter of compatibility for Agreement States and implementation of the revisions will be reviewed during IMPEP.

2006 Action 4-1: The NRC should consider imposing additional measures to verify the validity of licenses, before transfer of risk-significant radioactive sources, on all licensees authorized to possess Category 1 and 2 quantities of radioactive material.

Status: Complete.

In order to make requirements generally applicable to all licensees and allow for public participation, the NRC initiated a rulemaking in which security requirements for use of Category 1 and 2 quantities of radioactive material were incorporated in a new Part of the CFR: 10 CFR Part 37, “Physical Protection of Byproduct Material” [NRC 2013f]. All NRC licensees subject to the rule were required to comply with the final rule on March 19, 2014. The Agreement States have until March 19, 2016, to adopt compatible 10 CFR Part 37 requirements. Agreement States will accomplish this through the use of legally binding requirements, such as a regulation, order, law, or license condition imposed on the applicable licensees.

The license verification requirement in 10 CFR Part 37 addresses this action, (i.e., 10 CFR 37.71). Any licensee transferring Category 1 or 2 quantities of radioactive sources to an NRC or Agreement State licensee, prior to conducting such transfer, shall verify with the NRC’s LVS or the license issuing authority, that the transferee’s license authorizes the receipt of the type, form, and quantity of radioactive sources to be transferred. The LVS was deployed in May 2013 and is a part of the ISMP. The LVS is a web-based NRC system designed to enable users to verify electronically the validity of a license issued by the NRC or an Agreement State. If the

verification is conducted by contacting the license issuing authority rather than utilizing the LVS, the transferor shall document the verification. For transfers within the same organization, the licensee does not need to verify the transfer. Because Category 1 quantities of radioactive sources are of greater concern than Category 2 quantities, the transferor must also verify that the licensee is authorized to receive radioactive sources at the location requested for delivery for Category 1 quantities of radioactive sources.

V. Tracking of Sources

Since 2004, the NRC has maintained an interim inventory of nationally tracked radioactive sources, which was a voluntary annual accounting of licensees' Category 1 and 2 sources. The EPAct required establishment of the NSTS, which superseded the interim inventory. The NSTS was deployed for licensee and regulator use in January 2009. This computer system tracks the possession and transfers of Category 1 and 2 radioactive sources from the time they are manufactured or imported through the time of their disposal or export, or until they decay below Category 2 thresholds. The NSTS enhances the ability of the NRC and Agreement States to conduct inspections and investigations, determine which licensees and sources may be affected when responding to emergencies, communicate information to other government agencies, and verify legitimate possession and use of nationally tracked sources. The deployment of the NSTS is a major accomplishment in strengthening the accountability for Category 1 and 2 sources.

Licensees were required to report their initial inventories of Category 1 and 2 sources, as defined in Appendix E, "Nationally Tracked Source Thresholds," to 10 CFR Part 20, "Standards for Protection against Radiation," by January 31, 2009. The NRC's regulation in 10 CFR 20.2207, "Reports of Transactions Involving Nationally Tracked Sources," requires licensees to do the following:

- Report all related transactions (manufacture, transfer, receipt, disassembly, or disposal of Category 1 and 2 sources) to the NSTS by close of the next business day.
- Correct any error in previously filed reports or file a new report for any missed transaction within 5 business days.
- Annually verify the inventory in the NSTS and reconcile that information with their records.

Licensee compliance with the NSTS reporting requirements is verified by inspection.

Accomplishments

- √ The NRC has continued conducting extensive outreach with Agreement States and licensees to ensure adherence to reporting requirements. Outreach included speaking at industry meetings, conducting a customer satisfaction survey to assess improvement areas for future outreach activities, posting information to the NSTS website and blog, and developing and distributing a variety of NSTS informational materials.
- √ Licensees have reconciled their inventories with the NSTS five times since the deployment of NSTS.

- √ NSTS Version 2 was deployed in May 2011. Version 2 included functionality enhancements designed to broaden the system capabilities for all system users. Enhancements included event-triggered alerts, extended licensee functions, automated system interfaces, full reporting and query capabilities, and the ability to download data for other Federal agencies.
- √ In September 2011, the NRC reevaluated the NSTS security categorization and the electronic authentication risk assessment to determine if the Level 4 authentication assurance level first established for the system was still appropriate [NRC 2011b]. The Commission approved the staff recommendation to reduce the authentication assurance level of NSTS from Level 4 to Level 3 for all users [NRC 2011c]. Due to the implementation of physical security measures, the information in the NSTS was less sensitive than when the system was initially deployed. The NRC has implemented One Time Password (OTP) devices for Level 3 access to NSTS to replace the Level 4 smart card credentials. The implementation of OTP devices significantly reduced the certificate collection challenges experienced by some users and encourages licensees that currently use manual methods such as faxing/e-mailing to use the online system.
- √ In 2010, DOE initiated the reporting of Category 1 and 2 radioactive source transactions between DOE and the NRC and Agreement State licensees, exports, and imports to the NSTS. Annually, DOE has completed the verification and reconciliation of DOE inventory information in the NSTS. DOE policy (DOE Order 231.1B) [DOE 2011] was approved in 2011, which assigns roles and responsibilities for the reporting of certain Category 1 and 2 radioactive source information by DOE to the NSTS. DOE Order 231.1B replaced DOE Notice 234.1 [DOE 2008a]. Reporting and documenting Category 1 and 2 radioactive sealed source transactions between DOE and the NRC licensees or Agreement State licensees in the NSTS as transactions occur has strengthened the accountability for high-activity radioactive sources throughout each of the lifecycle stages – manufacture, shipment, receipt, disassembly, and end-of-life disposal.

2006 Action 11-2: The NRC should consider programming the NSTS to provide automatic daily information to [U.S.] Customs [and Border Protection] on import/export shipment notifications.

Status: Complete.

In 2011, staff reevaluated the NSTS security categorization and the electronic authentication risk assessment to determine if the Level 4 authentication assurance level was still appropriate. It was determined that import/export notifications would negatively impact the security and corresponding access level permitted for users of the system due to the sensitive nature of the shipment information, and therefore, the feature was not fully implemented in NSTS Version 2, which was deployed in May 2011. Instead, it was determined that DHS/U.S. Customs and Border Protection (CBP) may better meet their objectives and needs by accessing the WBL System when import/export licensing is included in WBL. WBL was deployed for use in August 2012; the import/export licensing is planned to be included in a future maintenance release of WBL. NRC plans to include input from DHS/CBP about its needs for accessing licensing information at a National level.

VI. Transportation Security

Since 2010, a number of initiatives have been completed or are well underway to improve the transport security of radioactive sources.

Accomplishments

2006 Recommendation 5-1: The Task Force recommends development of a Transport Security Memorandum of Understanding to serve as the foundation for cooperation in the establishment of a comprehensive and consistent transport security program for risk-significant sources.

Status: Ongoing.

The memorandum of understanding (MOU) for the secure transport of radioactive material was completed and signature is expected in Calendar Year 2014. The parties to the MOU are the NRC; U.S. Department of Transportation's (DOT) Pipeline Hazardous Materials Safety Administration, Federal Motor Carrier Safety Administration; Federal Aviation Administration; Federal Railroad Administration; DHS' Transportation Security Administration (TSA); U.S. Coast Guard; and CBP. The MOU's scope was expanded to include all radioactive materials that have applicable security requirements. The MOU includes the following 12 elements: Risk Assessments; Strategic Planning; Standards; Regulations, Guidelines, Advisories, Orders and Directives; Inspections and Enforcement; Technical Support; Sharing Information During an Emergency Response; Legislative Matters; Budget; Communication, Intelligence and Information Sharing; Background Investigations; and Cooperative Research Programs. The goal of this MOU is to ensure that the transportation of radioactive material in the U.S. and across U.S. borders is carried out in a secure manner that protects the public health and safety; and in a manner that does not impact the common defense and security of the U.S.

2006 Recommendation 5-2: The Task Force recommends that the U.S. Government evaluate the feasibility of using new and existing technologies to detect and discourage the theft of risk-significant radioactive material during transport. The evaluation should include the findings of operational testing of existing technologies offering enhanced security of motor carrier shipments of hazardous material; shipment tracking, including communication systems; radio-frequency identification; vehicle disabling technologies; and mobile and stationary radiation detection systems.

Status: Complete.

The Tracking of Radioactive Sources Focus Group completed a report on June 30, 2010, titled "Tracking of Radioactive Sources Focus Group White Paper" [TRSFG 2010]. The report provides the pros, cons, and availability of technologies that may be used for tracking conveyances, packages, or individual radioactive sources. Advances in technologies with respect to tracking of radioactive sources will continuously be monitored by DHS' Government Coordinating Council.

In October of 2010, DNDO completed a study that evaluated tracking Category 1 and 2 well-logging and radiography sources. The study contained Official-Use-Only information and was titled, "DNDO Feasibility Study of Electronically Tagging and Tracking Portable Radiation

Radiography and Oil Well Logging Sources, SAND2010-6905” [DHS 2010]. The study determined that due to many technological hurdles, tagging and tracking of the source was not feasible with then commercially available technology. Additionally, it was found the adversary could defeat any of the suggested solutions easily. DNDO continues to work with Federal, State, local, and Tribal stakeholders to develop and enhance mobile and stationary detection systems to detect and report on radiological and nuclear materials that are out of regulatory control.

In 2013, NNSA/GTRI began mobile source security projects, in partnership with key industry stakeholders, to enhance the security of the most common high-activity mobile sources in the U.S. NNSA/GTRI's early program focus was on the highest priority and highest activity sources in commercial or industrial uses, which are generally used in geographically fixed operations. In order to enhance the security of mobile sources in a holistic manner, NNSA/GTRI intends to address the security of the sources during all phases of transport and use including source distribution, source storage, source transport to job sites, and operational field use.

Although different, NNSA/GTRI's approach complements what DNDO studied in 2010. NNSA/GTRI's design focuses on tracking the device and detecting the source presence through integrated radiation detection. NNSA/GTRI's mobile source security projects are initially focused on the security of high-activity sources used in the oil field service industry for well-logging applications and certain radiography devices used in the nondestructive testing industry. The goals of these projects are to provide the mobile source users immediate notification of potential source loss or theft through the integration of tracking technologies with device tamper and radiation detection sensors on the source containers. Industry partners in the oil field service and radiography industries are engaged in the design effort and will assist the program in field testing and validation of prototype units. NNSA/GTRI expects to have detailed designs transferred to vendors for manufacturing and sale by mid-2015. NNSA/GTRI is also working closely with industry and professional organizations to promote the technologies and encourage the adoption of these tracking systems by mobile source users in these industries.

The systems developed for the well-logging industry and specific radiography devices have the potential for use in several additional source transport or mobile device security applications, which will be investigated after the successful validation of the initial mobile source security projects. In addition, NNSA/GTRI plans to work with mobile device manufacturers to incorporate these security technologies into future product designs, and with other domestic and international partners to expand and promote the use of these technologies in other industries both domestically and overseas.

2006 Recommendation 5-3: The Task Force recommends that the U.S. Government immediately develop a strategy and take actions to address the security of international shipments of Category 1 and 2 radioactive sources that transit or are transshipped through the land territory of the United States.

Status: Complete.

The Task Force conducted a series of meetings with CBP and TSA in 2013 to specifically address transshipment issues. The group was able to conclude from a comparison of CBP Category 1 and 2 quantities of radioactive material transshipment data to Category 1 and 2 quantity domestic, import, and export shipment data tracked in NSTS for a certain timeframe

that CBP is tracking all the Category 1 and 2 radioactive material transshipments. It was concluded that the majority of Category 2 shipments are shipments of Ir-192 sources. Assuming that all of the Ir-192 and Se-75 Category 2 shipments are being shipped by air because of their short half-life and that all of the other reported non-Ir-192 Category 2 shipments of Am-241, Am/Be, Co-60, and Cs-137 are shipped by air, then a very small percentage of these shipments are being shipped by non-air modes of transport and even a smaller amount of these are transshipments. Based on the results of the analysis that confirmed the accuracy of the transshipment data captured by CBP, and which also revealed that there are a small amount of transshipments that are being conducted, the group discussed whether or not it is necessary to pursue adding security measures on Category 1 and 2 transshipments. It was agreed that despite the fact that there appears to be visibility of the majority of these transshipments through voluntary reporting to the NRC (i.e., reporting of Category 1 shipments), the Task Force proposed further engagement with DOT and CBP to address possible implementation of security requirements, policies, or procedures regarding these types of shipments, such as adopting similar security requirements from the new 10 CFR Part 37 rulemaking into the revalidation certifications for Type B packages that may contain transshipped material. Some of these actions can be considered in the development of the applicable separate supplementary documents to the Secure Transport of Radioactive Material MOU.

2006 Action 5-1: The Transportation Security Subgroup should review the findings and conclusions of all research conducted on securing “high hazard” hazardous materials transport to determine if any of the measures should be applied to transport of risk-significant radioactive sources.

Status: Complete.

The completion of 10 CFR Part 37 provides security requirements for licensees who transport Category 1 and 2 sources. In developing these requirements, various transport requirements applicable to “high hazard” materials were considered. Guidance was also issued in support of the new regulation in February 2013 and is titled, “Implementation Guidance for 10 CFR Part 37, Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material, (NUREG-2155)” [NRC 2013e].

VII. Import and Export Controls

The U.S. Government continues to fulfill its G-8 Summit commitments and its political commitment to the IAEA Director General to act in accordance with the IAEA “Guidance on the Import and Export of Radioactive Sources” (Import/Export Guidance), issued March 2005 [IAEA 2005]. The U.S. Government was not only instrumental in developing the 2005 Import/Export Guidance, which represents the only international export control framework for radioactive sources, but also is a leader in encouraging its implementation globally. Promoting the successful implementation of the Import/Export Guidance is a U.S. priority because it provides the basis for improving the security of legitimate cross-border transfers of sources and preventing the diversion of materials potentially usable in an RDD.

Accomplishments

2006 Action 10-1: The U.S. Government should continue the efforts to promote international harmonization of import and export controls for Category 1 and 2 radioactive sources.

Status: Complete.

Since the 2010 Task Force report, the U.S. has continued to support IAEA efforts to strengthen and harmonize application of export controls for radioactive sources. Part of this effort was aimed at encouraging nations to make a political commitment to work towards following the IAEA Import/Export Guidance, a document that is supplementary to the Code of Conduct, published in 2005. To date, 89 nations have made a political commitment to follow the Import/Export Guidance and of these nations, 31 made this commitment since 2010.

In 2011-12, the U.S. took a major role in the IAEA process to review and revise the Import/Export Guidance document in order to update and clarify its provisions. In particular, the Annex of the Import/Export Guidance was rewritten to more adequately assess an importing State's ability to appropriately manage sources. The revised Import/Export Guidance was approved by the IAEA Board of Governors in 2012.

The U.S. supported IAEA efforts to develop a non-binding Code of Conduct for the transboundary movement of scrap metal and other products contaminated with radioactive material. This Code of Conduct would be aimed at preventing incidents of imported contaminated scrap metal and products - a problem that continues globally.

The U.S. was instrumental in convening the 10-member *ad hoc* Group of countries that are major suppliers of radioactive sources, to continue a dialogue on ways to improve harmonized implementation of the Import/Export Guidance so as not to undercut suppliers. The U.S. co-leads the drafting of the document entitled "Best Practices for the Import and Export of Radioactive Sources," that is currently being developed by the Group.

The Task Force agencies will continue to engage with the international community on harmonized application of import/export controls of Category 1 and 2 materials, as directed by the Task Force Charter.

2006 Action 10-2: The U.S. Government should encourage suppliers to provide arrangements for the return of disused sources and examine means to reduce regulatory impediments that currently make this option unavailable.

Status: Ongoing.

Since the 2010 Task Force report, some recent positive developments include:

- The U.S. took an active role in assisting the IAEA with organizing the *International Conference on the Safety and Security of Radioactive Sources: Maintaining Continuous Control Throughout the Lifecycle*, October 2013 in Abu Dhabi, United Arab Emirates. The U.S. was instrumental in developing one of the key findings of the Conference: that the IAEA should develop additional guidance at the international level which may be

supplementary to the Code of Conduct dedicated to end-of-life management of radioactive sources, including guidance on the return of disused sources;

- On August 28, 2013, the NRC published a “Branch Technical Position (BTP) on the Import of Non-U.S. Origin Radioactive Sources” (78 FR 53020) [NRC 2013a] to provide additional guidance on the application of a 2010 NRC rule on the export and import of radioactive sources. The BTP recognizes the difficulty importers may have in making a determination on the country of origin of a radioactive source and it provides greater flexibility for what is deemed to be of U.S.-origin for purposes of the exclusion to the definition of “radioactive waste” in the 2010 rule. As such, the BTP facilitates the return of sources to the U.S. under a general license and, in doing so, supports U.S. policy to prevent sources from being orphaned overseas where regulatory programs may not exist or function to an optimal level;
- The U.S. has continued to meet periodically with other major source exporting countries to discuss best practices associated with the repatriation of legacy sources without viable, commercially available reuse or recycle options;
- Canada’s Department of Foreign Affairs, Trade, and Development and the DOE are in discussions with the Brazilian National Nuclear Energy Commission to collaborate on a tripartite project to remove Canadian- and U.S.-origin disused high-activity sources from Brazil. It is contemplated that the U.S.-origin sources would be repatriated to the U.S. and the Canadian-origin sources would be shipped to another country for recycling;
- Under an MOU with the IAEA, France repatriated five French-origin sources from Madagascar, Costa Rica, Sudan, Lebanon, and Morocco. Projects are underway to repatriate two sources from Cameroon and five additional sources from Morocco;
- Russia changed its law to allow for the repatriation of disused Russian and Soviet-era sources pending the resolution of technical issues by the National Operator; and
- India successfully repatriated Indian-origin sources from Uruguay and Sri Lanka.

2006 Action 10-3: The Task Force suggests the use of education and the creation of incentives to discourage the export of used Category 1 and 2 radioactive sources as an alternative to disposal.

Status: Complete.

Updates to export control regulations for radioactive sources have allowed for considerable progress on this action by permitting the NRC and regulatory bodies in other countries greater ability to screen sources to ensure that they are not being exported abroad as an alternative to disposal. Specifically, under the NRC’s export licensing program, the importing country must consent to the import of a Category 1 source or device before shipment; pertinent documentation is required to be provided to the importer regarding the age and activity of the source; and the NRC regulations exclude disused sources that are being returned to an authorized entity from the regulatory definition of radioactive waste. This facilitates their return to the U.S. supplier at the end of their useful life (thereby reducing the probability of them being retransferred to another country as a means of disposal).

2010 Recommendation 3: Contingent upon the availability of alternative technologies, the Task Force recommends that the NRC evaluate whether the export licensing for Category 1 and 2 CsCl sources should be discontinued, taking the availability of disposal capacity and the threat environment into consideration.

Status: Complete.

The NRC issued the “Draft Policy Statement on the Protection of Cesium-137 Chloride Sources” and held a public meeting on November 8-9, 2010 [NRC 2010a], to solicit comments on it. The public meeting included technical sessions with panel presentations, followed by a facilitated discussion. The meeting was attended by the general public, users, representatives from health and industry associations, source and device manufacturers, alternate technology manufacturers (x-ray and Co-60), and Federal and State Government agencies.

The majority of the comments supported the draft Policy Statement. All of the written and oral comments were considered when finalizing the Policy Statement. None of the comments resulted in changes to the basic principles that are in the Policy Statement.

The Final Policy Statement was published in the *Federal Register* on July 25, 2011 (76 FR 44378) [NRC 2011a]. Specifically, with respect to regulatory actions, the Final Policy Statement indicates that the NRC monitors the threat environment and maintains awareness of international and domestic security efforts. In the event that changes in the threat environment necessitate regulatory action, the NRC, in partnership with the Agreement States, would issue additional security requirements, if necessary, to apply appropriate limitations for the use of CsCl in its current form. In addition, the NRC believes that, for the near term, it is more appropriate to focus on continued enforcement of the U.S. security requirements and to mitigate risk through cooperative efforts and voluntary initiatives of industries that currently manufacture and use CsCl sources.

Chapter 2

Status of the Recovery and Disposition of Radioactive Sealed Sources

I. Management and Disposal of Commercial Disused Sources⁵

Significant progress has been made to address the commercial sealed source management and disposal challenges identified in the 2006 and 2010 Task Force reports [NRC 2006, NRC 2010b]. Disposal options for many commercial Class A, B, and C⁶ sealed sources are now available to low-level radioactive waste (LLRW) generators in all 50 States, including the 36 States which had been without such an option when the 2010 Task Force report was published. Progress has also been made in addressing ongoing challenges regarding both the transportation and disposal of the highest activity sealed sources.

Despite this progress, challenges remain. Although disposal options for many sealed sources are now available, there are currently few incentives for generators to dispose of their disused sealed sources in a timely fashion. In addition, commercial disposal options are still unavailable for many Category 1 and 2 sources, and there remains a shortage of certified Type B shipping containers required for their transport. To address these challenges, the Task Force is making one new recommendation to encourage timely disposal of disused sources, and has identified additional initiatives that stakeholders can take to improve sealed source management and disposal.

A. Background

Sealed sources are used thousands of times each day in the U.S. in a wide variety of medical, industrial, and research applications. The service lives of the most commonly used sealed sources generally range between 10 and 30 years, after which a source becomes disused.⁷

⁵ A disused sealed source is defined as “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” [IAEA 2004, page 3]. To meet this definition, a licensee or owner for the sealed source must be clearly identifiable. Disused sealed sources should not be confused with abandoned or “orphan” sources, which are sources identified by regulatory or other authorities for which there is no determinable responsible party. The challenges with regard to orphan sources often overlap with, but are not identical to, the challenges (and solutions) addressed in most of this chapter.

⁶ Radioactive source categories defined by the IAEA Code of Conduct and NRC waste classes defined in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61 are not directly correlated. Explanations of the differences between IAEA categories and NRC waste classifications are detailed in the 2006 Task Force report.

⁷ While some disused sealed sources may have the potential for recycle (i.e., sold or transferred to a new licensee for continued use), the vast majority are either decayed below the point of utility or for other reasons are not amenable to further use. A sealed source may also become disused before the end of its service life, if the licensee determines not to use it further and does not sell or transfer it to another licensee.

The radioactivity of commonly used sealed sources ranges from microcuries (μCi) to kilocuries (kCi) for the largest sources used in industry and medicine.

When sealed sources reach the end of their service lives, many remain radioactive and of concern from the perspective of National security, public health, and safety. Thousands of sources become disused and unwanted every year in the U.S. and must be safely and securely stored pending final disposition. Category 1 and 2 quantities of radioactive sources, whether in use or in storage, are subject to security requirements. However, while secure storage is a temporary measure, the longer sources remain disused or unwanted, there is a higher probability that they will become unsecured or abandoned [NRC 2010b, GAO 2005].

The Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPA) [LLRWPA 1985] makes States responsible for the disposal of Class A, B, and C LLRW generated within States' borders (except for certain waste generated by the Federal Government).⁸ The LLRWPA further authorizes States to enter into Compacts for the establishment and operation of regional LLRW disposal facilities and authorizes Compacts to impose certain restrictions on disposal of LLRW generated outside the Compact region. Pursuant to the LLRWPA, the Federal Government is responsible for the disposal of greater-than-Class C (GTCC) LLRW generated by the U.S. Nuclear Regulatory Commission (NRC) and Agreement State licensees, including sealed sources classified as GTCC LLRW.⁹ The U.S. Department of Energy (DOE) is the agency responsible for GTCC LLRW disposal. Section 631 of the Energy Policy Act of 2005 (EPA) [EPA 2005] provides that before DOE can make a final decision on a disposal alternative(s) for GTCC LLRW, it must first submit a report to Congress describing the disposal alternatives under consideration and await Congressional action. The NRC or Agreement States are responsible for licensing and regulating the use of commercial radioactive material, including sealed sources, pending final disposition.¹⁰

⁸ The Low-Level Waste Policy Act of 1980 (P.L. 96-573), subsequently amended by the LLRWPA, first introduced the concept of LLRW State Compacts.

⁹ Pursuant to the LLRWPA, the Federal Government is also responsible for disposal of LLRW owned or generated by DOE, LLRW owned or generated by the U.S. Navy as a result of the decommissioning of vessels of the U.S. Navy, and LLRW owned or generated by the Federal Government as a result of any research, development, testing, or production of any atomic weapon. The Task Force did not consider challenges related to disposal of this Federal Government waste. The challenges discussed in this chapter relate to disposal of commercial Class A, B, C, and GTCC LLRW.

¹⁰ States may assume NRC regulatory authority under Section 274 of the Atomic Energy Act of 1954, as amended (AEA) [AEA 1954], which provides a statutory basis under which the NRC relinquishes to the States portions of its regulatory authority to license and regulate sealed sources and certain other materials. The mechanism for the transfer of NRC's authority to a State is an agreement signed by the Governor of the State and the Chairman of the Commission, in accordance with section 274b of the Act. States that develop and maintain such a regulatory program are called "Agreement States."

B. Progress in Commercial Sealed Source Management and Disposal Since 2010

As described in the 2010 Task Force report, commercial LLRW generators in 36 States were unable to dispose of any sealed sources following the July 2008 closure of the EnergySolutions Barnwell, South Carolina (“Barnwell”) disposal site to all but three States.¹¹ The lack of commercial sealed source disposal access has contributed to a substantial increase in the number of disused sealed sources in storage.¹² The 2010 Task Force report concluded that “[b]y far the most significant challenge [to sealed source security] identified is access to disposal for disused radioactive sources.” The report also identified the lack of sealed source disposal options as one of two major challenges that require attention at higher levels of government [NRC 2010b, page iii]. Since 2010, Federal, State, and LLRW Compact stakeholders have increased the number of LLRW generators with disposal options for commercial Class A, B, and C sealed sources, and have made progress toward increased disposal access for higher activity sources.

1. Generator Access to Class A, B, and C Commercial Sealed Source Disposal

In April 2012, Waste Control Specialists (WCS) began operations at its newly-licensed LLRW Compact Waste Facility in Andrews County, Texas. The primary purpose of the WCS facility is to serve commercial generators in States with membership in the Texas Low-Level Radioactive Waste Disposal Compact (Texas Compact), currently Texas and Vermont (party States). However, in accordance with Federal and State legislation, and rules approved in 2011 by the Texas Low-Level Radioactive Waste Compact Commission (Texas Commission), WCS may also accept waste from generators in States that are not members of the Texas Compact (non-party States). Each shipment of non-party waste to WCS must be approved by the Texas Commission prior to transport.

WCS license requirements establish a 30 Ci Class C limit for disposal of cesium-137 (Cs-137), one of the most common types of sealed sources used in industry and medicine, and particularly important from a risk-reduction perspective. In accordance with current NRC guidance on waste classification and other regulatory requirements, WCS also applies a 30 Ci

¹¹ EnergySolutions/Barnwell facility continued to serve the Atlantic Interstate Compact, comprised of Connecticut, New Jersey, and South Carolina. The U.S. Ecology site in Richland, Washington (“Richland”) continued to serve both the Northwest Interstate Compact (“Northwest Compact”), comprised of Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington, and Wyoming, and the Rocky Mountain Low-Level Radioactive Waste Compact (“Rocky Mountain Compact”), comprised of Colorado, Nevada, and New Mexico.

¹² The precise number of disused sealed sources in storage, either before or after 2008, is unknown because licensees that use sealed sources are not currently required to identify or report when their sealed sources have become disused.

Class C limit to other common sealed sources.¹³ None of the currently operating commercial disposal facilities in the U.S. accept sealed sources above the 30 Ci limit.

The licensing and development of the WCS facility is a significant achievement. It is the first LLRW Compact site to open since the Compact system was established in 1980, and the Texas decision to accept non-party waste provides a commercial disposal option for many sealed sources to generators in the 36 States, which had been without such an option since 2008. Table 2-1 summarizes the changes in commercial sealed source disposal access since the initial Task Force report was published in 2006.

In addition, the Texas Commission from the outset has recognized the importance of disused sealed source disposal for the protection of National security, public health, and safety. In 2011, the Texas Commission adopted administrative procedures to ensure that disused sealed sources from small generators (such as hospitals, universities, and industrial licensees, which generate the vast majority of disused sealed sources) are allocated disposal capacity within the annual non-party volume and curie limits set by Texas legislation.¹⁴

In its initial year of operations, the Texas Commission procedures to accommodate disposal of sealed sources proved to be important. The Texas Commission was able to accommodate all the requests for non-party sealed source disposal that would be deemed eligible. Even with the procedures adopted by the Texas Commission, the potential volume and curies represented by sealed source waste (relative to non-sealed source waste from large generators) are highly unlikely to have an impact on when WCS reaches its lifetime operational capacity limits.

¹³ The WCS facility license requires that LLRW be classified in accordance with NRC's 1995 "Final Branch Technical Position on Concentration Averaging and Encapsulation" [NRC 1995]. However, the WCS license also identifies specific limits for Cs-137 sources and several other common sealed source types.

¹⁴ In 2013, the annual non-party disposal capacity limit was set at 50,000 cubic feet and 100,000 Ci. In addition, non-party commercial waste disposed at WCS during its operational lifetime may not exceed 30 percent of its total licensed capacity, which currently stands at 2,310,000 cubic feet and 3,890,000 Ci of radioactivity.

Table 2-1: Commercial Sealed Source Disposal Options*: Timeframe and Activity Limits**

Years	Compact	# of States	Class C Limit*	Disposal Option
Pre-2008	Northwest and Rocky Mountain Compacts	11	30 Ci	Richland
	Atlantic Compact	3	10 Ci	Barnwell
	All Other States/Compacts	36	10 Ci	Barnwell
2008-2012	Northwest and Rocky Mountain Compacts	11	30 Ci	Richland
	Atlantic Compact	3	10 Ci	Barnwell
	All other States/Compacts	36	No Disposal Options	
2012-Present	Northwest and Rocky Mountain Compacts	11	30 Ci	Richland
	Atlantic Compact	3	10 Ci/30 Ci	Barnwell/WCS**
	Texas Compact and all other States/Compacts***	36	30 Ci	WCS

* The cited Class C limits are for Cs-137. Significant limits are often applied to other commonly used sealed sources, including cobalt-60 (Co-60), another risk-significant sealed source type.
** Atlantic Compact generators may dispose of Cs-137 and other common sources up to 10 Ci at the Barnwell facility; these generators may dispose of Cs-137 between 10 Ci and 30 Ci at WCS.
*** **Commercial disposal options for sealed sources above 30 Ci remain unavailable.**

An additional disposal option for certain commercial Class A sealed sources was made available for 1 year at the EnergySolutions LLRW disposal facility located near Clive, Utah (“Clive”) beginning in 2013. This effort was originally initiated in 2011 before WCS became operational and was specifically intended to address the National security, public health, and safety concerns surrounding the number of sealed sources in storage since 2008. The Clive facility historically had been prohibited from accepting sealed sources due to site characteristics that had since changed. Upon the request of the DOE/National Nuclear Security Administration’s Global Threat Reduction Initiative (NNSA/GTRI), EnergySolutions engaged Utah regulators and other stakeholders to develop a 1 year license variance for disposal of certain commercial Class A sealed sources at Clive. Under the terms of the variance, only sources identified and collected through the Conference of Radiation Control Program Directors (CRCPD) Source Collection and Threat Reduction Program (SCATR) [CRCPD 2013] were eligible for Clive disposal. Although outside the scope of the Task Force, the effort facilitated the recovery and disposal of thousands of Class A sources in the States that lacked access to commercial disposal access for sealed sources after 2008.

2. Revised Branch Technical Position on Concentration Averaging

Commercial LLRW generators must classify waste as Class A, B, C, or GTCC prior to shipping the material for disposal. In order to do so, the radioactivity of the waste must be averaged over its volume. The NRC’s 1995 “Final Branch Technical Position on Concentration Averaging and Encapsulation” (1995 BTP) [NRC 1995] provides guidance to generators on the calculation of these averages given the physical and radiological characteristics of the waste. It also provides ‘generic’ class limits for commonly disposed types of LLRW, including sealed sources. All of the

States which regulate commercial disposal facilities (South Carolina, Utah, Washington, and now Texas) require LLRW generators to use part or all of the 1995 BTP.

While the 1995 BTP recognizes that alternative approaches may be used for concentration averaging based on the actual (and not generic) waste and waste facility characteristics, those sections have been generally interpreted in a way which has prevented deviation from the generic limits provided in the 1995 guidance document. As a result, the generic Class A, B, and C limits for sealed sources described in the 1995 BTP have effectively become the upward limit for each waste class, such as the 30 Ci limit for Cs-137 and other common sealed sources. The radioactivity of commercially disposed sealed sources is thus a fraction of the class limits specified in the NRC waste classification regulations at 10 CFR 61.55.¹⁵

In 2010, the NRC Commission directed the NRC staff to update certain sections of the 1995 BTP to reflect the risk-informed and performance-based approach characteristic of the NRC's overall policy for regulation. After receiving this direction, NRC staff restarted its task to revise the 1995 document in its entirety. Following extensive public and stakeholder engagement, including submission and consideration of written comments, the NRC released a final draft revised BTP in May 2012 (revised BTP) [NRC 2012].

The draft revised BTP provides updated guidance for determining classification of commercial LLRW, including sealed sources. The NRC plans to publish the final revised BTP in late 2014 with few, if any, substantive revisions to the sections addressing sealed source disposal. The generic sealed source disposal limits under each waste class in the draft revised guidance are based on an updated 'intruder scenario' for determining the activity limits that apply to sealed source waste under generic conditions for each class of waste.

Consistent with the draft BTP, the NRC expects the generic Class C limits for the disposal of Cs-137 sealed sources to increase from 30 Ci to 130 Ci. The revised BTP should also provide greater latitude for the disposal of additional sealed sources containing radioactive quantities of concern. In addition, the revised BTP is expected to include more detailed 'alternative approach' provisions that could be used by regulators to review proposals for disposal of sealed sources that exceed the revised generic radioactivity limits. The significant positive impact that these changes could have on the disposal of disused sources is described in Section II of this chapter, which addresses ongoing challenges in commercial sealed source disposal.

C. Public and Private Roles and Responsibilities

Legislation governing the management and disposal of LLRW, including the Atomic Energy Act (AEA) [AEA 1954], the EPA Act, and LLRW PAA, envisions distinct roles and responsibilities for government and the private sector. Federal and State Governments are responsible for the

¹⁵ In addition, waste acceptance criteria at licensed commercial disposal facilities may be lower than the generic limits described in the BTP. For example, in lieu of the 1995 BTP generic Class C limit for Cs-137 sealed sources of 30 Ci, the Barnwell license agreement establishes a 10 Ci Class C limit for Cs-137 and similar sources.

regulation of commercial radioactive material use, transport, and disposition, including support for the development and licensing of commercial LLRW disposal facilities. Responsibility for disposal of commercial Class A, B, and C LLRW, including sealed sources, lies with the private sector (i.e., the appropriately licensed businesses, hospitals, research institutions, and other organizations that use radioactive materials). Pursuant to the LLRW PAA, the Federal Government is responsible for the disposal of GTCC LLRW.

National security concerns after September 11, 2001, and the reduction in commercial disposal options following the closure of Barnwell to non-compact States, resulted in increased government involvement in commercial sealed source management and disposal. There is general agreement, however, that as commercial disposal options increase, government involvement should decrease accordingly. Sealed source disposal arrangements between private entities (such as licensed users, brokers, transporters, and disposal facilities) should function efficiently and effectively without government involvement beyond the regulatory frameworks and supporting activities that ensure the security, health, and safety of licensees and the public.

II. Ongoing Challenges in Commercial Sealed Source Management and Disposal

While initiation of operations at WCS and the increased generic limits expected in the revised BTP are important accomplishments, significant commercial sealed source disposal challenges remain to be addressed. Disused sealed sources with commercial disposal pathways may remain in storage longer than necessary unless generators have the proper incentives to dispose of them in a timely manner. In addition, the most risk-significant sealed sources commonly used in medicine and industry, still present disposal challenges once they become disused and unwanted. These disused sources are generally classified as Class B, C, and GTCC LLRW for the purposes of disposal. Furthermore, the recovery and disposition of these sources is severely constrained in both time and cost by a limited supply of certified Type B transportation containers required for transport.

A. Timely Disposal of Disused Sealed Sources

Current NRC regulations provide only limited incentive for LLRW generators to dispose quickly of sealed source waste. Unlike many types of non-sealed source LLRW, disused sealed sources require only limited storage space or in-storage maintenance. In addition, commercial disposal of sealed source waste is costly: both time and funding are required for packaging, transportation, and burial at a licensed commercial LLRW disposal facility. Without greater incentives, licensees that use sealed sources may delay these efforts. Furthermore, as described in the 2006 Task Force report, licensees are less likely to keep track of disused and

unwanted sources than sources that are still in use.¹⁶ Disused sources in storage are more likely to become lost, stolen, or abandoned than those still in use.¹⁷ With commercial Class A, B, and C disposal options now widely available for many disused sealed sources that previously had no disposal pathway, including Cs-137 and Co-60 sources, a significant remaining challenge is to encourage generators to dispose of these sources in a timely fashion.

To address these challenges, the Task Force recommends that NRC formally consider supplementing existing requirements for licensees possessing Category 1 and 2 quantities of sealed radioactive sources to address the disposition costs of these sources through source disposition/disposal financial planning or similar requirements. In addition, the Task Force has identified several further initiatives that it believes will encourage timely disposal of disused and unwanted sealed sources and improved sealed source management and disposal practices.

1. Financial Assurance or Similar Requirements for the Disposition of Disused Sources

The nuclear industry has long used financial assurance requirements to effectively manage facilities that require extensive or costly end-of-life decommissioning, including LLRW disposal.¹⁸ However, there are currently no NRC requirements aimed at the funding of LLRW disposal prior to facility closure. Rather, current NRC financial assurance requirements in 10 CFR 30.35 are intended to specifically address site decommissioning.¹⁹ As a result, there is little direct correlation between NRC financial assurance requirements and the Category 1 and 2 sealed sources of greatest concern from a National security standpoint.

As a result, the Task Force concluded in 2006 that existing NRC financial assurance requirements may not sufficiently address sealed source management and disposal. The 2006 Task Force report noted that, “[n]ot all possessors of sealed sources need to have financial

¹⁶ In its discussion of storage time limits, the Task Force noted that “such a requirement could make licensees more aware of the source’s existence, trigger an evaluation of the adequacy of storage conditions, and encourage the use of sound business and regulatory principles that would lead to the removal of sources which should not remain in storage” [NRC 2006].

¹⁷ Stored or disused Category 1 and 2 quantities of radioactive material are subject to physical protection requirements imposed by the NRC and Agreement States. In addition, since January 2009, NRC and Agreement State licensees have been required by the NRC, per 10 CFR 20.2207, to track their Category 1 and 2 sources in the National Source Tracking System (NSTS).

¹⁸ Financial assurance, as generally defined, is the demonstration of an ability to fund the expected costs associated with specific liabilities. Financial assurance mechanisms are often used in industries such as energy and mineral resource development in which there are significant costs related to environmental management after the operational (and revenue producing) life of the facility has ended.

¹⁹ Current financial assurance requirements for radioactive materials licensees are aimed at facility decommissioning and generally apply only to sealed source manufacturers and distributors, which may possess thousands of sealed sources (and unsealed radioactive materials) in inventory. (See 10 CFR 30.35 Financial Assurance and Recordkeeping for Decommissioning.)

assurance to cover the costs of disposal or other appropriate disposition of sources, potentially resulting in prolonged storage and possible misuse, abandonment, loss, or theft” [NRC 2006]. 2006 Recommendation 9-2, therefore, urged the NRC to “evaluate the financial assurance required for possession of Category 1 and 2 radioactive sources to assure that funding is available for final disposition of the sources.”

In consultation with its Federal and State partners, the NRC completed the evaluation of its financial requirements in January 2010, thus closing out 2006 Recommendation 9-2 in the 2010 Task Force report. It also considered a variety of appropriate mechanisms, such as broadening the NRC’s decommissioning requirements, assessing a source-specific surcharge on a fixed schedule over the life of the source, or imposing a more general surcharge on sealed sources. However, due to the lack of commercial disposal and other cost determining factors, such as transportation and packaging, it was premature to pursue financial assurance rulemaking at that time.

In addition to the increase in commercial sealed source disposal options since 2012, and the potential for disposal of higher activity sealed sources, if the NRC issues the draft revised BTP as expected, the Task Force notes that two further challenges to implementing financial assurance requirements or similar mechanisms have been mitigated since 2010. First, new sealed source transportation containers will soon be available, starting in 2014, as the result of both government and private sector efforts. The new containers will help to remove a significant obstacle to timely disposition of Category 1 and 2 disused and unwanted sources. Second, both the availability of the new containers and ongoing commercial disposal operations at WCS can potentially assist regulators and licensees in the identification of likely costs related to commercial disposal of sealed source waste. The potential availability of this information enables exploration of a broader range of financial assurance requirements or similar mechanisms than was the case in 2010.

With significant progress in addressing the challenges, the Task Force has concluded that the NRC should evaluate the need for licensees possessing Category 1 and 2 quantities of radioactive sealed sources to address the disposition costs of these sources. The costs included in source disposition/disposal financial planning or other mechanisms should reflect the expected costs of packaging and transport of the waste, as well as the cost of LLRW disposal, when available.

2014 Recommendation

2014 Recommendation 2: The Task Force recommends that the NRC evaluate the need for sealed source licensees to address the eventual disposition/disposal costs of Category 1 and 2 quantities of radioactive sources through source disposition/disposal financial planning or other mechanisms. Disposition costs should include the cost of packaging, transport, and disposal (when available) of these sources.

A wide range of financial mechanisms are available for NRC consideration in addressing this recommendation. For example, financial assurance mechanisms acceptable to the NRC in the context of nuclear reactor or complex materials facility decommissioning may provide helpful models to determine requirements for Category 1 and 2 quantities of sealed sources. In addition, several Agreement States have instituted more stringent requirements to help cover the cost of disused and “orphan” sealed source packaging, transport and disposal unrelated to

facility decommissioning. Illinois, Texas, and Florida are among those with provisions for sealed source disposal, although they vary with regard to the precise purpose, mechanisms, and activity thresholds for rule application.

These efforts demonstrate the potential feasibility and effectiveness of such requirements and may inform further potential NRC rulemaking activities undertaken to implement the recommendation. However, implementation of source disposition/disposal financial planning or similar requirements may have to address both Category 1 and 2 quantities of sealed sources that are new and have not yet been distributed to a licensed user, as well as those already in use. In both cases, the Task Force believes that the integration of stakeholder input throughout the rulemaking process will ensure that the new requirements will not place undue burden on those affected. Furthermore, the rulemaking process should carefully consider the compatibility category assigned to the rule, recognizing the importance of Agreement States maintaining flexibility in developing a compatible requirement that meets or exceeds the NRC standard.

The Task Force believes that source disposition/disposal financial planning or similar requirements are likely to have several beneficial impacts, although these impacts may vary according to the financial assurance mechanism adopted. First, such requirements are likely to decrease the time that commercial sealed sources remain in storage because the funds necessary for source disposal will be immediately or quickly available. Without financial assurance, generators may have little incentive to dispose of disused sources sooner rather than later, particularly for large and infrequent disposal expenses. In any given year, bearing the cost of disposal would be optional.

For similar reasons, requiring licensees to assess and account for the expected costs related to disposition of disused and unwanted sources will facilitate broader awareness within licensee organizations with regard to the financial and logistical factors associated with the packaging, transport, and disposition of Category 1 and 2 quantities of sealed sources. Finally, source disposition/disposal financial planning or similar requirements will help to ensure that costs related to the use of sealed sources are borne by those who receive the benefits derived from the sealed sources prior to disposal.

2. Disused Sealed Source Identification and Storage

The 2010 Task Force report, which was published prior to the 2012 expansion of sealed source disposal options, recommended that the NRC request additional information from licensees about their sealed sources in storage. 2010 Recommendation 6 identified the inspection process as a way to obtain the information.

2010 Recommendation 6: The Task Force recommends that the NRC incorporate procedures to review the status, such as the date of, the reason for, and location of sources in long-term storage, in the current inspection program.

Status: Complete.

The intent of the recommendation was to “ascertain when a source goes from being an economic asset to a licensee to being disused and unwanted, with limited or expensive disposition options” [NRC 2010b, page 38]. The Task Force is now closing 2010 Recommendation 6 due to the increase in commercial sealed source disposal options. However, the Task Force has also concluded that a practice of sealed source use-status

information sharing will encourage more efficient sealed source management, as well as the timely disposal of disused and unwanted sealed sources which now have a commercial disposal pathway.

The NRC currently requires licensees that possess sealed sources to report annually through the NSTS whether or not their Category 1 and 2 sources are still in their possession, have been transferred to another licensed user, or have been disposed. However, neither these or other licensees that possess sealed sources are required to report to Federal or State regulators the 'use-status' of their sealed sources (i.e., whether or not their sources are in use or have become disused).

The NSTS as currently configured could facilitate the exchange of such 'use-status' information for Category 1 and 2 sources, and a number of States already have registries to track sealed sources below the Category 1 and 2 threshold, should they wish to do so. If a licensee identifies a sealed source as 'in storage pending further use,' the intended purpose and timeframe for reuse would also be both relevant and beneficial information for licensees to consider and share through the NSTS and other appropriate tools used by regulators. On May 12, 2014, the NRC issued Regulatory Issue Summary (RIS) 2014-04 [NRC 2014b] to encourage licensees to provide this information through the NSTS or through NRC Form 748 transaction reports. This RIS was issued to Agreement State regulators to share with their licensees, as appropriate.

As currently configured, licensees may specify that sources are in "Long-Term Storage." Sharing this information will benefit both the licensees, which provide the use-status and planning information, as well as the regulators who receive it. For licensees, such a practice will encourage increased awareness of, and attention to, effective disused sealed source management, which may include financial and logistical planning for disposal, including related transportation costs and challenges. For sealed sources without a commercial disposal pathway, planning may involve coordination with source recyclers, including manufacturers, or consideration of other options for disposition of disused sources. This type of attention and planning will not only facilitate timely sealed source disposition, but also increase licensee awareness of the National security, public health, and safety concerns related to keeping disused and unwanted sealed sources in storage for longer than necessary.

For regulators, 'use-status' information will increase their awareness of how many sealed sources under their purview are disused and in storage, where they are located, and what types of disposal challenges their licensees may encounter. It may also enhance the ability of regulators to foresee and manage instances in which licensees are unable to dispose of their sources before going out of business. For both regulators and licensees this type of information sharing will improve the quality and efficiency of sealed source management and disposition, which, in turn, can benefit National security, public health, and safety. Furthermore, current NRC regulations do not impose limits on the time that licensees may keep disused sources in storage, as long as all such sources are counted against license possession limits and properly stored in accordance with NRC safety and security regulations. The NRC could examine a reasonable timeframe for licensees to plan for and dispose of disused and unwanted sources in storage for which a disposal path is available.

3. Clarification and Communication of Potential Liabilities

One of the primary impacts that could result from a misused or mishandled sealed source is the economic cost of contamination, emergency response, and social disruption.²⁰ Depending on the type of sealed source involved and the location of the incident, these costs could be significant [DHS 2008]. For licensees to make informed decisions on the management and use of sealed sources, information on the potential liabilities must be as clear as possible. Increased clarity and communication on the liabilities that sealed source licensees may face as the result of a lost or stolen source could also function as an incentive to licensees for timely disused sealed source disposal.

State and Federal emergency response cost recovery fees, when applicable, may be expensive for licensees in the case of lost or stolen sealed sources, even without significant contamination damage. Similar costs on a much smaller scale have resulted from the response and recovery efforts involved when sealed sources have been misplaced. None of these cases have resulted in significant contamination damage or social disruption, but regardless have been costly to the States and localities in which they have taken place. In response to these potential costs, Illinois, for example, has passed legislation giving regulators the ability not only to fine licensees for any regulatory infractions involved in such instances, but also to charge licensees for the cost of the emergency response effort.²¹

4. Type B Packages for Sealed Sources Disposition

While this report addresses a number of sealed source transportation security challenges in Chapter 1, the limited availability of “Type B” containers certified to transport high activity disused sources (usually Class B, C, or GTCC waste) is a challenge for sealed source management and disposition. As a result of 2004 changes in 10 CFR Part 71, certifications for a significant number of these containers expired in 2008.²² These packages are necessary for the transport of high activity Cs-137 and Co-60 sources, such as those used in irradiator, calibration, and cancer treatment devices. NRC RIS 2008-18 [NRC 2008d] provided information on what would be considered in requests for extending use of these packages beyond October 1, 2008. DOT provided a limited number of special permits and authorizations on a temporary and case-by-case basis for use of the expired packaging. However, these special permits effectively expired in June of 2011.

²⁰ The NSTS tracks 80,000 sources held by over 1,400 licensees. Thefts and losses of Category 1 and 2 sources have been rare. There has been no theft or loss of Category 1. Since 2005, there have been four losses and thefts of Category 2 sources. In this case, three of these were recovered, one source was not.

²¹ Illinois Radiation Protection Act of 1990 and 32 Ill. Adm. Code 310.75.

²² These “specification” Type B packaging certifications expired as the U. S. Department of Transportation (DOT) and the NRC aligned with international transport regulations (HM-230: Docket No. RSPA-99-6283).

Most manufacturers only produce packages licensed to transport devices they are currently selling. The result is a significant reduction in the number of multi-use packages needed to transport the older sealed sources and devices as they become disused and unwanted.

2010 Recommendation 8: The Task Force recommends that the U.S. Government enhance support of short-term and long-term research and development of certified Type B containers for use in domestic and international source recovery efforts.

Status: Ongoing.

Since the 2010 Task Force report was published, NNSA/GTRI has procured vendor services for the design, development, testing, and certification of two Type B packages to support the recovery and transportation of Category 1 and 2 sources commonly used in irradiators and cancer treatment devices. The new containers together will enable shipment of nearly 100 percent of all commercially used devices containing Cs-137 and Co-60, which are particularly significant from a National security, public health, and safety standpoint. However, designing, testing, and producing new transportation packages are a multi-year project. The regulatory approval process alone for new package designs can be up to 18 months.

The first of the NNSA/GTRI containers under development, the 435B, is an unshielded Type B container with a design appropriate for transport of a wide range of relatively common devices requiring Type B shipment. NNSA/GTRI expects the container to be certified for use in 2014. The second container, the 380B, is currently in the early stages of design and development. It will be a more complex shielded container designed for the transportation of a wide range of less common devices. NNSA/GTRI expects the 380B to be certified for use in 2016.

To facilitate private sector utilization of these or similar Type B transport containers in the future, the NNSA/GTRI will make the new Type B container designs available without cost to companies in the U.S. and abroad interested in using or modifying them to broaden the availability of Type B containers for source recovery. The wider availability of these designs could also encourage disused sealed source disposition. This recommendation will be completed upon the submittal of the second Type B transportation container for certification, anticipated in FY 2015.

5. Stakeholder Engagement on Sealed Source Management and Disposal

Like 2010 Recommendation 6, the Task Force identified 2010 Recommendation 7 while commercial sealed source disposal options were severely constrained.

2010 Recommendation 7: The Task Force recommends that the U.S. Government, in collaboration with responsible State agencies, evaluate and develop a plan to improve, as necessary, processes for dealing with unwanted, abandoned, or impounded sources, including storage, reuse, recycling, or other disposition method.

Status: Complete.

A special interest session was held during the 2011 CRCPD Annual Meeting on May 17, 2011, in Austin, Texas to discuss best practices related to storage of 'orphan' sources by States. Attendees were further encouraged to share best practices and emergency response planning information with States that may benefit from it. More importantly, however, the increase in

commercial disposal options will significantly mitigate the problem. While States may still at times keep unwanted, abandoned, or impounded sources in storage, the number of such sources is expected to decrease steadily as the backlog and any new sources with a commercial disposal pathway are disposed.

The closure of Barnwell in 2008, to all but three States, significantly increased awareness with regard to the National security, public health, and safety importance of sealed source management and disposal. While the expansion of commercial options for the disposal of disused and unwanted sealed sources has significantly diminished the urgency behind 2010 Recommendation 7, the collaboration among Federal, State, private sector, and non-governmental stakeholders continues and warrants closing this recommendation.

B. Disposal of Disused Sources Exceeding Current Disposal Facility Limits

2010 Recommendation 4: The Task Force recommends that the U.S. Government, regional compacts, and States continue to evaluate disposal options for disused radioactive sources, including options for handling a potentially large number of disused cesium chloride sources that may be replaced once viable alternatives are available.

Status: Ongoing.

While commercial disposal options for Class A, B, and C sealed sources waste have increased since 2010, a large number of challenges remain. There are currently no disposal options for disused sealed sources which exceed the generic radioactivity limits specified in the 1995 BTP, or for disused sources which are classified as GTCC LLRW. Commonly used sealed sources of these types include americium-241 (Am-241), and cesium chloride (CsCl) sources commonly used in both industry and medicine, and particularly significant from a National security, public health, and safety standpoint.

1. High-Activity Class B and C Sealed Sources

The NRC expects the generic sealed source disposal limit specified in the revised BTP to increase from 30 Ci to 130 Ci for Cs-137 and to remove the upper limit on Co-60. However, sealed sources within the 30 Ci to 130 Ci range for Cs-137, for example, are not nearly as common as Cs-137 sources with activities between 130 Ci and the Class C limits established in 10 CFR 61.55. Although a significant and positive development, the impact that this change alone will have on the reduction of sealed sources that must remain in storage may not be dramatic.

The revised BTP, however, also includes detailed guidance on 'alternative approaches' for the disposal of sealed sources between the limits recommended in the BTP and the Class C limits in 10 CFR 61.55. For example, for Cs-137, the BTP limit is 130 Ci and the 10 CFR 61.55 Class C limit is 4,600 Ci/m³. For a 55-gallon drum (0.2082 m³), this results in a total activity of 957 Ci (i.e., 4,600 Ci/m³ x 0.2082 m³ = 957.72 Ci). Under the provisions as currently drafted, licensees could request regulatory approval of sealed sources larger than those specified in the BTP, based on site-specific features of disposal sites (such as depth of burial or the emplacement of intrusion barriers) or the protective design of disposal containers. Several currently operating LLRW disposal facilities indicated that these alternative approaches have the potential to significantly expand the activity range of sealed sources that they could accept, if approval were granted by the Agreement State regulator.

However, transition to the revised BTP, given the critical role of the 1995 guidance to LLRW disposal for nearly two decades, constitutes an important remaining challenge. Discretion with regard to the use of the new guidance, including the alternative approaches, will remain with the States that regulate commercial LLRW disposal facilities. Transition to the guidance is likely to require regulators who wish to adopt it to consider and address a wide range of changes. In addition to working with disposal facilities to assess any necessary changes to the facility license, adoption of the guidance may require States to develop new rules or procedures.

In recognition of these challenges, the NRC and other Federal agencies have committed to work with States, generators, and other stakeholders to facilitate transition to the new guidance, as appropriate. However, from a National security, public health, and safety standpoint, adoption of the new guidance, particularly the alternative approaches, would represent significant progress. The Task Force supports continued Federal engagement with stakeholders on this and other challenging sealed source management and disposal issues.

2. Disposal of Sealed Sources Classified as GTCC LLRW

2006 Action 9-1: The DOE should continue its ongoing efforts to develop GTCC [LLRW] disposal capability.

Status: Ongoing.

Pursuant to the LLRWPA, DOE is responsible for disposal of GTCC LLRW, including sealed sources that are determined to be waste and classified as GTCC LLRW. Common examples of such sources include CsCl sources greater than 957 Ci, Am-241, plutonium-238 (Pu-238), and plutonium-239 (Pu-239) sources greater than 27 mCi. On February 18, 2011, DOE issued the Draft Environmental Impact Statement for the Disposal of GTCC LLRW (DOE DEIS) for public review and comment [DOE 2014]. The DOE DEIS evaluates disposal options for GTCC LLRW, which includes many Category 1 and 2 sealed sources. DOE continues to work on the Final GTCC LLRW EIS.

Before making a final decision on the disposal alternative(s) to be implemented, DOE will submit a report to Congress regarding the disposal alternatives considered in the EIS and await Congressional action. As required by Section 631 of the EPA Act, the Report to Congress will identify and describe the alternatives under consideration, the types of waste involved, the Federal and non-Federal disposal options, a process for safe disposal of the waste, and any statutory changes or new authorities required for implementation.²³ The report will also include options for ensuring that those who benefit from the activities resulting in waste generation will bear reasonable costs for its disposal.

²³

Background information about this effort can be found at <http://www.gtccceis.anl.gov> [DOE 2014].

3. Sealed Sources Containing Foreign-Origin Am-241, Pu-238, and Pu-239

Sealed sources manufactured with foreign-origin Am-241, Pu-238, and Pu-239 material present unique challenges. Although disposal options under consideration in the DOE EIS may eventually address these sources, they are currently without commercial or Federal options for disposal. NNSA/GTRI has authority to recover sealed sources that present a threat to National security, public health, or safety. However, options for the staging and storage of sources without an identified path to disposal, such as the foreign-origin Am-241, Pu-238, and Pu-239 sources, are limited.

Based on extensive research and information developed through engagement with sealed source manufacturers, NNSA/GTRI has concluded that all of the Am-241, Pu-238, and Pu-239 sealed sources manufactured in the U.S. after December 31, 2003, contain foreign-origin radioactive material exclusively. Because the use-life of these sources is typically 10 to 15 years, concerns regarding the lack of disposal are increasing. NNSA/GTRI estimates, for example, that since 2004 U.S. commercial sealed source manufacturers have imported approximately 3,000 Ci per year of Am-241, with between 10,000 to 20,000 sealed sources put into use in that period. Because of the 10 to 15 year use-life, experts expect these sources to become disused at an increasing rate over the coming decade. Furthermore, as the use-life of these sources concludes, the devices in which they are used are generally re-sourced with new Am-241 material. The current rate of such re-sourcing is approximately 150 to 300 devices per year per manufacturer.

2010 Recommendation 5: The Task Force recommends that Federal and State Governments investigate options such as providing short-term secured storage of sources recovered from U.S. owners that contain foreign-origin americium-241 radioactive material, so that these sources can be recovered now, and increase efforts to investigate options for disposal of these sources.

Status: Ongoing.

Since the publication of the 2010 Task Force report, DOE has continued to investigate options for disposal of certain waste for which there is currently no identified disposal path, including foreign-origin Am-241, Pu-238, and Pu-239 sealed sources recovered by NNSA/GTRI.

III. Summary

There have been significant changes in LLRW disposal landscape since 2010 that enhance opportunities for safe and secure disposition of radioactive sealed sources, most notably the initiation of commercial LLRW disposal operations at the WCS disposal facility in Texas. Its addition to the fleet of commercial LLRW disposal facilities suggests adequate capacity for disposal of sealed sources for the foreseeable future. However, there remain significant challenges related to other aspects of disused source disposition. Despite this capacity, there continue to be constraints related to LLRW compact limitations. Further, individual sites have waste acceptance criteria that may appropriately restrict disposal of sources within waste Class B and Class C limits. While the final revisions to the NRC's BTP on Concentration Averaging may reduce the extent of the challenge, it will not entirely eliminate it. Furthermore, there are also challenges related to the transportation containers necessary to facilitate source disposition. The fleet of usable Type B containers is limited. Although certification of new

containers is a lengthy process, NNSA/GTRI continues to make progress in their program to increase the number of available Type B transport containers. Finally, there is the challenge of licensees pursuing timely disposition of disused and unwanted sources. The challenges noted here often translate to disposition costs that many licensees, to date, have been unable or unwilling to incur. For this reason, the new recommendation proposed in this chapter is directed towards incentivizing licensees to provide for management of disused sources.

Chapter 3

Progress in the Area of Alternative Technologies

I. Introduction

In the Energy Policy Act of 2005 (EPAAct) [EPAAct 2005], which created the Task Force, Congress emphasized the importance of alternative technology development and implementation to reduce the risks posed by radioactive sealed sources. The EPAAct directed the Task Force to identify and recommend “appropriate regulations and incentives for the replacement of devices and processes” which use Category 1 and 2 sealed sources.

At the time of the EPAAct legislation, domestic consideration of alternative technologies had not reached the point at which implementation planning could begin on an application-specific basis. However, as progress in the technical, operational, and economic feasibility of these replacements continues, Task Force consideration of policy options to facilitate implementation has become increasingly important. Radiation source replacement continues to be a primary focus of the overall Task Force effort “to reduce the risk of terrorist threats, including acts of sabotage, theft, or use of a radiation source in a radiological dispersal device” [EPAAct 2005].

In addition to the Task Force mandate, the EPAAct requested two additional examinations of design policies and programs aimed at the replacement of Category 1 and 2 radioactive sealed sources and devices:

- EPAAct directed the U.S. Department of Energy (DOE) to survey “industrial” use of sealed sources and to initiate alternative technology research and development activities. DOE identified certain International Atomic Energy Agency Category 1 to 3 sealed sources as relevant to its study under the directive. DOE submitted its report to Congress in August 2006.
- Congress also requested that the National Academy of Sciences (NAS) develop a comprehensive technical assessment of replacement options and policy approaches to guide future efforts. The scope of the study was limited to Category 1 and 2 sources.

Table 3-1 describes the primary applications and devices that use Category 1 and 2 sealed sources. Because of the variation in these applications, the feasibility of replacement technologies will depend primarily upon technical, operational, and financial factors related to replacement.²⁴ There may also be challenges related to disposal of the radioactive sealed

²⁴ Technical requirements include the performance of the replacement device, including its ability to achieve the same or similar results as the radioactive device replaced. ‘Operational’ factors may include the size, power requirements, or shape of the device, or challenges related to staff training or device maintenance. ‘Financial characteristics’ include the cost of device production and use, as well as the characteristics related to the market (current or expected) for the device.

sources replaced by alternatives.²⁵ Consideration of all these factors helps to ensure that transition to alternatives does not adversely impact either the quality of services provided or the overall risk environment.

Table 3-1: Category 1 and 2 Sealed Source Applications and Devices

Application	Common Devices	Source Types	IAEA Category
Medical. Cancer treatment, blood, and research irradiation	External beam radiation therapy, blood and research irradiators, medical radiosurgery devices	cobalt-60 (Co-60), cesium-137 (Cs-137)	1, 2
Sterilization. Medical instrument and food irradiation	Large irradiators (panoramic irradiators)	Co-60	1
Geophysical well-logging. Petroleum and other natural resource exploration, production, and development	Neutron and gamma-ray well-logging devices	americium-241/ beryllium (Am/Be)*, Cs-137	2*
Non-Destructive Inspection/Evaluation. Quality assurance, defect analysis	Radiography and fixed industrial gauges	Co-60, Cs-137, Ir-192, Selenium-75 (Se-75)	2
*Am-241 when mixed with beryllium (Be) can produce neutrons. These neutron sources may be denoted as Am/Be throughout this chapter.			

II. Background and Accomplishments

The Task Force concluded in its initial 2006 Task Force report that application-specific recommendations regarding replacement technologies should await the outcome of the NAS and DOE efforts. However, the report identified “critical concerns” regarding the transition to alternative technologies once developed, “including incentives for adoption, collaboration between Federal agencies, and disposition of displaced sources” [NRC 2006, page 136]. To address these concerns, the report provided guidance on these and related policy challenges, concluding that transition efforts must include both “technical and economic criteria as top considerations to ensure that the results are practical” [NRC 2006, page 137]. In addition, the Task Force requested that its Alternative Technologies Subgroup “evaluate financial incentives, research needs for both alternative technologies and alternative designs, including financial

²⁵ Chapter 2 of this report describes in more detail the challenges related to radioactive sealed source disposal.

support; and the cost versus the benefit of potential alternatives for Category 1 and 2 radioactive sources” to inform the Task Force in the development of the 2010 Task Force report [NRC 2006, page 139].

A. Background

NAS completed its study in 2007 and released the public version in January 2008 focusing on replacement technologies for Am-241, Cs-137, Co-60, and Ir-192, which together account for “nearly all (over 99 percent) of the sealed sources that pose the highest security risks in the United States” [NAS 2008]. In accordance with the EPAct directive, the NAS assessed the most prevalent uses of these sources, including the technical and economic factors most relevant for the development and implementation of alternatives. The study also included specific and detailed findings and recommendations [NAS 2008, page 1]. Although the scope of the study was limited to the use of Category 1 and 2 sources, the NAS noted that sources that fall into Category 3 and lower can be assembled into Category 1 or 2 quantities of radioactive material, and that, “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” [NAS 2008, page 43, n.1]. While current security requirements address aggregation of radioactive sources in that the requirements are applicable to licensees possessing Category 1 and 2 quantities of radioactive sources as opposed to specific source quantities, there remains concern associated with some sources manufactured slightly below the Category 2 threshold. The NAS study concluded that while “replacements exist for nearly all applications of the radiation sources examined...they may not all now be economically viable or practical” [2008 NAS, page 1].

In its assessment of approaches toward alternative technology implantation, NAS also identified several characteristics that may encourage over-use of sealed sources that pose a risk. NAS found that neither sealed source licensees nor sealed source manufacturers “bear the full life-cycle cost, including disposal costs, of some of these radiation sources.” Nor do these parties “bear the full cost of liabilities related to misuse of Category 1 and 2 radiation sources” [NAS 2008, pages 9-10]. As a result, the NAS concluded that alternative technologies are at an artificial cost disadvantage relative to devices that use Category 1 and 2 sources. To address these concerns, NAS recommended that the U.S. Government “adopt policies that provide incentives (market, regulatory, or certification) to facilitate the introduction of replacements and reduce the attractiveness and availability of high-risk nuclide sources” [NAS 2008, page 10]. Additionally, NAS described both generic and application-specific policy approaches that may be appropriate as alternative technologies become available.

In 2008, at the request of the Task Force, the Task Force Alternative Technologies Subgroup used the NAS report as a basis for the evaluation of alternative technologies for seven commonly used applications using Category 1 and 2 quantities of Am-241, Co-60, Ir-192, and Cs-137. The subgroup analysis included life-cycle operational cost estimates for potential replacements, and identified financial incentives that would likely be required to facilitate adoption of the replacement devices. The subgroup presented its findings to the Task Force in 2009. As a result, the Task Force concluded in its 2010 Task Force report that while alternative technologies existed for some of the applications assessed by the Subgroup, “the viability, relative risk reduction, and stage of development of these alternatives vary,” and that “[n]o alternative currently exists that is able to meet all user needs for any of the seven applications” assessed by the subgroup [NRC 2010b, page 43].

In addition, the Task Force concluded that when replacement technologies become available, Federal Government policy support is likely to be necessary to preserve the quality of services provided by current radioactive sealed sources or devices during the transition process. Successful transition to replacements will also depend upon engagement and coordination among sealed source licensees' device manufacturers and vendors, regulators, and policymakers on an application-specific basis. Because of these complex technical and policy concerns, the Task Force identified the development and implementation of alternative technologies as one of two key challenges requiring attention at higher levels of the Federal Government²⁶ [NRC 2010b, page iv].

B. Accomplishments Since 2010

Despite the identified challenges, progress has been made in the identification and development of alternative technologies for several widely used devices that use Category 1 and 2 sealed sources. For example, blood irradiators using x-ray technologies instead of high-activity sealed sources are now available commercially in both domestic and international markets. Although limited in scope, this example of successful sealed source replacement encourages future progress and aids in the overall risk-reduction effort. Additional accomplishments identified by the Task Force since the publication of the 2010 Task Force report include:

- A new generation of blood irradiators using x-ray technologies has become available in the U.S. The new technologies may meet the technical and operational requirements to replace the Category 1 sealed source devices used in large-scale commercial operations. Also, foreign irradiator replacement manufacturers with strong sales and reliability records have expressed interest in entering the U.S. market pending regulatory approval;
- The U.S. Department of Defense (DOD) applied a risk-based approach to determine if alternative technologies can replace radioactive sources to accomplish its mission. One initiative has been to convert from Cs-137 based blood irradiators to x-ray based irradiators. To date, the x-ray based irradiators have proven to be as effective as the Cs-137 based irradiators. The U.S. Army has reduced overall costs by no longer requiring a U.S. Nuclear Regulatory Commission (NRC) license and the increased security requirements of 10 *Code of Federal Regulations* Part 37, "Physical Protection of Byproduct Material" [NRC 2013f] due to the fact that those requirements do not apply to x-ray based irradiators. The U.S. Army now covers the x-ray irradiators under their Army Radiation Authorization process;
- The U.S. Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO) supported a project to design, build, test, and evaluate a prototype non-radioactive neutron generator for potential replacement of Am/Be sources. The technology design criteria included the scale, function, and durability characteristics necessary for well-logging applications [GAO 2013];

²⁶ The other key challenge identified by the Task Force in 2010 was the development of disposal options for high-activity sealed sources. Findings and recommendations with regard to disposal of sources is considered in Chapter 2 of this report.

- In 2013, the DOE/National Nuclear Security Administration's Global Threat Reduction Initiative (NNSA/GTRI) established blood irradiation and well-logging experts groups to evaluate current alternative technologies for these applications relative to technical and operational requirements for replacements; and
- In October 2013, the NNSA/GTRI supported a World Institute of Nuclear Security (WINS) workshop on Alternative Technologies in order to encourage and support international coordination on the use and implementation of alternative technologies.

As efforts to develop alternative technologies continue, and transition to replacements is considered on an application-specific basis, Task Force member coordination on alternative technology development and stakeholder engagement will become increasingly important.

C. Technical Challenges

A wide range of radiological source replacement technologies are being developed for blood irradiation, biomedical research, non-destructive inspection/evaluation, and oil well-logging applications. Technology development has been successful in some of these areas, but challenges remain that hinder their adoption in other areas. These challenges are the focus of ongoing research and development efforts in both the public and private sectors.

Bulk blood irradiation is an example where newly developed x-ray generators can replace the traditional Cs-137 based irradiators. The technical readiness is demonstrated by the successes in encouraging and incentivizing conversion of blood irradiators, as demonstrated by the U.S. Army efforts. Yet, commercial scale blood irradiation is still often performed using Cs-137 sources. Conversion to x-ray sources is hindered by past and perceived issues with mechanical reliability, efficacy, and complexity as well as required maintenance. These perceptions are changing as operational experience with new x-ray sources is demonstrated. Capital cost is another hindrance to conversion of existing Cs-137 based facilities. On the other hand, the cost and complexity of installing and maintaining the security infrastructure required for the Cs-137 based irradiators has been a positive incentive for conversion to x-ray systems.

Other applications with wider breadth of technical requirements have not been as easily addressed. Replacement of existing highly specialized irradiators for biomedical research is hindered by the very specific technical requirements and the need to compare results to legacy data. Non-destructive inspection/evaluation applications are utilizing replacement technologies in some cases, but wider conversion will require further miniaturization. Utilization of alternative technologies for well-logging has proven to be a particularly difficult task due to packaging and legacy data issues. While alternative sources exist, an important challenge lies in correlating historical Am/Be data to alternative source data.

While alternative technologies exist for the replacement of radiological sources for many applications, their adoption has been hindered by perceived and real economic and technical issues. The technical issues are the subject of ongoing research.

III. 2010 and 2014 Recommendations

The 2010 Task Force report included three recommendations to facilitate progress in the research, development, and implementation of alternative technologies. Activities under 2010 Recommendation 9 are ongoing, while the assessment of potential cesium chloride (CsCl)

phase-out described in 2010 Recommendation 11 is complete. The programs referenced in 2010 Recommendation 10 remain important and relevant for future efforts. However, the Task Force has decided to status as 'complete' the 2010 recommendation and include the programs it references in a new 2014 recommendation addressing transition to alternative technologies as they become available.

2010 Recommendation 9: The Task Force recommends that the U.S. Government enhance support of short-term and long-term research and development for alternative technologies.

Status: Ongoing.

Despite the progress and accomplishments since 2010 in the research and development of alternative technologies, specific technical and operational challenges remain which prevent potential replacements from making the transition from research and development or prototype to implementation. DHS/DNDO continues to be interested in and DOE/NNSA and other government and non-government partners continue to track and assess these technical obstacles. As a result, alternative technology program and funding support is targeted to areas in which it can be used most efficiently and effectively in the overall risk-reduction effort. Continued research and development is therefore necessary to further develop technologies and system components that will be suitable to replace devices containing Category 1 and 2 sealed sources. A comprehensive approach to the replacement of devices that use Category 1 and 2 sources with alternative technologies cannot be developed or implemented until progress is made in these research and development efforts. In its 2006 and 2010 Task Force reports, the Task Force recognized that policy support mechanisms would be essential in the successful transition to alternative technologies as they become available.

2010 Recommendation 10: The Task Force recommends that the U.S. Government, contingent upon the availability of alternative technologies and taking into consideration the availability of disposal pathways for disused sources, investigate options such as a voluntary prioritized, Government-incentivized program for the replacement of Category 1 and 2 sources with effective alternatives, with an initial focus on sources containing CsCl.

Status: Complete.

2014 Recommendation 3 addresses both the development of programs to incentivize adoption of replacement technologies identified in 2010 Recommendation 10, as well as the first steps toward implementation of replacement technologies as they become available.

2010 Recommendation 11 of the Task Force identified the potential replacement of Category 1 and 2 CsCl sources as a high priority.

2010 Recommendation 11: Contingent upon the availability of viable alternative technologies, the Task Force recommends that the NRC and the Agreement States review whether the licensing for new Category 1 and 2 CsCl sources should be discontinued, taking the threat environment into consideration.

Status: Complete.

In 2008, the NRC and Agreement States evaluated progress in the development of alternative technologies for medical and industrial applications which currently use CsCl devices. The 2008 assessment concluded that without sufficient replacement technologies for the medical and industrial services provided by CsCl sources, a policy to discontinue CsCl sealed source licensing would be premature as also stated by the CsCl Final Policy Statement [NRC 2011a]. In addition, the current lack of financial assurance mechanisms and commercial disposal options for these high-activity sealed sources may also constitute a significant factor in future consideration of CsCl replacement. Similar disposal concerns arise with regard to implementation of replacement technologies more generally. The Task Force continues to assess the progress of alternative technologies for these sources and devices, as recognized in 2014 Recommendation 3. The Task Force also continues to monitor progress on sealed source disposal challenges.

2014 Recommendation

2014 Recommendation 3: The Task Force recommends that the U.S. Government, as appropriate,²⁷ investigate options such as voluntary, prioritized, incentivized, programs for the replacement of Category 1 and 2 radioactive sources with effective alternatives. The Task Force further recommends that U.S. Government agencies, where appropriate, lead by example in the consideration of and transition to alternative technologies that meet technical, operational, and cost requirements.

Incentives and Stakeholder Engagement

In addition to the technical and operational requirements that must be met for alternative technologies to be viable, successful transition to replacements also depends on economic and other non-technical factors. The NAS study and 2010 Recommendation 10 noted development and implementation of appropriate programs and policy mechanisms will be essential to this process. Government incentives for adoption of the alternative technologies can encourage potential 'early-users' in the transition process. Before these incentive programs can be implemented, they must be at the appropriate level of government and must balance National security concerns with cost-effectiveness and efficiency. Stakeholder and expert groups can provide essential support to assist in the evaluation and development of these and similar efforts. With respect to CsCl, the NRC published a Final Policy Statement in the *Federal Register* on July 25, 2011 (76 FR 44378) [NRC 2011a]. The NRC is focusing on continued enforcement of the U.S. security requirements.

²⁷ NRC's statutory mandate precludes it from promoting one technology over another for non-safety or security reasons. The NRC would review in accordance with its procedures any new license application for new technologies.

Initiatives to increase information sharing regarding device use and performance may also be appropriate as alternative technology devices become commercially viable. These efforts can facilitate purchaser consideration of alternative technologies at the time of purchase, such as helping the purchaser ensure that the quality of services provided by the alternative technologies is not diminished in comparison to the use of the sealed source device. These engagement, collaboration, and information sharing efforts should include, as appropriate, the agencies and organizations which develop, regulate, manufacture, and use the devices containing radioactive sealed sources and potential replacements. Other beneficial engagement activities include:

- Evaluation of application-specific technical, operational, and cost requirements for replacement technologies and devices;
- Assessment of application-specific policies that may be effective in supporting technology transitions;
- Prioritization of transition support efforts based on the development status of replacement technologies (including technical, operational, and cost factors) and their risk-reduction potential; and
- Engagement with the appropriate stakeholder communities regarding the benefits of potential replacements, as well as solutions to overcoming transition challenges.

In addition, Federal agencies should consider additional activities to support these and related efforts, such as:

- Develop, maintain, and share, as appropriate, an inventory of commercially available alternative technologies for both outreach and policy planning purposes;
- Cost-benefit analyses to assist in the evaluation of replacement technologies as they become available;
- Develop general and application-specific reference standards and best practices to assist device users in purchasing decisions when replacement technologies are available; and
- Evaluate international efforts in the development and implementation of alternative technologies, including policy support mechanisms and outcomes.

NNSA's Office of Global Threat Reduction and Office of Nuclear Nonproliferation and Verification Research and Development are working together to support the advancement of alternative technologies as replacements for high activity radiological sources. This existing partnership will help initiate the effort to facilitate collaboration among the interagency. NNSA/GTRI has agreed to take the lead on this effort.

Transition to Alternatives

As progress continues in the development of replacement technologies, the Task Force believes that it will be important for the Federal Government to lead by example. An example of a Federal agency leading the way in assessing their needs regarding alternative technologies is the DOD. The DOD through directives, instructions, and service regulations, has made a concerted effort to reduce radioactive sources in the DOD where possible. The DOD has successfully converted from Cs-137 based blood irradiators to x-ray irradiators, is working to

transition to non-radioactive luminosity devices and chemical agent detectors, but has determined there is a need for radioactive moisture density testers. A range of options are available for Federal agencies to encourage the adoption of replacement technologies which meet technical, operational, and cost requirements. For example, Federal agencies procuring Category 1 and 2 sealed sources and devices could document their assessment regarding the replacement of those devices in comparison with available non-radioactive alternatives. If shared among agencies, this information could help purchasers become familiar with replacement trends and decision factors, and could also be used to assess overall progress in conversion efforts. Similar assessment requirements could also be included in Federal research grant applications. These assessments would not only encourage consideration of potential replacement technologies during purchase and funding decisions, they would also serve as an important mechanism to inform stakeholder communities with regard to alternative technology options.

Summary Table of 2006 and 2010 Recommendations and Actions and New 2014 Recommendations

The following table presents the status of the open 2006 and 2010 Task Force recommendations and actions, as presented in the 2010 Task Force report and the new 2014 recommendations and actions. The recommendations and actions that were closed in the 2010 Task Force report have not been included in this report, nor have they been included in this table. The table indicates the type of action that may be necessary to implement the recommendation—legislative change, regulatory change (those recommendations that would require a policy, rule, or procedure change or development in order to implement) or neither (those recommendations that do not involve a change in law or regulation). The table also indicates the status of the recommendation or action and a reference to the applicable page and chapter in the 2006, 2010, and/or 2014 Task Force reports where the initiative is discussed.

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
2006 Recommendation 3-1	The Task Force recommends that the U.S. Government periodically reevaluate the list of radioactive sources that warrant enhanced security and protection to assess their adequacy in light of the evolving threat environment [and consistent with current national consequences of concern in order to provide a consistent level of protection with other critical infrastructure].			Complete, reassessed in 2009 and 2012 as part of periodic reevaluations with consideration of amended bracketed text. Future reevaluations performed as directed by the Task Force, in accordance with the Task	7 (2006 report - "Radioactive Source List" and 2010 and 2014 reports –"Advances in the Security and Control of Radioactive Sources")

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
				Force Charter.	
2006 Recommendation 4-2	The Task Force recommends that the Federal agencies and States continue efforts to improve coordination and communication of their ongoing activities in the area of radiation protection and security for Category 1 and 2 sources.			Complete	6 (2006 report – “Security and Control of Radioactive Sources,” 2010 report – “Coordination and Communication Improvements,” and 2014 report – “Advances in the Security and Control of Radioactive Sources”)
2006 Action 4-1	The NRC should consider imposing additional measures to verify the validity of licenses, before transfer of risk-significant radioactive sources, on all licensees authorized to possess Category 1 and 2 quantities of radioactive material.			Complete	17 (2006 report – “Security and Control of Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
					Sources”)
2006 Recommendation 5-1	The Task Force recommends development of a Transport Security Memorandum of Understanding to serve as the foundation for cooperation in the establishment of a comprehensive and consistent transport security program for risk-significant sources.			Ongoing	20 (2006 report – “Transportation Security of Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Recommendation 5-2	The Task Force recommends that the U.S. Government evaluate the feasibility of using new and existing technologies to detect and discourage the theft of risk-significant radioactive material during transport. The evaluation should include the findings of operational testing of existing technologies offering enhanced security of motor carrier shipments of hazardous material; shipment tracking, including communication systems; radio-frequency identification; vehicle disabling technologies; and mobile and stationary radiation detection systems.			Complete	20 (2006 report – “Transportation Security of Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Recommendation 5-3	The Task Force recommends that the U.S. Government immediately develop a strategy and take actions to address the security of international shipments of Category 1 and 2 radioactive sources		Yes	Complete	21 (2006 report – “Transportation Security of

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
	that transit or are transshipped through the land territory of the United States.				Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Action 5-1	The Transportation Security Subgroup should review the findings and conclusions of all research conducted on securing “high hazard” hazardous materials transport to determine if any of the measures should be applied to transport of risk-significant radioactive sources.			Complete	22 (2006 report – “Transportation Security of Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Action 6-1	The NRC should expeditiously complete its implementation of the fingerprinting provisions of the EAct for those applicants for and licensees with Category 1 and 2 quantities of radioactive material. The NRC should place a high priority on completing the EAct Section 652 rulemaking. As part of the rulemaking, the NRC should require fingerprinting for any individual who could have access to Category 2 or above quantities of			Complete	12 (2006 report – “Background Checks” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
	radioactive materials. The NRC should also require periodic reinvestigations of such persons.				Sources”)
2006 Action 6-2	The NRC should evaluate the feasibility of establishing a national database for materials licensees that would contain information on pending applications and information on individuals cleared for unescorted access.			Complete	13 (2006 report – “Background Checks” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
2006 Action 9-1	The DOE should continue its ongoing efforts to develop GTCC [LLRW] disposal capability.	Possibly		Ongoing	40 (2006 report – “National System to Provide for the Proper Disposal of Radioactive Sources,” 2010 report – “Status of the Recovery and Disposition of Radioactive Sources,” and 2014 report - “Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources”)
2006 Action 10-1	The U.S. Government should continue the efforts to promote international harmonization of import and export controls for Category 1 and 2 radioactive sources.			Complete	23 (2006 report – “Import and Export Controls for Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
2006 Action 10-2	The U.S. Government should encourage suppliers to provide arrangements for the return of disused sources and examine means to reduce regulatory impediments that currently make this option unavailable.			Ongoing	23 (2006 report – “Import and Export Controls for Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Action 10-3	The Task Force suggests the use of education and the creation of incentives to discourage the export of used Category 1 and 2 radioactive sources as an alternative to disposal.			Complete	24 (2006 report – “Import and Export Controls for Radioactive Sources” and 2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2006 Action 11-2	The NRC should consider programming the NSTS to provide automatic daily information to [U.S.] Customs [and Border Patrol] on import/export shipment notifications.			Complete	19 (2006 report – “National Source Tracking System” and 2010 and 2014

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
					reports – “Advances in the Security and Control of Radioactive Sources”)
2010 Recommendation 1	The Task Force recommends that U.S. Government agencies use the radionuclides and the associated Category 2 threshold quantities in Table II, “Radionuclides that Warrant Enhanced Security and Protection” (as shown on page 11 of the 2010 Task Force report), as the appropriate framework for considering which sources warrant enhanced security* and that they adopt the definitions for a significant RED and a significant RDD (as shown on page 8 of the 2010 Task Force report) for prioritizing and allocating resources to eliminate, control, or mitigate risks of malevolent radiological incidents. *By warrants enhanced security and protection is meant enhanced in comparison to the security and protection applied to radioactive sealed sources before September 11, 2001.			Complete	8 (2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2010 Recommendation 2	The Task Force recommends that U.S. Government agencies should reevaluate their protection and mitigation strategies to protect against significant RED or RDD attack using both potential severe immediate or short-term exposure and contamination consequences to public health, safety, and the environment as the consequences of concern.		Possibly	Ongoing	8 (2010 and 2014 reports – “Advances in the Security and Control of Radioactive

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
	Agencies should use the Task Force-endorsed definitions, radionuclides, and thresholds for a significant RED and RDD and the associated assumptions and parameters as common guidance in the assessment of risk and management of homeland security activities.				Sources”)
2010 Recommendation 3	Contingent upon the availability of alternative technologies, the Task Force recommends that the NRC evaluate whether the export licensing for Category 1 and 2 CsCl sources should be discontinued, taking the availability of disposal capacity and the threat environment into consideration.		Yes	Complete	25 (2010 and 2014 reports – “Advances in the Security and Control of Radioactive Sources”)
2010 Recommendation 4	The Task Force recommends that the U.S. Government, regional compacts, and States continue to evaluate disposal options for disused radioactive sources, including options for handling a potentially large number of disused cesium chloride sources that may be replaced once viable alternatives are available.	Possibly	Possibly	Ongoing	39 (2010 report – “Status of the Recovery and Disposition of Radioactive Sources” and 2014 report - “Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources”)
2010 Recommendation 5	The Task Force recommends that Federal and State Governments investigate options such as providing			Ongoing	41 (2010 report –

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
	short-term secured storage of sources recovered from U.S. owners that contain foreign-origin americium-241 radioactive material, so that these sources can be recovered now, and increase efforts to investigate options for disposal of these sources.				"Status of the Recovery and Disposition of Radioactive Sources" and 2014 report - "Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources")
2010 Recommendation 6	The Task Force recommends that the NRC incorporate procedures to review the status, such as the date of, the reason for, and location of sources in long-term storage, in the current inspection program.			Complete	35 (2010 report – "Status of the Recovery and Disposition of Radioactive Sources" and 2014 report - "Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources")

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
2010 Recommendation 7	The Task Force recommends that the U.S. Government, in collaboration with responsible State agencies, evaluate and develop a plan to improve, as necessary, processes for dealing with unwanted, abandoned, or impounded sources, including storage, reuse, recycling, or other disposition methods.			Complete	38 (2010 report – “Status of the Recovery and Disposition of Radioactive Sources” and 2014 report - “Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources”)
2010 Recommendation 8	The Task Force recommends that the U.S. Government enhance support of short-term and long-term research and development of certified Type B containers for use in domestic and international source recovery efforts.			Ongoing	38 (2010 report – “Status of the Recovery and Disposition of Radioactive Sources” and 2014 report - “Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources”)
2010 Recommendation 9	The Task Force recommends that the U.S. Government enhance support of short-term and long-term research and development for alternative			Ongoing	48 (2010 report – “Progress in the

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
	technologies.				Area of Alternative Technologies")
2010 Recommendation 10	The Task Force recommends that the U.S. Government, contingent upon the availability of alternative technologies and taking into consideration the availability of disposal pathways for disused sources, investigate options such as a voluntary prioritized, Government-incentivized program for the replacement of Category 1 and 2 sources with effective alternatives, with an initial focus on sources containing CsCl.		Yes	Complete	48 (2010 report – “Progress in the Area of Alternative Technologies”)
2010 Recommendation 11	Contingent upon the availability of viable alternative technologies, the Task Force recommends that the NRC and the Agreement States review whether the licensing for new Category 1 and 2 CsCl sources should be discontinued, taking the threat environment into consideration.			Complete	48 (2010 report – “Progress in the Area of Alternative Technologies”)
2014 Recommendation 1	The Task Force recommends that U.S. Government agencies assess the adequacy of and coordinate strategies for preventing and mitigating cybersecurity vulnerabilities related to Category 1 and 2 radioactive sources.		Yes		13 (2014 report – “Advances in the Security and Control of Radioactive Sources”)

	Recommendations and Actions	Legislative Change	Regulatory Change	Status	Page Number, Report, and Chapter Reference
2014 Recommendation 2	The Task Force recommends that the NRC evaluate the need for sealed source licensees to address the eventual disposition/disposal costs of Category 1 and 2 quantities of radioactive sources through source disposition/disposal financial planning or other mechanisms. Disposition costs should include the cost of packaging, transport, and disposal (when available) of these sources.		Yes		34 (2014 report – “Status of the Recovery and Disposition of Commercial Radioactive Sealed Sources”)
2014 Recommendation 3	The Task Force recommends that the U.S. Government, as appropriate, ²⁸ investigate options such as voluntary, prioritized, incentivized, programs for the replacement of Category 1 and 2 radioactive sources with effective alternatives. The Task Force further recommends that U.S. Government agencies, where appropriate, lead by example in the consideration of and transition to alternative technologies that meet technical, operational, and cost requirements.				49 (2014 report – “Progress in the Area of Alternative Technologies”)

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NRC’s statutory mandate precludes it from promoting one technology over another for non-safety or security reasons. The NRC would review in accordance with its procedures any new license application for new technologies.

One of the above recommendations and one of the above actions either highlight or may necessitate legislative changes. The following provides further information:

- 2006 Action 9-1: Pursuant to EPA Act Section 631, before the U.S. Department of Energy can issue a final decision on a disposal alternative for greater-than-Class C low-level radioactive waste, it must first issue a report to Congress describing the disposal alternatives under consideration and await Congressional action. Some alternatives may require legislative action to implement.
- 2010 Recommendation 4: The current State compact disposal system, as established in the Low-Level Radioactive Waste Policy Amendments Act, is partially working as intended, but not providing disposal options for all generators of low-level radioactive waste. Potential disposal solutions must be fostered at the highest levels of Federal and State Government.

The Task Force will continue to maintain and update an implementation plan for all of these recommendations and actions. The implementation plan was developed as a living document following the issuance of the first report. The implementation plan includes timelines for completion and tracks achievements towards completion of these activities. In its development of the first implementation plan update following the issuance of this report, the Task Force plans to outline its strategic plan to more effectively and efficiently track open recommendations and actions via other mechanisms. These other mechanisms, such as through other routine interagency coordination groups or through developments of agreements with applicable agencies that have the responsibility and authority to carry out the recommended initiatives, may better foster timely completion of some of the initiatives.

References

- [AEA 1954] Atomic Energy Act of 1954, as amended. Pub. L. 83-703, 68 Stat. 919 (42 U.S.C. 2011 et seq.) (1954).
- [CRCPD 2013] Conference of Radiation Control Program Directors, Inc. "SCATR Program (Source Collection and Threat Reduction)." January 18, 2013. <http://www.crcpd.org/StateServices/SCATR.aspx>.
- [DOE 2008a] Department of Energy (U.S.). DOE Directive DOE N 234.1, "Reporting of Radioactive Sealed Sources." February 27, 2008 (expired but extended by DOE Notice 251.76).
- [DOE 2008b] Department of Energy (U.S.). DOE Directive DOE O 462.1, "Import and Export of Category 1 and 2 Radioactive Sources and Aggregated Quantities." November 10, 2008.
- [DOE 2011] Department of Energy (U.S.). DOE Directive DOE O 231.1B, "Environment, Safety and Health Reporting." June 27, 2011.
- [DOE 2014] Department of Energy (U.S.). "Greater-Than-Class C Low-Level Radioactive Waste EIS Information Center." 2014. <http://www.gtcceis.anl.gov/>.
- [DHS 2008] Department of Homeland Security (U.S.). "2008 Strategic Homeland Infrastructure Risk Assessment (SHIRA), 2008 Data Call Guidance Materials." October 10, 2008.
- [DHS 2010] Department of Homeland Security (U.S.). "DNDO Feasibility Study of Electronically Tagging and Tracking Portable Radiation Radiography and Oil Well Logging Sources, SAND2010-6905." October 2010. (non-publicly available).
- [EPAct 2005] Energy Policy Act of 2005. Pub. L. 109-58, Sec. 170H.f. August 8, 2005.
- [GAO 2005] Government Accountability Office (U.S.). GAO-05-967, "DOE Needs Better Information to Guide Its Expanded Recovery of Sealed Radiological Sources."
- [GAO 2007] Government Accountability Office (U.S.). GAO-07-1038T, "Testimony Before the Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, United States Senate, 'Actions Taken by NRC to Strengthen Its Licensing Process for Sealed Radioactive Sources Are Not Effective.'" July 12, 2007.
- [GAO 2013] Government Accountability Office (U.S.). GAO-13-732, "Department of Homeland Security – Opportunities Exist to Better Evaluate and Coordinate Border and Maritime Research and Development." September 25, 2013.
- [IAEA 2004] International Atomic Energy Agency. "Code of Conduct on the Safety and Security of Radioactive Sources." January 2004.
- [IAEA 2005] International Atomic Energy Agency. "Guidance on the Import and Export of Radioactive Sources." March 2005.

[LLRWPA 1985] Low-Level Radioactive Waste Policy Amendments Act (LLRWPA) of 1985, as amended. Pub. L. 99-240. 1985.

[NAS 2008] National Research Council of the National Academies. "Radiation Source Use and Replacement, Abbreviated Version." 2008.

[NRC 1995] Nuclear Regulatory Commission (U.S.). "Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part to Waste Classification Technical Position." January 17, 1995.
<http://pbadupws.nrc.gov/docs/ML0336/ML033630732.pdf>.

[NRC 2005] Nuclear Regulatory Commission (U.S.). "In the Matter of All Licensees Authorized To Possess Radioactive Material Quantities of Concern, Order Imposing Increased Controls (Effective Immediately)." *Federal Register*, Vol. 70, No. 230, December 1, 2005, pp. 72128–72132.

[NRC 2006] Nuclear Regulatory Commission (U.S.). "Radiation Source and Protection Task Force Report." August 15, 2006. (ADAMS Accession No. ML062190349).

[NRC 2007a] Nuclear Regulatory Commission (U.S.). "In the Matter of: Licensees Authorized To Possess Radioactive Material Quantities of Concern; Order Imposing Fingerprinting and Criminal History Records Check Requirements for Unescorted Access To Certain Radioactive Material (Effective Immediately)." *Federal Register*, Vol. 72, No. 239, December 13, 2007, pp. 70901–70905.

[NRC 2007b] Nuclear Regulatory Commission (U.S.). SECY-07-0147, "Response to U.S. Government Accountability Office Recommendations and Other Recommendations to Address Security Issues in the U.S. Nuclear Regulatory Commission Materials Program." August 25, 2007.
<http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2007/secy2007-0147/2007-0147scy.pdf>.

[NRC 2007c] Nuclear Regulatory Commission (U.S.). SRM-SECY-07-0147, "Staff Requirements—SECY-07-0147—Response to GAO Recommendations and Other Recommendations to Address Security Issues in the NRC Materials Program." September 18, 2007.
<http://www.nrc.gov/reading-rm/doc-collections/commission/srm/2007/2007-0147srm.pdf>.

[NRC 2008a] Nuclear Regulatory Commission (U.S.). "Comprehensive Assessment of Security Vulnerabilities in the NRC's Radioactive Materials Program, Final Report of the Materials Program Working Group." October 23, 2008. (ADAMS Accession No. ML082970734) (non-publicly available).

[NRC 2008b] Nuclear Regulatory Commission (U.S.). "Final Report of the Independent External Review Panel to Identify Vulnerabilities in the U.S. Nuclear Regulatory Commission's Materials Licensing Program." March 11, 2008. (ADAMS Accession No. ML080700957).

[NRC 2008c] Nuclear Regulatory Commission (U.S.). "Request to Implement the Checklist to Provide a Basis for Confidence that Radioactive Material will be Used as Specified on a License

and the Checklist for Risk-Significant Radioactive Material.” September 22, 2008. (ADAMS Accession No. ML082630230) (non-publicly available).

[NRC 2008d] Nuclear Regulatory Commission (U.S.). Regulatory Issue Summary 2008-18, “Information on Requests for Extending Use of Expiring Transportation Packages.” August 14, 2008. (ADAMS Accession No. ML081920729).

[NRC 2010a] Nuclear Regulatory Commission (U.S.). “NRC to Hold Public Workshop on Cesium Chloride Policy Statement Nov. 8-9 in Rockville, MD, No. 10-176.” October 5, 2010. <http://pbadupws.nrc.gov/docs/ML1027/ML102780526.pdf>.

[NRC 2010b] Nuclear Regulatory Commission (U.S.). “The 2010 Radiation Source Protection and Security Task Force Report.” August 11, 2010. (ADAMS Accession No. ML102230141).

[NRC 2011a] Nuclear Regulatory Commission (U.S.). “Policy Statement of the U.S. Nuclear Regulatory Commission on the Protection of Cesium-137 Chloride Sources.” *Federal Register*, Vol. 76, No. 142, July 25, 2011, pp. 44378–44383.

[NRC 2011b] Nuclear Regulatory Commission (U.S.). SECY-11-0094, “Advantages and Disadvantages of Changing the Current Authentication Assurance Level (Level 4) of the National Source Tracking System.” July 13, 2011. <http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2011/2011-0094scy.pdf>.

[NRC 2011c] Nuclear Regulatory Commission (U.S.). SRM-SECY-11-0094, “Staff Requirements–SECY-11-0094–Advantages and Disadvantages of Changing the Current Authentication Assurance Level (Level 4) of the National Source Tracking System.” September 6, 2011. <http://www.nrc.gov/reading-rm/doc-collections/commission/srm/2011/2011-0094srm.pdf>.

[NRC 2012] Nuclear Regulatory Commission (U.S.). “Draft Branch Technical Position on Concentration Averaging and Encapsulation, Revision 1.” May 2012. <http://pbadupws.nrc.gov/docs/ML1211/ML121170418.pdf>.

[NRC 2013a] Nuclear Regulatory Commission (U.S.). “Branch Technical Position on the Import of Non-U.S. Origin Radioactive Sources.” *Federal Register*, Vol. 78, No. 167, August 28, 2013, pp. 53020-53025.

[NRC 2013b] Nuclear Regulatory Commission (U.S.). “NRC Inspection Manual Chapter (IMC) 1248 Formal Qualifications Program for Federal and State Materials and Environmental Management Programs.” April 19, 2013. (ADAMS Accession No. ML12240A129).

[NRC 2013c] Nuclear Regulatory Commission (U.S.). “NRC Inspection Manual Chapter (IMC) 1248, Appendix A, Materials Health Physics License Reviewer Qualification Journal.” April 19, 2013. (ADAMS Accession No. ML12240A131).

[NRC 2013d] Nuclear Regulatory Commission (U.S.). “NRC Inspection Manual Chapter (IMC) 1248, Appendix B, Materials Health Physics Inspector Qualification Journal.” April 19, 2013. (ADAMS Accession No. ML12240A135).

[NRC 2013e] Nuclear Regulatory Commission (U.S.). NUREG-2155, Implementation Guidance for 10 CFR Part 37, “Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material.” February 2013. (ADAMS Accession No. ML13053A061).

[NRC 2013f] Nuclear Regulatory Commission (U.S.). “Physical Protection of Byproduct Material: Final Rule.” *Federal Register*, Vol. 78, No. 53, March 19, 2013, pp. 16922–17022.

[NRC 2013g] Nuclear Regulatory Commission (U.S.). “Security Orders and Requirements.” August 15, 2013. <http://www.nrc.gov/security/byproduct/orders.html>.

[NRC 2014a] Nuclear Regulatory Commission (U.S.). NUREG-1556, “Consolidated Guidance About Materials Licenses.” January 8, 2014. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/>.

[NRC 2014b] Nuclear Regulatory Commission (U.S.). Regulatory Issue Summary 2014-04, “National Source Tracking System Long-Term Storage Indicator.” May 12, 2014. (ADAMS Accession No. ML14100A152).

[TRSGF 2010] Tracking of Radioactive Sources Focus Group of the Radioisotopes Subcouncil of the Nuclear Government and Sector Coordinating Councils. “Tracking of Radioactive Sources Focus Group White Paper, Deliverable of the Tracking of Radioactive Sources Focus Group of the Radioisotopes Subcouncil of the Nuclear Government and Sector Coordinating Councils.” June 30, 2010.

[10 CFR Part 20] *U.S. Code of Federal Regulations*, “Standards for Protection Against Radiation,” Part 20, Chapter I, Title 10, “Energy.”

[10 CFR Part 30] *U.S. Code of Federal Regulations*, “Rules of General Applicability to Domestic Licensing of Byproduct Material,” Part 30, Chapter I, Title 10, “Energy.”

[10 CFR Part 37] *U.S. Code of Federal Regulations*, “Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material,” Part 37, Chapter I, Title 10, “Energy.”

[10 CFR Part 61] *U.S. Code of Federal Regulations*, “Licensing Requirements for Land Disposal of Radioactive Waste,” Part 61, Chapter I, Title 10, “Energy.”

[10 CFR Part 73] *U.S. Code of Federal Regulations*, “Physical Protection of Plants and Materials,” Part 73, Chapter I, Title 10, “Energy.”

[10 CFR Part 110] *U.S. Code of Federal Regulations*, “Export and Import of Nuclear Equipment and Material,” Part 110, Chapter I, Title 10, “Energy.”

Appendix A

Acronyms and Abbreviations

AEA	Atomic Energy Act
Am	americium
Am/Be	americium beryllium (containing Am-241)
Be	beryllium
BTP	Branch Technical Position
CBP	Customs and Border Protection, U.S.
CFR	<i>Code of Federal Regulations, U.S.</i>
Ci	curie
Co	cobalt
CRCPD	Conference of Radiation Control Program Directors
Cs	cesium
CsCl	cesium chloride (containing Cs-137)
DEIS	Draft Environmental Impact Statement
DHS	Department of Homeland Security, U.S.
DNDO	Domestic Nuclear Detection Office (DHS)
DOE	Department of Energy, U.S.
DOS	Department of State, U.S.
DOT	Department of Transportation, U.S.
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency, U.S.
EPAct	Energy Policy Act of 2005
FBI	Federal Bureau of Investigation
FY	Fiscal Year
GAO	Government Accountability Office, U.S.
GTCC	greater-than-Class C
GTRI	Global Threat Reduction Initiative
G-8	Group of Eight
IAEA	International Atomic Energy Agency
IERP	Independent External Review Panel
IMPEP	Integrated Materials Performance Evaluation Program
Ir	iridium
ISMP	Integrated Source Management Portfolio
kCi	kilocuries
LLRW	low-level radioactive waste
LLRWPA	Low-Level Radioactive Waste Policy Amendments Act of 1985

LVS	License Verification System
MOU	memorandum of understanding
MPWG	Materials Program Working Group
NAS	National Academy of Sciences
NGCC	Nuclear Government Coordinating Council (DHS)
NNSA	National Nuclear Security Administration (DOE)
NOC	National Operations Center
NRC	Nuclear Regulatory Commission, U.S
NSTS	National Source Tracking System
OAS	Organization of Agreement States
OTP	One Time Password
PLGWG	Pre-Licensing Guidance Working Group
PPD	Presidential Policy Directive
Pu	plutonium
Pu/Be	plutonium beryllium (containing Pu-239)
RDD	radiological dispersal device
RED	radiation exposure device
RIS	Regulatory Issue Summary
SCATR	Source Collection and Threat Reduction Program
Se	selenium
Task Force	Interagency Task Force on Radiation Source Protection and Security
TSA	Transportation Security Administration (DHS)
U.S.	United States
U.S.C.	United States Code
WBL	Web-Based Licensing System
WCS	Waste Control Specialists
WINS	World Institute of Nuclear Security
μCi	microcuries

Appendix B

Glossary

Agreement State

A State that has signed an agreement with the U.S. Nuclear Regulatory Commission (NRC), pursuant to section 274 of the Atomic Energy Act, 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.

Compact

A group of two or more States that have formed business alliance to dispose of low-level radioactive waste on a regional basis, as authorized by the Low-Level Radioactive Waste Policy Amendments Act of 1985, as amended.

Curie

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 (3.7×10^{10}) disintegrations per second, so 1 Ci also equals 37 billion (3.7×10^{10}) 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.

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. To meet this definition, a licensee or owner for the sealed source must be clearly identifiable.

Greater-than-Class C Radioactive Waste

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

License

A permit, granted by an appropriate governmental body, allowing an entity to carry on some authority subject to regulation by the governmental body. The NRC issues licenses in accordance with Title 10 CFR, or an Agreement State issues a license under its equivalent regulations. The NRC and Agreement States issue about 21,000 specific licenses for medical, academic, and industrial uses of nuclear materials. Reactor and accelerator-produced radionuclides are used extensively throughout the United States for civilian and military

industrial applications, basic and applied research, the manufacture of consumer products, civil defense activities, academic studies, and medical diagnostics, treatment and research. The regulatory programs of the NRC and Agreement States are designed to ensure that licensees safely use these materials and do not endanger public health and safety or cause damage to the environment.

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 (1) a lack of a final disposal option, (2) a lack of available funds, (3) a need for time to complete an amended or new authorization, or (4) a 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 or security risk posed by a source. However, long-term storage may not permanently alleviate the risk associated with the source.

Radiation Exposure Device

An object used to maliciously expose people, equipment, and/or the environment to ionizing radiation without dispersal of radioactive material.

Radioactive Source

Radioactive material that is permanently sealed in a capsule or closely bonded, in a solid form, and which is not exempt from regulatory control. It does not mean material encapsulated for disposal, or nuclear material within the nuclear fuel cycles of research and power reactors.

Radiological Dispersal Device

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

Risk-Significant Source

A risk-significant source refers to Category 1 and 2 sources as defined in the International Atomic Energy Agency's (IAEA) Code of Conduct.

Risk-Significant Quantity

A risk-significant quantity refers to aggregated radioactive material that together meets or exceeds the Category 1 or 2 thresholds from the IAEA Code of Conduct.

Safeguards Information

A special category of sensitive unclassified information that must be protected. Safeguards Information concerns the physical protection of operating power reactors, spent fuel shipments, strategic special nuclear material, or other radioactive material.

Source Collection and Threat Reduction (SCATR) Program

The Conference of Radiation Control Program Directors (CRCPD) launched the SCATR Program in 2006, based on funding from the U.S. Department of Energy. 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 to proper dispositioning to reduce the threat of these sources being used for malicious intent.

Special Nuclear Material

Special nuclear material is defined by Title I of the Atomic Energy Act of 1954 as (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.

Spent Nuclear Fuel

Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

Storage

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

