

**Challenges in Disposal of Off-Site Source Recovery Project Sources at the Waste Isolation Pilot Plant – 14530**

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**ABSTRACT**

The Off-Site Source Recovery Project (OSRP), operating within National Nuclear Security Administration (NNSA) Global Threat Reduction Initiative (GTRI), has a critical role in supporting national security, public health, and public safety by recovering and disposing of disused and unwanted sealed sources at the Waste Isolation Pilot Plant (WIPP). In the past 3 years, OSRP disposed of more than 10,000 radioactive sealed sources by sending 445 drums to WIPP. Sources were recovered at more than 1076 sites in the United States (US) and more worldwide.

During 2012, OSRP was a major player in the 3706-m<sup>3</sup> transuranic (TRU) waste removal campaign at Los Alamos National Laboratory (LANL). The objectives of this campaign were established using a Framework Agreement between the Department of Energy (DOE)/NNSA and the New Mexico Environment Department (NMED). This campaign's mission is to address the highest-risk, aboveground TRU waste located within Technical Area 54 at LANL by June 30, 2014.

OSRP worked closely with other LANL and WIPP entities in shipping more than 98% of OSRP legacy waste to WIPP in 2012. Changes to OSRP characterization and disposal activities streamlined the process to increase the output and meet LANL shipment demands. As a result of these changes, the drums OSRP packaged for WIPP disposal during FY 2013 were ready for disposal before they arrived at LANL for secure interim storage. The advanced work ensures that all WIPP-compliant requirements are met for the characterization of every source recovered to ensure that a LANL drum backlog will not occur.

One current challenge OSRP is facing is recovery and characterization for disposal at WIPP of sealed sources that contain radionuclides such as Cm-244, Cf-252, or Np-237. A multistep process has been developed to ensure defense determination approvals and proposed changes to waste streams that include the new isotopes and characterization of the radionuclides according to WIPP regulations.

However, the single largest emerging challenge is obtaining enough support from regulators to expand OSRP's mission for the recovery of sources containing foreign-origin radioactive material, even when recovered from locations within the US. If

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left unrecovered, these sources may become at-risk and will pose the same dangers to our national security, public health, and public safety as any of the other radioactive sources. Estimates show that in the past 10 years, manufacturers have distributed over 10,000 sealed sources using foreign-origin Americium-241 (as well as other radionuclides). Because many of these foreign-origin sources are rapidly approaching the end of their recommended working life, a looming disposal crisis appears to be on the horizon.

## **INTRODUCTION**

The National Nuclear Security Administration (NNSA) Global Threat Reduction Initiative's (GTRI's) mission is to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide. The Off-Site Source Recovery Project (OSRP) funded by GTRI at Los Alamos National Laboratory (LANL) has the primary mission to recover disused and unwanted sealed sources, therefore addressing a major national security concern and supporting public health and safety. GTRI/OSRP has the authority to recover sealed sources that present threats to national security and/or public health and safety and provides for secure storage or disposition of the sources pursuant to the Department of Energy's (DOE's) authority to acquire and provide for the disposition of radioactive materials under sections 55, 6, 81 and 161 of the Atomic Energy Act (AEA) of 1954, as amended.

At the end of October 31, 2013 over 37,200 sources had been registered within GTRI/OSRP database. Over 30,600 of those have already been recovered by GTRI/OSRP (Figure 1), and over 1300 drums were delivered to the Waste Isolation Pilot Plant (WIPP) for disposition. Of those sources remaining unrecovered, 1720 sources are listed as still-in-use, and over 4700 registered sources are excess and are still waiting to be collected by GTRI. In addition, somewhere between 2000 and 3000 new unwanted sources are added to the database each year for recovery consideration. It is clear that future work is still needed in managing these disused sources as radioactive waste when radioactive sealed sources reach the end of their working life.

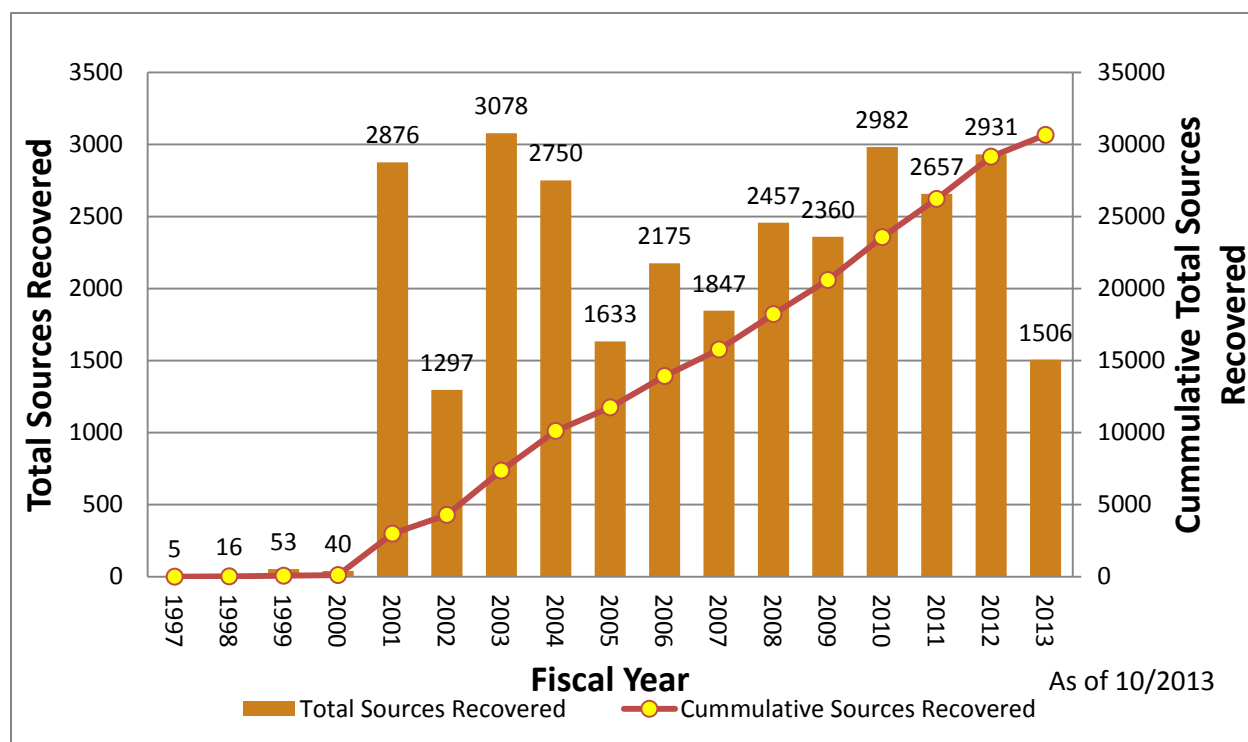


Fig. 1. Total OSRP Source Recoveries per Fiscal Year

In addition, the Conference of Radiation Control Program Directors (CRCPD) Source Collection has recovered 6,347 commercially disposable sources funded via a grant from GTRI.

During its 15 years of source recovery, the GTRI/OSRP's mission continuously expanded by extending its capabilities from the recovery of the three main transuranic (TRU) isotopes (Am-241, Pu-239 and Pu-238), to high-activity beta-gamma sources containing Co-60, Cs-137, Sr-90, and other sources containing Cm-244, Cf-252 and Np-237. The scope increase was due to expansion from environmental concerns to address broader national security, public health, and safety requirements in the wake of 9/11. Figure 2 provides a snapshot of the amount of sources GTRI/OSRP recovered by isotope type.

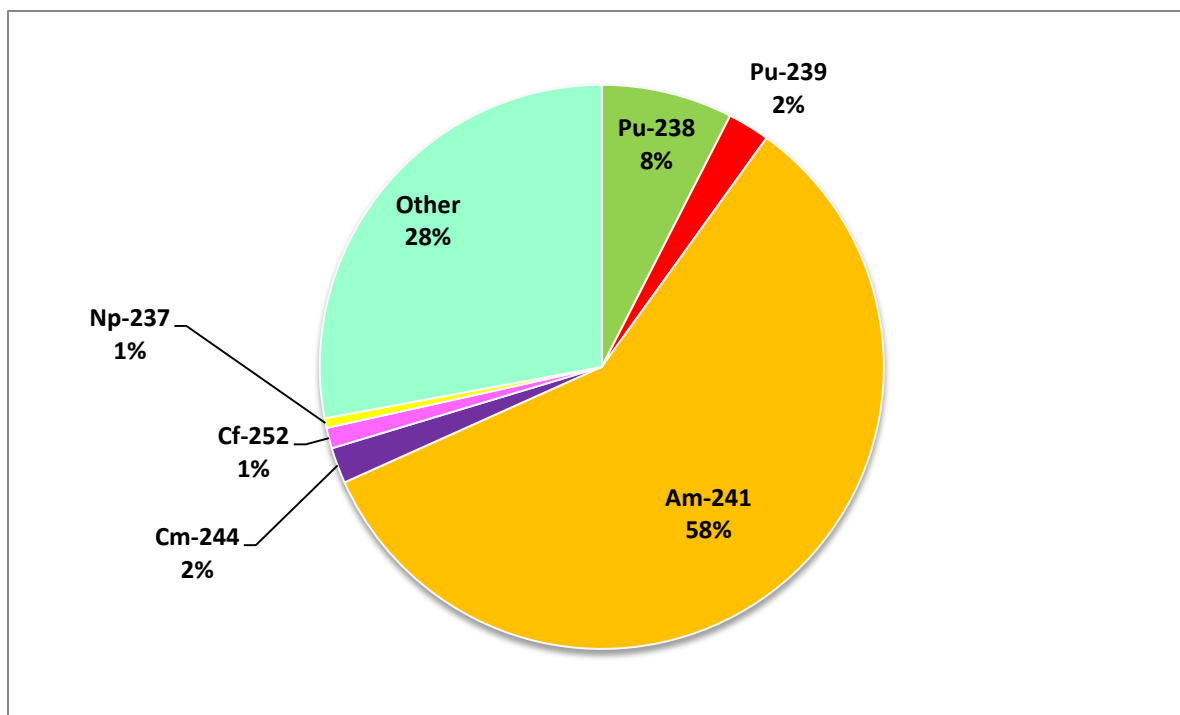


Fig. 2. Type of Sources Recovered by GTRI/OSRP

The source recovery mission is not complete without a path forward for source disposal. Commercially disposable sources are handled through the SCATR program and are disposed of at one of the four commercial disposal sites. Transuranic (TRU) [1] waste comprised of US-origin defense related material, including Am-241, Pu-238, and Pu-239, are shipped to WIPP. Non-TRU sources with no commercial disposal pathway are disposed of at other near-surface DOE disposal sites.

Even though Cm-244 and Cf-252 are less common than other TRU sources, the need for recovery of these sealed sources called for GTRI/OSRP's action in identifying or developing a viable disposal pathway. Challenges encountered ranged from establishing the material's TRU pedigree, to obtaining approvals for its disposal at WIPP.

A significant set of challenges encountered by OSRP are found in relation to the recovery and disposal of sealed sources containing foreign-origin radioactive material, which may be licensed, stored, used, and transported within the US by authorized licensees. This paper provides a snapshot of the GTRI/OSRP's efforts to finding a path forward for those new sources encountered during US recoveries, as well as the status of current disposal efforts to WIPP.

## **GTRI/OSRP DISPOSAL EFFORTS IN MEETING THE DELIVERABLES FOR THE 3706 m<sup>3</sup> CAMPAIGN**

In 2012, in the Framework Agreement between DOE/NNSA and New Mexico Environmental Department (NMED) [2] it was agreed that one of the highest environmental priorities at LANL had to be addressed: -removal of the above ground TRU waste located at Technical Area (TA)-54, Area G.

The TRU waste removal became a priority because of increased public concern and national media attention after the Las Conchas, New Mexico fire in 2011. A schedule was developed for the removal campaign of 3706 m<sup>3</sup> of TRU waste, and deadlines were set through June 2014.

Until 2012, a large number of packaged GTRI/OSRP drums had been stored at TA-54 (LANL) and was awaiting disposition. GTRI/OSRP had a major role in assisting the laboratory in meeting the deliverables set for the end of fiscal year (FY) 12. Figure 3 identifies the number of drums and sources OSRP shipped to WIPP since 2010, including the last 2 years, as part of the 3706 m<sup>3</sup> waste removal campaign. Although the annual OSRP drum disposal output for WIPP has decreased, the number of sources sent to WIPP since FY10 has increased. This is due to the consolidation approach GTRI/OSRP took when packaging the sources. More sources are being packaged in fewer drums to decrease the amount spent on packaging materials. During FY12 and FY13, GTRI/OSRP sent more than 9600 sources, totaling more than 195TBq (5,290 Ci) of activity of TRU waste, to WIPP.

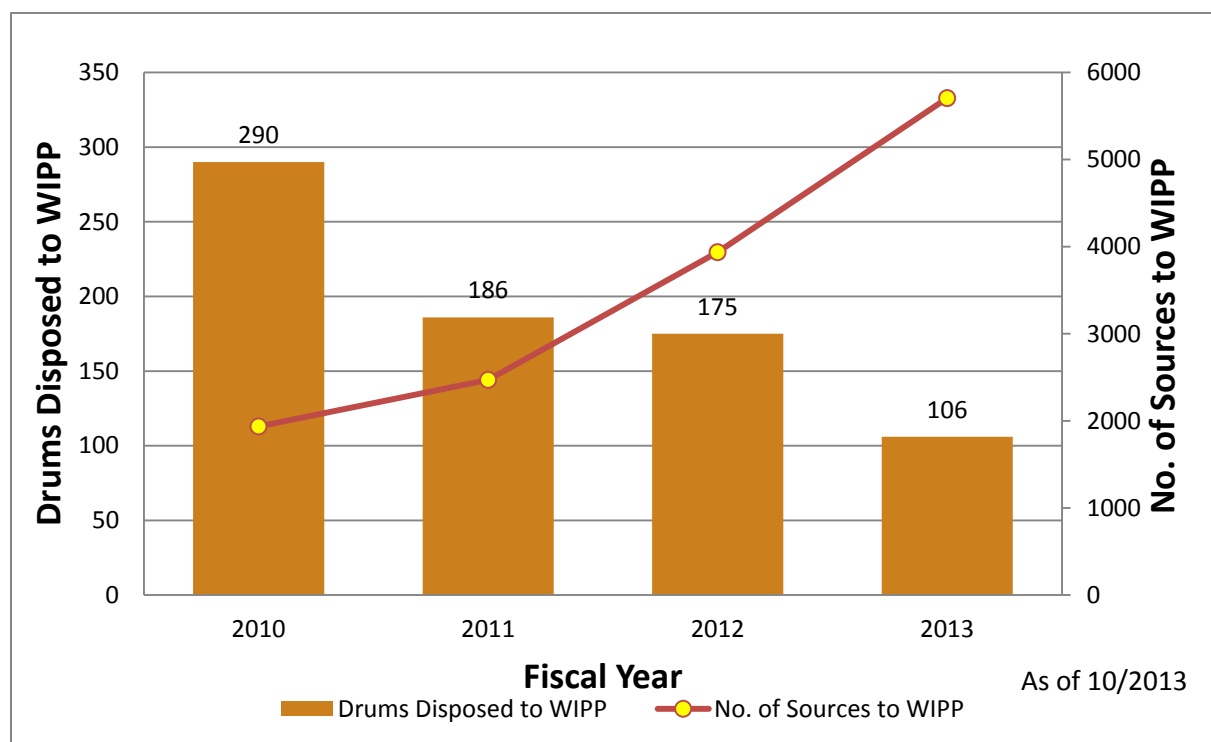


Fig. 3. Disposal of Drums and Sources to WIPP with the Fiscal Year

To achieve these successes, changes were implemented to streamline the data review process and to provide a greater output. These changes were implemented in FY13 and required a more thorough review of each source's Acceptable Knowledge (AK) information to meet Waste Acceptance Criteria [3] before recovery and packaging could be performed. The new process ensured a review of all data present in Batch Data Reports before any future drums were brought on site, and ensured a timely resolution on all Nonconformance Reports (NCRs) and all changes.

In FY 2013 GTRI/OSRP successfully accomplished an output of 106 drums. A more efficient process is now in place that will prevent future drum accumulation at the secure TA-54 interim storage site. Having all documentation in place before the drums are transported to LANL ensures that they are moved to WIPP at the most efficient pace possible.

### THE CHALLENGE OF Cm-244 AND Cf-252 DISPOSAL TO WIPP

GTRI/OSRP started to recover Cm-244 sources in 2004 and Cf-252 sources in 2006. The current inventory for recovered sources still waiting for disposal is nearly 700 sources for Cm-244 and over 400 sources for Cf-252. Figure 4 identifies the number of these sources recovered each fiscal year, with a peak of around 2008 and 2009, and a decrease in

numbers afterward. Currently, just 63 Cm-252 sources and 49 Cm-244 sources are still at registered sites waiting to be recovered. The backlog of unrecovered sources is only expected to increase in the coming years because GTRI/OSRP's capability for the temporary storage of these types of sources has reached its limits.

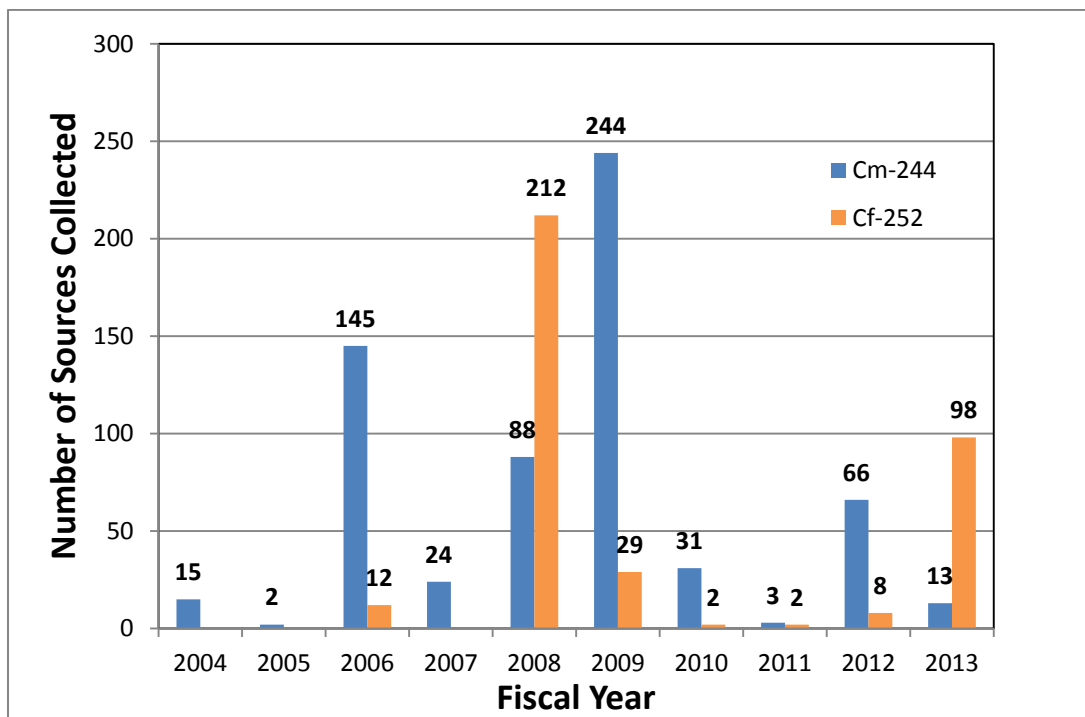


Fig. 4. Number of Cm-244 and Cf-252 Sources Recovered per Fiscal Year

GTRI/OSRP has submitted defense determinations for adding Cm-244, Cf-252, and Np-237 to its list of WIPP approved isotopes. This lengthy process requires multiple approvals from the NNSA, DOE WIPP and DOE EM. Currently, OSRP has not been able to obtain the necessary approvals for the disposal of these sources at WIPP.

Once the defense determinations are approved, new characterization methods for these isotopes will be audited and approved. The new isotopes will be added to the existing waste streams; thus, waste stream profile modifications are also necessary.

Research papers were written to explain the rationale for why Cm-244 and Cf-252 should qualify for WIPP disposal. WIPP disposal requires that the waste contain alpha-emitting TRU radionuclides, with half-lives greater than 20 years, and in concentrations greater than 100nCi/g [4]. Because of their short half-lives, Cm-244 (18.1 y) and Cf-252 (2.6y) do not meet the definition of TRU waste used by WIPP, on their own.

The Cm-244 and Cf-252 sources have the same beneficial uses as other TRU sources. Curium-244 sources are used as  $\alpha$ -particle emitters as well as X-ray emitters. Its half-life is 18.1 years, which is just below the 20 years used in the WIPP definition of TRU material, which, by itself, makes it non-eligible for WIPP disposal. The alpha decay chain of Cm-244 includes Pu-240 as its first daughter, which is a TRU isotope [5]. Some of the impurities in the Cm-244 batch material also have half-lives greater than 20 years and contribute to the TRU content of the Cm-244 sealed sources as well. The calculated TRU content for a 10-year-old Cm-244 sealed source, which based on the manufacture data would be one of the “newest” sources OSRP could recover, exceeds the 100 nCi/g criteria necessary for WIPP disposal. The TRU content is mostly due to the accumulation of Pu-240, as Cm-244 decays, and to a lesser extent, to the Curium TRU “impurity” isotopes present in the source material.

Californium-252 sources are used in reactor start-up sources and neutron inspection probes in industry, as well as in well-logging and neutron emission standards testing. Californium-252 decays by  $\alpha$ -emission and spontaneous fission. This TRU radionuclide is also not eligible by itself for WIPP disposal because of its half-life of 2.65 years. Similar to Cm-244, Cf-252 sources can qualify for WIPP disposal because of existing Cf-249 and Cf-251 TRU impurities present in the original source material [6]. Because of the decay, the TRU content of the material only increases with time. For example, the calculated TRU content for a 10-year-old Cf -252 sealed source is more than 100nCi/g, thus making these eligible for WIPP disposal.

Based on information obtained from various US manufacturers, the material used in the fabrication of Cm-244 and Cf-252 sealed sources is almost exclusively of US origin.

## **THE CHALLENGE OF RECOVERING SEALED SOURCES CONTAINING FOREIGN-ORIGIN RADIOACTIVE MATERIAL IN US**

The US DOE Office of Nuclear Energy Isotope Production and Distribution Program stopped the commercial sale of US-origin Am-241 in 2003. Because the remaining stocks of this Am-241 in the US were depleted and the US source manufacturers were in continuous need of feedstock material, the only viable option was importing foreign Am-241, notably from Russian production facilities. No distinction exists between the uses of US origin material and the uses of foreign-origin material in source manufacturing or distribution. Source manufacturers often replace older source used in gauges or devices, when they reach the end of their recommended working life, with newer sources now containing foreign material. Sources made from foreign-origin material are indistinguishable from US sources and serve the same numerous beneficial applications



as a US-origin source. The applications extend from well-logging, to moisture density gauges, industrial gauging, medicine, university research and education.

Data from source manufacturers and gauge distributors show that since 2004 at least 10,000 sealed sources containing foreign-origin material were distributed to licensees in the US. These sources contain over ten thousand of Ci of activity mostly Am-241 (17,800Ci or 660TBq). Both US-origin and foreign-origin sources are currently in the US and are authorized for distribution, and are used under the licenses issued by Nuclear Regulatory Commission (NRC) or Agreement States.

The GTRI/OSRP's mission to recover sealed sources containing TRU isotopes is in the interest of national security, defense nuclear material safeguards, and general public safety. Because of the exclusion of non-US material from WIPP disposal, GTRI/OSRP is unable to recover foreign-origin sealed sources present and used in the US, because they would be considered sources with "no-disposal-path".

Although GTRI/OSRP's authority to recover sealed sources is not limited to the recovery of sources for which DOE has identified a path to disposal, options for recovery of such sources are limited because of sensitivities between DOE sites and their host states. Similarly, no commercial, State-regulated storage facilities are permitted by their regulators to store no-disposal-pathway waste for more than 1 year.

The inability to recover sources containing foreign material leaves those unwanted sources in the temporary storage of owners, which defies GTRI/OSRP's mission of securing radioactive sealed sources in the interest of national security. In such cases, in the past, those sources have been orphaned, abandoned, or otherwise "lost" when the owner failed to manage them appropriately.

The majority of sources recovered by GTRI/OSRP are included under approved defense determinations for the three main US-origin isotopes: Am-241, Pu-238 and Pu-239. In these cases the source material was a byproduct of US weapons programs and therefore is clearly defense related. These sources have a clear path forward for disposal to WIPP. The WIPP Land Withdrawal Act prohibits the disposal of non-defense wastes in the repository.

In 2007 a limited defense determination was approved for a small amount of OSRP sources, in storage at LANL, that were determined to contain foreign-origin material. The approval document emphasized that the retrieval of the sealed sources was performed for national security and safeguard purposes. The defense determination was granted only for these sources in storage at LANL as of 2007, and did not authorize any further disposal of sources containing foreign material.

Since 2011, DOE has worked with Congressional members and their staffs to draft legislation to allow for the disposition of federally-owned, non-defense related TRU waste at WIPP. In June 2013, the US House of Representatives adopted an amendment in their FY14 National Defense Authorization Bill (H.R. 1960) to allow federally-owned, non-defense related TRU waste to be stored at WIPP. This amendment was not included in the Senate version of the bill. If put into law, this legislation would potentially facilitate GTRI/OSRP recovery and disposal of the sealed sources containing foreign-origin TRU material. DOE is continuing to work with Congressional members on this effort.

Recently, many source manufacturers and device distributors have not been accepting the return of sources containing non-US origin radioactive material back from customers or other device owners, leaving the licensed source owners in a conundrum as to storage and disposal options. This issue may cause the unwanted sources to eventually become unmanaged and uncontrolled and thus raises a concern that they may become orphaned, abandoned, or otherwise lost from regulatory control.

## **CONCLUSIONS**

The GTRI/OSRP mission is continuously expanding as more and more unwanted or disused sources with a wide range of isotopes are encountered in the field. The current efforts are directed in finding disposal pathways for radionuclides that have no viable commercial disposal options. After many years of use, both Cm-244 and Cf-252 sealed sources, decay into TRU isotopes, making them eligible for WIPP disposal. Each GTRI/OSRP waste container offered for WIPP disposal will be evaluated to demonstrate compliance with the 100 nCi/g requirement. OSRP has requested, but has not yet received necessary approvals for defense determinations for disposal of these isotopes at WIPP.

The single largest emerging challenge is obtaining enough support from licensees, regulators, and other interested parties, to expand GTRI/OSRP's mission for recovery of sources containing foreign-origin radioactive material when recovered from locations within the US. If left unrecovered, they may become at-risk and will pose the same dangers to our national security, public health, and public safety as the any other radioactive source.

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