Offsite Source Recovery Project – Ten Years of Sealed Source Recovery and Disposal - 10460

Julia Whitworth, Ioana Witkowski, Mark Wald-Hopkins, Mike Pearson – Los Alamos National Laboratory
Abigail Cuthbertson – NNSA Office of Global Threat Reduction

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 number has since increased to more than 23,000). 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 special form certifications or fall out of regular use. As OSRP has collected and stored sealed sources, initially using "No Path Forward" waste exemptions for storage within the Department of Energy (DOE) complex, it has consistently worked to create disposal pathways for the material it has recovered. The project was initially restricted to recovering sealed sources that would meet the definition of Greater-than-Class-C (GTCC) low-level radioactive waste, assisting DOE in meeting its obligations under the Low-level Radioactive Waste Policy Act Amendments (PL 99-240) to provide disposal for this type of waste. After being transferred from DOE-Environmental Management (EM) 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 GTCC when it became waste, but also any other materials that might constitute a "national security consideration." It was recognized at the time that the GTCC category was a waste designation having to do with environmental consequence, rather than the threat posed by deliberate or accidental misuse. The project faces barriers to recovery in many areas, but disposal continues to be one of the more difficult to overcome.

This paper discusses OSRP's disposal efforts over its 10-year history. For sources meeting the DOE definition of "transuranic," OSRP has achieved many milestones, including defense determinations for various isotopes, a WIPP RCRA permit modification to accommodate headspace gas sampling requirements, and approval of a peer-reviewed non-assay radiological characterization methodology. For non-transuranic sources, which OSRP began to recover in 2004, OSRP has achieved NEPA coverage for storage and implemented consolidated storage at both DOE and commercial locations, as well as completing several specific disposal operations. The closure of the Barnwell low-level waste disposal site in 2008 has left 36 states with absolutely no commercial disposal pathway for most sealed sources, increasing the demands on OSRP. This and other current challenges and future work will also be discussed.

BACKGROUND

From 1979 to 1999, a Pu-239/Be Neutron Source Recovery Program accepted unwanted Pu-239/Beryllium (Be) sealed sources at LANL and processed about 1,100 Pu-239 sealed sources during this time period, recovering the Pu-239 for possible reuse (Reference 1). Another LANL program, the Radioactive Source Recovery Program, removed some unwanted irradiator devices from high schools, with source recycling as the disposition pathway. However, by 1999, problems such as expense, low throughput, and radiation exposure resulted in DOE combining these and other efforts into a single project, the Offsite Source Recovery Project (OSRP) managed in the DOE-Environmental Management program. Early project documents state that part of the project mission was to meet DOE's obligations under PL 99-240 to provide for disposition of GTCC waste (Reference 1), and a 2003 GAO report noted that DOE created OSRP "to comply with Public Law 99-240 until a disposal facility became available…" (Reference 2). Initially, OSRP primarily recovered sources from federal governmental users with clear defense missions, but in 2002 started to recover large Am-241 sealed sources from civilian sites for which there was no disposal path at the time. In addition to developing transportation packages, OSRP immediately began to work on disposition pathways such as recycling and permanent disposal.

OSRP had achieved some initial success in the area of transuranic (TRU) waste disposal, when in 2004, the types of waste generated began to change with OSRP's mission. At this time, the project was directed to begin recovering non-GTCC isotopes and concentrations, particularly high activity Co-60, Cs-137, and Sr-90 source-containing devices such as irradiators and radioisotope thermal generators (RTGs) (Reference 3). At this time, commercial disposal was only available for sources smaller than 10 Ci. Because OSRP's threat reduction mission often resulted in recovery of higher-activity sources/devices, most of what it recovered could not be disposed commercially, although in some cases it could be recycled by manufacturers.

As of October 31, 2009, LANL OSRP has recovered approximately 20,250 disused sealed sources and disposed of 524 55-gallon drums (127 m^3) of TRU waste totaling 12,643 Ci (Reference 4). The project has also disposed of about 1,000 sealed sources as low-level radioactive waste. In addition, the project has recycled about 680 sources, although policy associated with recycling is currently under GTRI review.

TRANSURANIC WASTE DISPOSAL

First disposal from LANL

OSRP was the first TRU waste generator at LANL to ship waste drums to the nation's TRU waste disposal facility, the Waste Isolation Pilot Project (WIPP). In May 2003, after years of working with the LANLTRU waste certification program, OSRP was finally able to ship two drums of waste sealed sources to WIPP (Reference 5). The drums contained about 95g of Pu-239 sealed sources. Not long after this shipment, however, the existing LANL TRU waste program

was not recertified and the site began to transition to a new certification program . OSRP was not able to ship waste containers of disused sealed sources again until 2005, after DOE-Carlsbad's Central Characterization Program (CCP) accomplished certification at LANL. In the interim, all existing OSRP procedures related to packaging and characterization of TRU waste were rewritten in order to be brought into the new certification program. Approval for storage of "no disposal pathway" waste was also maintained. OSRP resumed disposal of TRU waste sealed sources again in July 2005 with a full TRUPACT-II shipment of OSRP drums (Reference 6).

WIPP RCRA Permit Modification to Limit Headspace Gas Sampling

Whenever possible, OSRP packages disused transuranic sealed sources a single time into a WIPP-approved configuration in order to minimize dose. The standard configuration (Figure 1) is to package sources inside of a stainless steel special form capsule comprising 1/2 –inch thick steel walls, overpack this capsule in a pipe component with 1/4-inch thick stainless steel walls, and place the pipe component in a 55-gallon drum. The pipe component may contain polyethylene shielding around the capsule, and may itself be centered in polyethylene neutron shielding within the 55-gallon drum (the S300 configuration).

Figure 1: Standard Pipe Overpack Configuration Used by OSRP

These configurations did not at the time meet any of the assumptions around which the WIPP headspace gas sampling program had been built and would have required OSRP to open each container to sample through the pipe component filter, absorbing substantial dose along the way. For this reason, OSRP chose to pursue a modification to the headspace gas sampling regime, arguing that its waste had already been analyzed for the TRUPACT-II SAR and been found to possess no gas generation potential, so that if no gas-generating items were added in the packaging process, the containers should be exempt from this requirement. The WIPP RCRA permit Waste Analysis Plan (WAP) (Reference 7) was

modified in July 2005 with the addition of Section B-3a(1)(iii), which allowed OSRP to not headspace gas sample every container in its sealed source waste streams if certain conditions were met, including verification of sealed sources integrity and special form status of sources. OSRP also had to provide a "packaging source term" documenting VOCs in empty container configurations (Reference 8). Later WAP revisions have greatly decreased headspace gas sampling requirements, but OSRP continues to operate under this language and compile the additional supplemental Acceptable Knowledge information required in Section B4-2c of the WAP (Reference 7).

Non-assay Radiological Characterization of Sealed Sources

As previously mentioned, OSRP packages disused sealed sources in pipe overpack containers. Both the shielded configuration and the high concentration of activity inherent in sealed sources make accurate quantification by container assay problematic. This problem is further aggravated by the fact that the TRU waste certification requirements limit available assay methodologies to certain types of equipment and processes, making it impossible for OSRP staff to, for example, assay sources at hundreds of recovery sites prior to packaging. As a result, OSRP early recognized the need to design and obtain approval for an alternative characterization process.

As summarized in the WIPP Waste Acceptance Criteria Attachment A (Reference 9), it is acceptable to use radiological characterization information not generated under a WIPP-approved QA program only if the information can be qualified by any one of four methods listed in 40 CFR 194.22 (b). Several of these, such as confirmatory testing, presented difficulties for OSRP. The project decided to pursue qualification by peer review (Reference 10). OSRP continues to collect extensive data from sealed source manufacturers, much of it source-specific. The project may have the most extensive files on sealed sources of US manufacture in the world. In any case, project personnel used such data as batch material records from manufacturers and the DOE isotope sales office, material type designations, and national database information to characterize the population of material made available for sealed source manufacture and develop isotopic ratios for the ten WIPP-required isotopes that must be quantified. OSRP then developed software to calculate the isotopic quantities for all 10 radionuclides given the known quantity of one (backed up by AK information), decay the distribution to the present date, and produce a report calculating all of the required parameters (such as fissile gram equivalents), as well as associated errors. After white papers were written to outline the available data and OSRP's proposed process, a peer review panel was convened according to NRC guidance (Reference 11). The panel issued its findings in December 2003, outlining its approval for use of the types of information proposed by OSRP, as well as some exceptions (such as unsuitability of the data in the case of irradiated sources) (Reference 12). The alternative characterization process using data approved by the peer review panel was

approved by DOE-CBFO and EPA, after review during the annual recertification audit at LANL, in July 2005.

Defense Determinations

On July 8, 2003, DOE-EM was copied on a memo from Jessie Roberson, the DOE Assistant Secretary for Environmental Management, to Dr. Inez Triay, stating that "EM and GC have concluded plutonium-239 sealed sources meet the definition of defense waste as defined in the NWPA…This determination is limited to Pu-239 sealed sources" (Reference 13). This was the final hurdle in making all such sources recovered by OSRP eligible for disposal at WIPP.

By this date, however, OSRP had already recovered more than 7,000 disused sealed sources, only a small fraction (< 10%) of which were Pu-239 sources. In 2005, GTRI OSRP began the process of applying for a defense determination for US-origin Am-241 and Pu-238 sealed sources, relying on the rational that such sources were made from material that was a byproduct of defense nuclear waste and materials, as well as having been recovered for defense nuclear materials security and safeguards purposes. These applications were approved in May 2006, but only for sources manufactured using US-origin radioactive material (Reference 14).

Throughout its history, OSRP had been asked to accept a relatively small number of foreign-origin sources, often from other governmental entities that had collected them for various reasons and found that they had no disposal pathway. OSRP received a memo from DOE-EM on November 8, 2007, concurring with a DOE-CBFO defense waste determination for foreign origin sources, but only "limited to those foreign origin sealed sources currently in storage at Los Alamos National Laboratory" and for which OSRP had already assumed ownership on behalf of DOE (Reference 15). Radiological characterization of these sources is still to be accomplished and OSRP is working with countries of origin to repatriate some of them.

As directed in the 2007 memo, any additional defense determinations requested by GTRI OSRP for material it must recover for threat-reduction purposes will be submitted to DOE-EM and reviewed on a case-by-case basis.

NEVADA TEST SITE (NTS) DISPOSAL FOLLOWING 2004 MISSION CHANGE

As previously mentioned, GTRI OSRP at LANL began to recover non-actinide sealed sources following the modification of its mission in 2004. Early recoveries included "Gammator" irradiators at high schools, RTGs containing thousands of Ci of Sr-90, and high-activity sources from a pool irradiator at Georgia Tech. Since 2004, GTRI OSRP has recovered more than 2,100 Cs-137, Sr-90, and Co-60 sealed sources containing about 730,000 Ci (at the time of recovery) and consolidated them for disposal. Much of this material has been certified for disposal at the Nevada Test Site (NTS) with the assistance

of Mr. Dave Parks (INEL), Mr. Jared Dominick (LLNL), and Mr. Chris Rasmussen (LLNL), who have obtained profiles and acted as waste certification officials for disposal of these sources as low-level waste. These program totals include 18 high-activity RTGs moved directly to NTS for disposal from a US Navy installation by INEL personnel with minimal LANL involvement. In total, of the sources recovered, GTRI OSRP has disposed of 371 waste sealed sources at NTS comprising about 700,000 Ci activity (at the time of disposal). Because OSRP accepts ownership of sources it recovers on behalf of DOE, disposal at NTS is compliant with DOE orders.

Co-60 sources

OSRP has disposed of 345 Co-60 sealed sources at NTS comprising about 58,000 Ci, about 230 of which were collected at a university from a pool irradiation facility (Reference 16). Challenges have included configuring disposal shields, removal of these high-activity sources from very heavy devices that can be old and not in good condition, and source-specific characterization to meet NTS Waste Acceptance Criteria (WAC). The metallic Co-60 sources, which have been collected from numerous different sites using them in various applications, can be in decades-old devices for which the manufacturers are no longer in business.

Figure 2: Recovered Co-60 Device and Sources in Hot Cell

Cs-137 Sources

OSRP has not yet disposed of Cs-137 sealed sources at NTS, primarily because these sources can often be recycled due to their longer half-life. However, OSRP has recovered more than 18,000 Ci of Cs-137 sealed sources (decayed to time of recovery) (Figure 3) and has submitted a profile for disposal of such sources.

Figure 3: Gammator Recovery from IL High Schools

Sr-90 RTGs

GTRI OSRP has disposed of 24 Sr-90 sealed sources comprising more than 600,000 Ci at NTS. These devices have generally been well-characterized, although not always in good condition. As with other types of sources, characterization of potential RCRA constituents has been important. In 2007, two RTGs that were recovered by OSRP in 2004 were being prepared for shipment as low-level waste from LANL to NTS. A subsequent review of the composition of the RTGs indicated the presence of cadmium, a RCRA regulated metal, as plating on the exterior of the device for corrosion resistance. OSRP worked with the manufacturer to collect sampling data that demonstrated that the cadmium did not meet the toxicity characteristic threshold and the devices were no mixed waste.

COMMERCIAL DISPOSAL

OSRP has requested from DOE-EM an exemption under DOE Order 435.1 to dispose of waste sealed sources commercially. OSRP's ability to use commercial disposal is limited for two reasons:

- Since the closure of the Barnwell facility to out-of-compact waste in July 2008, there has been no commercial disposal available in 36 states for sealed sources, with the exception of Ra-226 sources (although the potential availability of the WCS site in Texas for disposal of sealed sources in the future may impact this situation); and
- Where commercial disposal has been available, it has generally been limited to sources 10-30 Ci and smaller.

Also, DOE Order 435.1 requires OSRP to demonstrate that it will only use commercial disposal where it is in DOE's "best interest," which can be difficult to prove where the commercial disposal cost is significantly greater than the cost involved using DOE facilities. However, OSRP has conducted one commercial disposal of disused Ra-226 sources at the American Ecology facility in Richland, WA, as a pilot project to develop data and hopes to continue using the available commercial disposal pathway in the future.

GTRI also funds the CRCPD SCATR program, which collects and disposes of smaller sealed sources where commercial disposal is available.

Ra-226 sources

OSRP has recovered more than 500 Ra-226 sealed sources, out of which it has commercially disposed of 236 sources comprising 1.18 g. Unlike most other sealed sources, unwanted Ra-226 sources anywhere in the country can be commercially disposed. This is possible because, although the 2005 Energy Policy Act added Ra-226 "discrete sources" to the definition of byproduct material, the Act also excluded it, along with other types of byproduct material, from the definition of low-level waste. While disposal is available, it can be expensive, especially for larger sources, at about $100,000 per g (or Ci). OSRP has responded to many orphan source situations at the request of state and federal regulators, including a recent incident in which several tens of these sources were found in a barn after the owner passed away.

OSRP maintains a current Site Use Permit from the State of Washington for disposal at the American Ecology disposal facility. As with many other types of sources, OSRP consolidates Ra-226 sources prior to disposal if possible, seals them in special form capsules so that they can be shipped in Type A containers, and encloses the capsules in additional shielding for transportation compliance and dose rate minimization. Ra-226 sources are known to leak relatively more than other types of sealed sources due to gas generation causing weld breaches, so this is always a consideration when such sources are being handled. If OSRP's exemption request for commercial disposal is approved, the project will be ready to dispose of additional Ra-226 commercially.

Large beta-gamma-emitting sources/devices

The American Ecology facility has recently indicated that it can dispose of sources of up to 976 Ci for Cs-137 and 145 Ci for Co-60 sources, consistent with its concentration averaging procedures and staying below GTCC limits. OSRP is working to recover some source-containing devices within the states that are members of the Northwest and Rocky Mountain compacts, which have access to this facility for disposal, as a pilot project to demonstrate that direct disposal of such a device is possible. Again, this pilot is contingent on approval of OSRP's exemption request.

CONCLUSIONS

A significant portion of GTRI OSRP operations involves developing and implementing disposal pathways for a wide variety of different isotopes, activities, and configurations of sealed sources. While GTRI advocates for national disposal solutions for sealed sources (see related paper presented at WM '10), especially those that pose a threat to national security, health, and safety, OSRP will continue to work to responsibly manage

the sources it recovers. Future challenges include developing disposal pathways for Cm-244 and Cf-252 sealed sources that have substantial transuranic "impurities," disposing of mixed waste sealed sources at WIPP, and developing characterization methodologies for large accumulations of smaller sealed sources of varied isotopes that OSRP may be required to recover for threat reduction purposes.

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