10 YEARS AND 20,000 SOURCES: THE GTRI OFFSITE SOURCE RECOVERY PROJECT

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ABSTRACT

The Global Threat Reduction Initiative's (GTRI) Offsite Source Recovery Project (OSRP) has been recovering excess and unwanted radioactive sealed sources for ten years. In January 2009, GTRI announced that the project had recovered 20,000 sealed radioactive sources. This project grew out of early efforts at Los Alamos National Laboratory (LANL) to recover and disposition excess Plutonium-239 (Pu-239) sealed sources that were distributed in the 1960s and 1970s under the Atoms for Peace Program. Decades later, these sources began to exceed their design life or fall out of regular use. Sealed source recovery was initially considered a waste management activity, but after the terrorist attacks of 2001, the interagency community began to recognize the threat posed by excess and unwanted radiological materials, particularly those that could not be disposed at the end of their useful life. After being transferred to the U.S. National Nuclear Security Administration (NNSA) to be part of GTRI, OSRP's mission was expanded to include not only material that would be classified as Greater-than-Class-C (GTCC) when it became waste, but also any other materials that might constitute a "national security consideration." This paper discusses OSRP's history, recovery operations, expansion to accept high-activity beta-gamma-emitting sealed sources and devices and foreign-possessed sources, and more recent efforts such as involvement in GTRI's Search and Secure project. Current challenges and future work will also be discussed.

Keywords-Sealed source, radiological security, waste, orphan

1.0 INTRODUCTION: THE SEALED SOURCE PROBLEM

Radioactive sealed sources have been produced in the United States (U.S) and a few other countries for more than 100 years in one form or another. Perhaps the first sealed sources made in the U.S. were Ra-226 sealed sources produced early in the twentieth century. During World War II, successful fission experiments led to the manufacture of the first man-made isotopes (byproducts of the production of material for atomic weapons), including Plutonium (Pu)-239. By 1949, the Los Alamos National Laboratory had developed Pu-239 beryllium neutron sources that found a variety of research applications. In 1954, the United States began to distribute special nuclear materials under the Atoms for Peace Program introduced by President Eisenhower. In a December 1953 address to the United Nations, Eisenhower said, "It is not enough to take this weapon (i.e., fissionable material) out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace…" [1].

Toward that end, the U.S. made Pu-239 sealed sources available both domestically and internationally from the late 1950s through the early 1970s under a loan-lease program that serviced 31 countries, as well as domestic users. Production and sale of other isotopes quickly followed. Over the past 50 years, the U.S. alone supplied thousands of sealed radioactive sources and substantial amounts of material usable for sealed source manufacture to users in the U.S. and to numerous other countries. Although the U.S. no longer distributes many source-usable isotopes, other countries have become major suppliers, including Russia, Argentina, China, and India. A large number of beneficial uses now depend on these materials (Figure 1), including blood and medical supplies irradiation, food irradiation, oil exploration, moisture density measurements for road and building construction and agriculture, gauging for various industrial applications, radiography (to assess metal integrity), brachytherapy medical treatments, research, and many others.

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Figure 1: Beneficial Applications of Sealed Sources (Clockwise from top left). Well logging, Gauging (for moisture density and other types of measurements), Irradiation (blood), Radiography

While the number of beneficial uses has multiplied, the pathways for final disposition either never existed (in many countries) or have decreased. Many sources manufactured in the U.S. and other countries have already or are now reaching the end of their useful life due either to decay of the radioactive isotope, fatigue of the metal encapsulating material or sealing welds, or simple exceedance of their design life. As a result, many sealed sources are becoming disused and unwanted concurrently with the lack of a disposal pathway for their final disposition. This combination of wide beneficial use and lack of a disposal/end-of-life pathway leads to vulnerable sources that can fall out of regulatory control over time and, in some cases, accumulate. The unique concerns posed by concentrated radioactive material that is disused and not adequately controlled have been articulated many times over the history of the DOE OSRP, including the following by the European Commission: "…the sources at greatest risk of being lost from regulatory control are disused (unwanted) sources held in local storage at the user's premises waiting for final disposal or return to manufacturer"… [2]. The U.S. Government Accounting Office (GAO) also mentioned that the consequences of a radiological material dispersal "Even without an intentional act…can lead to radiation exposure, high decontamination costs, and public panic" [3].

2.0 EARLY SOURCE RECOVERY HISTORY

A. Pre-1999 Source Recoveries

A limited number of recoveries of disused, unwanted sealed sources were conducted by various national entities prior to the official start of the OSRP in 1999. One example is Gammator irradiator recoveries. Beginning in about 1967, the Radiation Machinery Corporation (RAMCO) manufactured the Gammator 50 self-shielded irradiator. More than 100 Gammator 50 devices were distributed to high schools, colleges, hospitals and other firms under the "Atoms for Peace" program. The Gammator irradiator was known by many different names over the years as the manufacturer was bought and sold or merged, including the Gammator 50, Gammator 50B, RAMCO-50-ORNL, RAMCO 50M or Model M irradiator and Gammacell 1000 (made by Atomic Energy of Canada, Limited (AECL) during the 1980s). In the early 1990s, the U.S. Nuclear Regulatory Commission (NRC) began receiving calls about high schools near and in New York City having problems dispositioning Gammator units, many of which were discovered to be unlicensed. In 1995, DOE EM received a request for assistance from the to remove two Gammator units at high schools in the northeast [3]. The high schools were the original owners of these units but had never been licensed. DOE-EM, including the then-LANL-Radioactive Source Recovery Program (RSRP), contracted with the original irradiator manufacturer to remove the Gammator units, with recycle of the sources as the disposition pathway [4].

Another program funded by DOE Defense Programs (DP) at LANL, the Pu-239/Be Neutron Source Recovery Program, accepted unwanted Pu-239/Beryllium (Be) sealed sources for destruction and recovery of the Pu-239 by chemical processing for potential reuse. From 1979 to 1999, the program accepted and processed 1,171 Pu-239 sealed sources [5]. However, problems including expense (> US$ 20,000 per source), throughput (no more than 80-100 sources per year could be processed), high contribution to employee radiation exposure, and creation of by-product process waste caused this project to be halted in 1998.

B. Operations and Milestones: 1999-2003

In January 1999, DOE-Albuquerque's (DOE-AL) Waste Management Division assumed management of three DOE EM programs at LANL that had been managed directly from DOE-Headquarters: the Off-Site Waste (OSW) Program, the RSRP, and the Pu-239/Be Neutron Source Recovery Program [5]. The immediate objectives of the project were to:

1. Recover 41 sealed sources as directed by DOE-AL based on a request from the NRC
2. Develop a scope for the new project, including developing a neutron-shielded Type A container in which sources could be consolidated for storage and disposal
3. Prepare to store actinide-bearing sealed sources safely and cost-effectively at LANL Technical Area (TA)-54 Area G, which was already a transuranic Waste Storage Facility

Part of the project mission from the start was to meet DOE's obligations under the Low-Level Radioactive Waste Policy Amendments Act (PL 99-240) to provide for disposition of Greater-than-Class-C (GTCC) low-level waste [5,6]. Pending development of a GTCC disposal facility that would meet these obligations, DOE "created the Off-Site Source Recovery Project, which, since fiscal year 1999 has been recovering unwanted greater-than-Class-C sealed sources from their owners…"[6]. The Government Accounting Office (GAO) also noted in 2003 that DOE created OSRP "to comply with Public Law 99-240 until a disposal facility became available: hence, the project was never envisioned as a permanent solution." However, as reported by GAO, DOE "had not made progress toward providing for the permanent disposal of greater-than-Class-C radioactive waste, and it is unlikely to provide such a facility by fiscal year 2007…because it is not a priority with the office" [6]. OSRP's mission has since become less tied to DOE's GTCC responsibilities, which are not related to the consequences of accidental or deliberate misuse of material. The project now is more linked to removal of material that poses a national security threat, as will be discussed later.

The scope of the unwanted sealed source problem was estimated at 18,000 GTCC sources at "hundreds of business and university locations throughout the country...with little or no security. The public health and safety will be better protected with these sources recovered and safely stored on a DOE site"[5]. It was also noted that removal of unwanted sources would reduce the potential for terrorism.

In the first months of existence, OSRP continued to recover Pu-239 sources, although this was now restricted to sources with a clear defense pedigree due to disposal requirements. The project also initiated planning for the recovery of Am-241 and Pu-238 sources in addition to the Pu-239 and recovered 90 sources during FY 2000 [5]. Finally, the project began using a database to track excess and unwanted sealed sources, ultimately setting up a website with a registration utility on which sources could be registered with the project to be assessed for recovery (see http://osrp.lanl.gov). Other major milestones in the early years of the project were as follows:

- June 1999: DOE and NRC, the US regulatory authority for licensing or radioactive material owners, entered into a memorandum of understanding formalizing agreements going back to 1992 under which DOE would recover and stored unwanted or "orphan" sources until it developed a GTCC disposal facility.
- September 1999: Provided an environmental analysis required under the U.S. National Environmental Policy Act (NEPA) to supplement a December 1995 Environmental Assessment 1059 in DOE/EIS-0238 [7], and documented NEPA review for storage at LANL (LAN-99-049) [8]. These analyses showed that the project posed no appreciable environmental risk over and above current site operations.
- 2000: Initiated Pu-238 pacemaker recoveries with limited funding. Sufficient budget was provided in 2001 to allow routine recovery of Pu-238 sources, so OSRP started modifying an existing special form capsule design to meet its needs
- 2001-2: After receiving certain authorizations, OSRP started Am-241 recoveries in August 2001. By the end of 2002, Am-241 and Pu-238 source recoveries were routine, with storage at LANL pending disposal.
- Safety Authorization Basis – OSRP produced Safety Analysis Reports covering storage and repackaging.
- January 2002: DOE Under Secretary Robert Card received a memo from NRC Chairman Richard Meserve [9] requesting acceleration of OSRP source recovery efforts in response to a post-September 11

evaluation of vulnerabilities that concluded that "the hazards associatred with radioactive materials registered with the OSRP warrant additional actions to reduce the risk to public health and safety." Meserve noted that NRC "had concluded that possession or storage of unwanted radioactive sealed sources with no disposal outlet presents a potential vulnerability." Card responded in December 2002 that DOE agreed "that recovery of these sources is important to mitigate a potential homeland security threat," that Congress had appropriated an additional $10 million for the acceleration, and that the recovery of 5,000 sources would be accelerated. The FY02 budget for OSRP included new funding of $10M to accomplish recovery of an additional 5000 sealed sources over the next 18 months.

- May 2003: A DOE/NRC interagency working group formed to address security concerns regarding the radioactive materials that could be used in a radiological dispersal device issued a report that, among other things, recommended that actions be taken to develop a national threat policy based on vulnerability assessments, a national source tracking system, and an integrated national strategy for disposing of unsecured sealed radiological sources [6, 10].
- May 2003: After years of developing the disposal pathway at DOE's Waste Isolation Pilot Plant (WIPP) for transuranic (TRU) sources, OSRP accomplished the first disposal of two drums containing waste sealed sources at WIPP. Also received a WIPP Resource Conservation and Recovery Act permit modification exempting OSRP from headspace gas sampling requirements for hazardous mixed waste
- June 4, 2003: Disposal of all U.S.-origin Pu-239 sealed sources at WIPP was approved
- December 2003: Successful radiological characterization methodology was approved by peer review, as an alternative to assay, due to robust shielded packaging configurations and other considerations
- Continued with development of a 220-liter pipe overpack container as a "multifunction" transport and storage container for OSRP [5] so that recovered sources would not require repackaging prior to disposal – and to enhance consolidation for both storage and disposal.

III. Operations and Milestones: 2003-Present

OSRP management and operations began to change in late 2003, at least partially in response to the terrorist attacks that occurred on September 11, 2001. GAO had noted in an earlier 2003 report [6] that DOE-EM, which managed OSRP, "would like the responsibility for the project to be placed in another DOE office because the mission of the project is inconsistent with the mission of the Office of Environmental Management" and that DOE-EM did not fully fund the project "because of other higher priority projects…" In the same report, GAO recommended that the Secretary of Energy "determine whether the priority given to the Off-Site Source Recovery project is commensurate with the threat posed by these sealed sources" and "ensure that adequate resources are devoted to the project…" These comments were made against a backdrop of increasing concern regarding potential misuse of radiological materials in dirty bombs [9].

A. Management Change

In October 2003, OSRP was transferred from DOE-EM to the new national Nuclear Security Administration (NNSA) as part of Nuclear Radiological Threat Reduction Task Force [17]. DOE's decision to move the OSRP from EM to NNSA to join the NA-21 Global Threat Reduction Initiative (GTRI) prompted a review of project operations and scope from a national security perspective. In addition, NNSA evaluated OSRP's progress toward meeting Congressional directives for enhanced recovery operations and the activities of the OSRP against similar activities underway internationally within the Office of Defense Nuclear Nonproliferation.

B. Scope Change - Recovery of Non-GTCC Sealed Sources

The assessments stemming from the management reorganization to NNSA resulted in changes to both the types of sources eligible for management by the GTRI OSRP and the activity contained within the sources. Specifically, NNSA eliminated restrictions precluding recovery of only those sources containing activities at concentrations exceeding NRC-defined GTCC limits for disposal [11], and it expanded the list of eligible nuclides to include Cf-252, Co-60, Ir-192, and Ra-226, in addition to those nuclides previously eligible (Pu-238, Pu-239, Am-241, Cu-244, Sr-90, and Cs-137).

After the official notice of scope change in 2004 [11], GTRI OSRP recovered two Gammator irradiators prior to the political convention in New York City in that year. In 2005, an additional 17 Gammators were recovered by OSRP, starting with three high schools in San Antonio, TX. In the same time period, the OSRP recovered four Radioisotope Thermal Generators (RTGs) containing Sr-90 sources at the request of the Department of

Homeland Security (DHS) in advance of the Superbowl. Recoveries of high activity irradiating devices continued with the recovery and identification of devices that were unused and unwanted, and contracting of an additional commercial facility at which sources could be removed from the irradiating devices (in hot cell facilities) and consolidated for disposal. Through early 2007, the OSRP contracted for and completed recovery of approximately 65 of these high-activity irradiating devices or sources.

The GTRI OSRP created and implemented disposal of devices/sources first with the RTGs and shortly thereafter with the disposal of more than 150 Cobalt-60 sources removed from high activity irradiators. Efforts for disposal of the current inventory of sources continue.

C. Pu-239 Recovery Success

In June 2006, GTRI OSRP completed the recovery of all registered excess non-governmental sealed sources of plutonium-239 in the United States. This multi-year effort involved the collection of about 270 sealed sources from 140 different sites and consolidation into 120 drums. Disposal of most of the drums at the DOE's Waste Isolation Pilot Plant (WIPP) was completed within the following year. OSRP continues to recover U.S. origin Pu-239 from international locations and from domestic owners when they are registered as excess.

D. Defense Determinations

In May 2006, defense determinations required under the WIPP-authorizing Land Withdrawal Act were completed for all U.S.-origin Am-241 and Pu-238 sealed sources. This enabled OSRP to begin disposing of a backlog of these sources that had been accumulating as no-disposal-pathway waste for more than five years at the WIPP facility in Carlsbad, NM.

E. Recovery of U.S.-origin Material from Abroad

GTRI began to task OSRP with repatriating U.S.-origin sealed sources in 2005. OSRP completed its first successful repatriation of foreign-owned U.S.-origin sealed sources from South Africa, Sudan, and Côte d'Ivoire in January 2006 as part of a joint regional project with the International Atomic Energy Agency (IAEA). Consolidation and packaging of the sources was completed at a facility in South Africa as a part of the South African government support to their African regional partnerships. The first U.S.-origin Pu-239 sealed sources were repatriated from Brazil in December 2007. To date, OSRP has recovered 456 U.S.-origin sources from 11 sites in eight countries.

OSRP continues to participate in new efforts, such as the Nonproliferation and Disarmament Fund (NDF) 258 Project. With funding from the U.S. State Department, IAEA is cooperating with GTRI OSRP and partner countries in South America to pilot a regional source recovery and repatriation capability in the region. The first mission in Brazil was completed in 2007, resulting in the recovery of 126 U.S.-origin sealed sources.

OSRP also has been involved in a major cooperative project in China in advance of the 2008 Beijing Olympics, involving source recovery and packaging workshops and recoveries of disused sources in the region. This project has resulted in significant follow-on cooperative recovery work in China.

OSRP has also cooperated with IAEA on multiple projects and consultancies, including the development of the SHARS portable hot cell facility and of the Catalogue of Sealed Sources and Devices. Further, OSRP participated in a fact-finding mission in Central America that investigated inventories of disused sealed sources in five different countries. OSRP is continuing to support use of the SHARS facility and is working with IAEA to develop a Type B container that can be used to transport sources consolidated using the facility.

IV. CURRENT CHALLENGES

After 10 years of operation, OSRP still encounters significant obstacles, some new and some that have always existed but have changed over the years. The basic activities of packaging, transportation, storage and disposal are still at the core of what OSRP does to reduce threats posed by disused radiological materials, but the challenges associated with these activities have changed. In addition, the OSRP resource in which DOE and NNSA have invested for years continues to be used for new missions and to supplemental existing programs.

A. Lack of Disposal

OSRP continues to encounter bureaucratic difficulties and technical challenges in disposing of the material it recovers. However, the problem is no longer related to disposal of actinides, but rather to disposal of beta-gamma emitting sealed sources. As previously mentioned, Public Law 99-240 in 1985 assigned responsibilities among governmental entities with respect to the disposal of low-level radioactive waste. This law gave States the responsibility and authority for disposal of low-level radioactive waste, while it gave DOE the responsibility for disposal of GTCC waste. It also allowed states to form "compacts" to support regionalized disposal. In the years since the 1985 law was passed, several attempts have been made by both states and compacts to site and license new disposal facilities, but until recently, all have failed. In addition, some facilities have closed and one compact facility, the Energy Solutions Barnwell facility in South Carolina, closed in 2008 to out-of-compact waste, restricting disposal at the site to generators in only three states. The result is that 36 states now have no outlet for the disposal of Class B and C low-level radioactive waste and sealed sources of any size. OSRP can no longer commercially dispose of beta-gamma emitting sources that it collects in these 36 states.

As an alternative, because OSRP assumes ownership of radiological sealed sources that it recovers on behalf of DOE, disposal at DOE facilities is possible. Disposal onsite at LANL is not encouraged due to agreements with the state regulator. Therefore, OSRP has applied for exemptions in accordance with DOE Order 435.1 that will allow it to dispose of recovered sources either at commercial facilities (for material recovered in compacts that have functioning disposal facilities) or other DOE facilities. Meanwhile, current GTRI OSRP manager Abby Cuthbertson is co-chairing an interagency focus group with DHS to articulate the unique security concerns associated with lack of disposal for sealed sources and investigate longer term options for disposal, including support for DOE-EM's effort to site a disposal facility for GTCC waste.

It should be noted that disposal of disused, unwanted sealed sources is also problematic internationally, especially for transuranic isotopes. Although recycling and return to manufacturers are sometimes options, they often are not, due to the half-life of the isotope, decayed source strength, defunct manufacturer, cost of return, and many other factors.

B. Lack of Type B containers

GTRI OSRP efforts to recover higher-activity sealed sources are currently being complicated by the expiration of specification Type B container certifications in October 2008, particularly for the 6M and 20 WC that were frequently used by OSRP and its subcontractors. While both of the containers had strong safety records, NRC allowed them to expire in order to come into alignment with Type B container requirements published by the IAEA in TSR-1.

More than half of all high-activity beta-gamma emitting sealed source/device recoveries were accomplished prior to 2008 using 20 WC containers due to ease of use, associated lower costs, and large payload capacity. However, a second suite of containers currently owned by EnergySolutions, the CNS 10-160B and 8-120B containers, was also believed to be usable for transporting such devices. Unfortunately, in July 2008 just before the expiration of the 20 WC specification container, EnergySolutions decided not to attempt to use these containers for transport of Cs-137 chloride sealed sources [12], eliminating them as possibilities for the recovery of high-activity devices. The timing of this was especially inopportune, as a National Academy of Sciences study had just been published earlier in 2008 [13] concluding that CsCl irradiators should be phased out over time due to the relatively high risk they pose for misuse in radiological dispersion devices. Although a few companies have been granted temporary extensions by NRC for continued use of their 20 WC containers, the number of containers currently available both nationwide and internationally for the transport of high-activity disused sources/devices, especially CsCl irradiators, is low enough to restrict recovery schedules. IAEA no longer maintains a current list of Type B containers with internationally–usable Certificates of Competent Authority, which increases the difficulty of locating suitable Type B containers internationally.

OSRP also extensively used the smaller 6M Type B container for recovery/consolidation of smaller sources such as 30 mCi Americium-Beryllium sources that lost their special form status, or otherwise required transport in a Type B container. OSRP is working to add sealed sources as approved content for a replacement container, the 9977, but this is not yet in place. In the interim, the U.S. Department of Transportation (DOT) has granted OSRP a special arrangement for continued use of the 6M through February 2010 for a limited number of shipments. The 9977 will not be as easy to use as the 6M; for example, evacuation of the container after closure is required. Still, without an expensive separate container development effort, this option will result in an operable solution.

C. Backlog of High-activity Sources and Source-Containing Devices

According to a recent report of the Radiation Source Protection and Security Task Force CsCl Working Group formed after the 2005 Energy Policy Act [14], there are approximately 1,200 Category 1 and 2 CsCl sealed sources currently in use in the United States. For the last two years, while the national program used alternative contracting mechanisms, a substantial backlog of high-activity sources/devices has accumulated. Because most of these devices have no commercial disposal pathway other than possible return to the manufacturer, OSRP has worked with some owners to self-ship devices to its consolidation facilities for disposal. However, it will likely take years to work off the backlog due to the transportation problems mentioned previously, lack of companies with license capacity to perform work on certain devices, and other problems. During this time, additional unwanted devices are expected to be registered as excess.

Although alternative technologies for many large source applications are not yet available [13], the federal government has been investigating whether to phase out CsCl irradiators in particular. Both the CsCl Working Group formed after the 2005 Energy Policy Act and the NRC issued reports in late 2008 on the topic [14,15]. Contrary to the Working Group report, in a November 2008 policy issue, NRC recommended that banning of new CsCl devices "is not practicable at this time" for various reasons, including lack of disposal availability and of an existing alternative chemical form of cesium for large sources, as well as the production infrastructure to manufacture it [15]. The level of public attention focused on this issue, as well as the cost and difficulty of complying with increased security controls, will likely keep registrations of unwanted sources high.

D. Movement of Radiological Material across International Boundaries

As GTRI OSRP continues to repatriate U.S.-origin sealed sources, it encounters several problems with moving material across international boundaries. Such movements requires compliance with IAEA TSR-1 transportation regulations, including containers tested to meet international Type B or other applicable requirements, or documenting special arrangements with national transportation competent authorities. The latter generally is not allowed for movement of material into the U.S. on a routine basis. U.S. regulations also prohibit air transport of plutonium into or within the United States, a problem for repatriation of these types of sources. Finally, clearing packaged radiological material and/or radiological monitoring equipment through Customs and national bureaucratic requirements can be difficult, especially when requirements vary significantly from country to country. OSRP has also not been able to recover U.S.-origin teletherapy due to logistical difficulties associated with the lack of certified Type B containers and the high costs involved. However, recovery efforts are currently being planned in two Latin American countries.

V. FUTURE WORK

Figure 1 shows the backlog of currently recoverable sources registered with GTRI OSRP in the United States that existed as of March 2009. However, this does not include small beta-gamma-emitting sources in 36 states that are registered as unwanted but have no current disposal pathway. If those sources are included, the backlog comprises approximately 9,000 sources. Approximately 2,000 new sealed sources are registered as excess each year on average. The graphic also does not show what has been registered with OSRP internationally. The need for OSRP recoveries will continue unless affordable solutions are developed in the private sector.

GTRI OSRP will continue to work to find ways to accelerate the recovery of high-activity source-containing devices such as CsCl irradiators. In the prioritization scheme agreed with NRC, high-activity source-containing devices are generally high on the list, so OSRP is taking several actions to address recovery barriers, including the shortage of certified Type B containers.

GTRI OSRP will also continue to work to remove disposal barriers previously discussed, as well as developing disposition pathways for Cm-244, Cf-252, Np-237, irradiated sources, and other types of sources it has already recovered to support threat reduction missions. GTRI OSRP's support for an interagency focus group on disposal will continue the search for solutions to the lack of commercial disposal capacity that is creating national security concerns.

In the international arena, GTRI OSRP will continue its work with IAEA to promote repatriation of radiological sealed sources to countries of origin (including U.S-origin sources) and provide technical expertise as requested. The program is also continuing to plan recoveries of US-origin sources bilaterally based on requests received from individual countries. Finally, OSRP is willing to share further details with partners in other countries, including lessons learned in safely addressing the recovery and management of disused sealed sources.

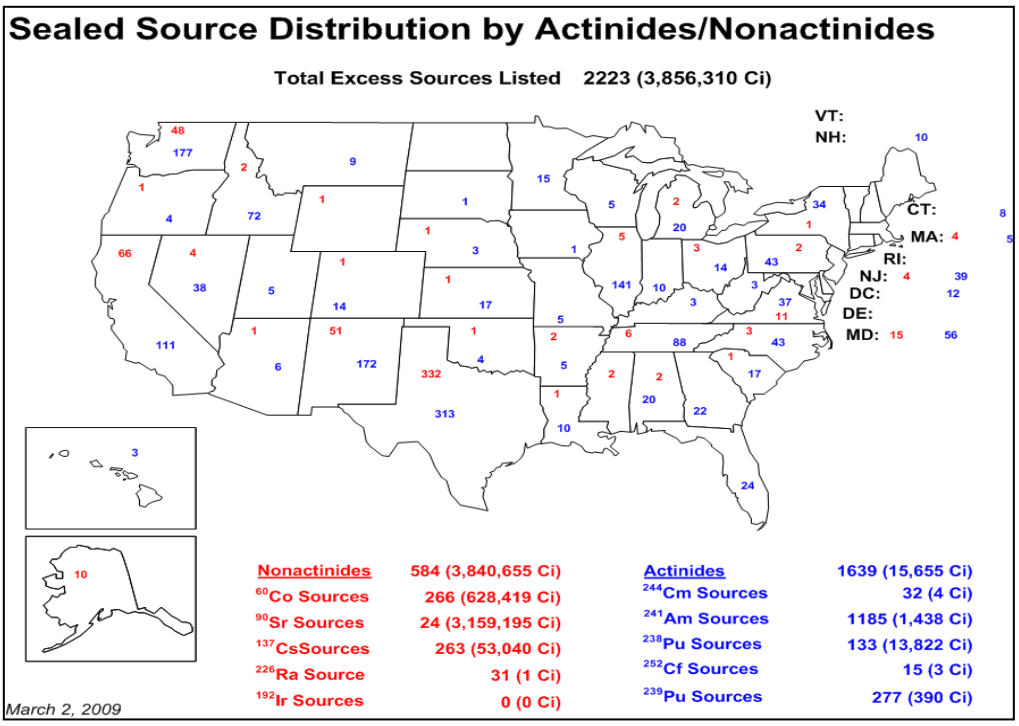

Figure 2: Excess Sources to Be Recovered in the U.S. (Source: Reference 16)

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