

## **The Off-Site Source Recovery Program Capabilities in Recovering Transuranic Sealed Sources-17599**

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### **HISTORY OF OSRP RECOVERY ACTIVITIES**

Over the past 16 years, the mission of the Off-Site Source Recovery Program (OSRP) has been recovering disused radioactive sealed sources in the interest of national security, public health and safety. This program, which is sponsored by the National Nuclear Security Administration's Office of Global Material Security's Office of Radiological Security, is managed at Los Alamos National Laboratory and Idaho National Laboratory and has recovered sources worldwide. To date, OSRP has recovered more than 38,000 sources from over 1,300 locations worldwide.

Since its inception, OSRP has grown from recovering only sealed sources containing one transuranic (TRU) isotope, Pu-239, in the early days of the program, to recovering sealed sources containing several other TRU and non-TRU isotopes. Primarily, OSRP's mission includes Pu-238, Pu-239, Am-241, Cf-252, Cm-244, Sr-90, Cs-137, Co-60, Ir-192 and Ra-226 sources that are US-origin, defense related and not commercially disposable.

Over the lifetime of this program the types of recoveries performed have expanded from a single site to multi-site round-up recoveries. An additional approach, referred to as self-ship recoveries, is also used in cases where only a few sources may be present at a licensee's site. In these situations, the licensee ships their source(s) to an OSRP staging facility for ultimate consolidation and disposal.

OSRP recovers sources from many types of licensees, with the majority of sources being removed from industry, universities and hospitals. These include sealed sources used in industrial radiological devices like moisture-density gauges and thickness gauges, medical devices such as blood irradiators and radiotherapy devices and sealed sources from nuclear power plants, among others.

Figure 1 presents a distribution of recoveries for different types of licensees during Fiscal Year (FY) 2016. The number associated with each type of licensee indicates the number of recoveries completed for each category.

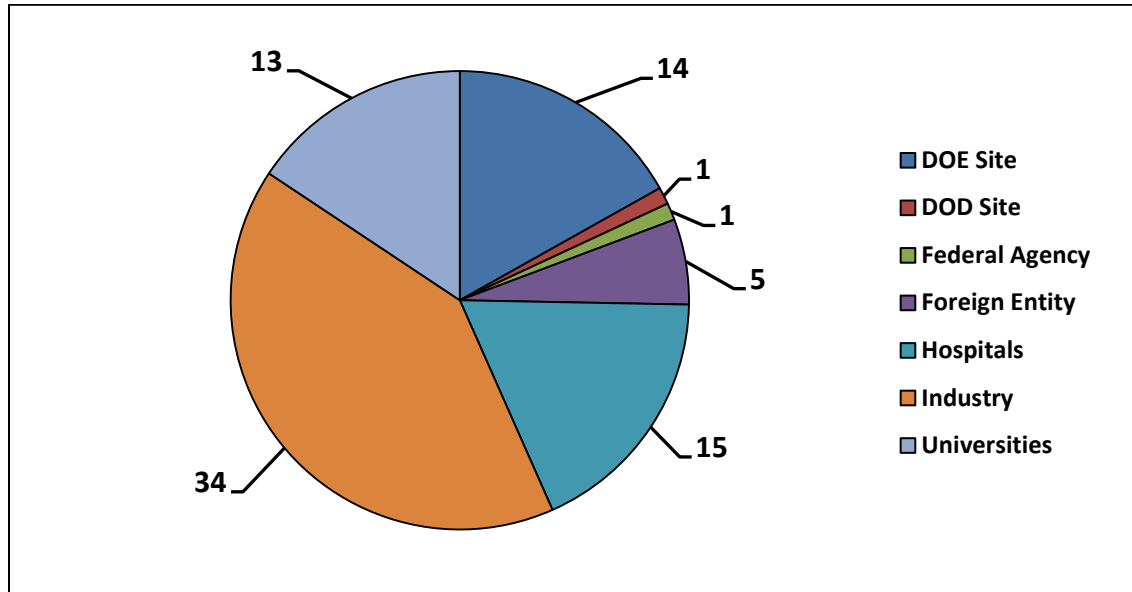


Fig. 1 Number of recoveries performed in FY16 based on licensee category

Each recovery mission shown in Figure 1 may have accounted for the removal of many sources from each location. The recovery and management of sealed sources is a complex process covering multidisciplinary areas, including source construction, characteristics of the radioactive material, source packaging and transportation per DOT regulations, safe and secure storage, and final disposition per waste acceptance criteria of repository sites.

### QUALIFYING TRU SOURCES FOR RECOVERIES

Registration of disused sources with OSRP is one of the most important steps in the recovery process. OSRP maintains a database of thousands of licensee inventories with sources categorized as "in-use" or "excess." Over 3000 national and international sites have registered their sources with OSRP, exceeding 70,000 sources throughout the lifespan of this program. The registration of disused sources with OSRP is completely voluntary and is necessary in order to qualify them for recovery via one of the OSRP removal options. OSRP encourages registration of sources at [osrp.lanl.gov](http://osrp.lanl.gov), even if they are still in use. Recoveries are prioritized as a function of total source activity at a licensee's site, proximity to populated areas, and site security. Removal of excess sources can be done via on-site recovery or through the self-ship process. Some recovery trips include more than one site to increase program efficiency.

TRU sources qualify for OSRP recoveries if the information provided by licensees meets the acceptable knowledge (AK) criteria developed for WIPP waste

characterization. Some examples of source information that may satisfy the AK requirements include:

- markings on the sources or devices that indicate isotope, activity and date
- Nuclear Materials Management and Safeguard System (NMMSS)
- source certificates
- source shipping records, or source drawings
- US NRC Sealed Source and Device Registry records

OSRP owns a large library of documents collected over the years which can be used in helping licensees to identify and obtain the best AK material to be used for recovery. This initial step of collecting adequate TRU source information is essential because this information will be used in characterizing the drums packaged for WIPP disposal. Without adequate source information, the recovery of sources cannot proceed. This step ensures that all sources recovered will ultimately have a disposal path. Another important step for proceeding with a recovery is obtaining current and clean radiological swipe tests.

Sources that qualify for commercial disposal may be recovered under a cost-sharing initiative known as the Source Collection and Threat Reduction Program (SCATR) managed by the Conference of Radiation Control Program Directors (CRCPD). This program uses the same inventory database managed by OSRP, and therefore OSRP encourages voluntary registration of all sources, even if they are commercially disposable.

## **QUALIFYING HIGH-ACTIVITY BETA GAMMA SOURCES FOR RECOVERIES**

OSRP can assist with disposition of eligible high-activity beta-/gamma-emitting sealed sources, such as those found in medical irradiation devices. These sources are voluntarily registered through OSRP and go through a process similar to that used for prioritization of TRU sources for recovery. Devices containing sealed sources with the highest activities may be given the highest priority for recovery. OSRP works with licensees to obtain all necessary information on their devices for removal and proper disposition. OSRP will then establish contracts for the removal of the prioritized devices with qualified and licensed vendors. Once under contract, a commercial vendor will remove a device and prepare it for shipping and subsequent disposal. OSRP contracts between 15 and 20 high-activity beta/gamma device removals per fiscal year.

## **PACKAGING AND SHIPMENT OF TRU SOURCES**

OSRP works with licensees in verifying the number of sources and the total source activity, and establishing special form status for the sources to be recovered. There are several factors that must be considered to determine packaging configurations and drum transportation arrangements, such as the total dose rate and the overall dimensions of the sources to be packaged.

Department of Transportation (DOT) regulations apply to the radioactive source shipment from a licensee site to the OSRP interim storage facility. OSRP has authorized shippers who prepare drum shipments on a regular basis. The sources prepared for ultimate disposal at WIPP have to be special form per 49 CFR 173.476, which means that the radioactive material is inside of a DOT certified sealed capsule and cannot be released unless the capsule is destroyed [1]. When sources are normal form, OSRP uses a DOT-certified field-sealable Special Form Capsule (SFC) to encapsulate them to avoid the potential need for a Type B shipment. Once encapsulated, sources can be packaged in Type A drums. OSRP uses a variety of capsules depending on the number of sources recovered. Figure 2 shows examples of SFCs used for TRU source packaging.

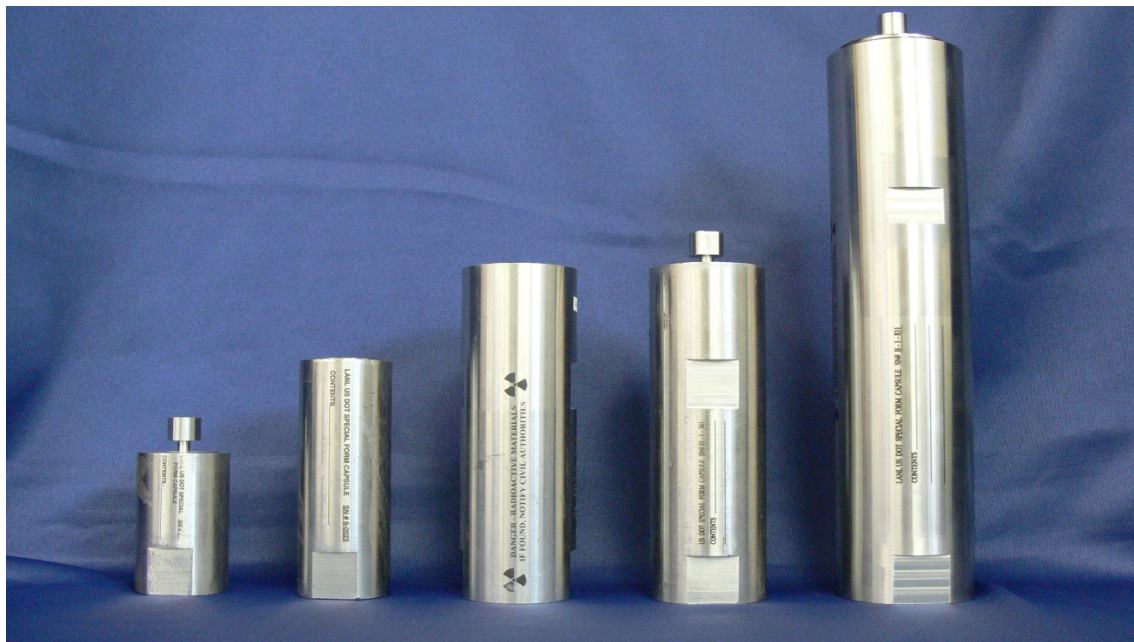


Fig. 2 SFC models I, II and III used for TRU source packaging

The packaging of TRU sources for WIPP disposal requires the use of one of three certified Type A drum configurations: the S100, S300 and the 12" Pipe Overpack Container (POC) drums. All these drums are 55-gallon and are WIPP-accepted packaging for contact handled (CH) waste. The S100 is a poly-shielded Type A drum that has a 6" POC and is used primarily when neutron sources are packaged. Compared to the 12" POC, the S100 internal volume is reduced in favor of the

external POC shielding, thus minimizing the dose rates. The S300 is an NRC-certified Type A Fissile (AF) drum used to package the fissile material being constructed as a 12" POC with internal shielding. The 12" POCs are Type A drums without the poly-shield and with a pipe component of 12" diameter. The larger internal volume makes it suitable for packaging a larger number of sources or a mix of sources and capsules and is used when external dose rates are not a concern. Larger size sources that are special form and do not fit into any of the SFCs are packaged directly into 12" POCs. Figure 3 shows examples of drums that are used for packaging TRU sources for WIPP disposal.



Fig. 3 S300 and S100 drums used for sources packaging

The packaging of sources for WIPP disposal has to satisfy the requirement for TRU waste content of 100nCi/g or more of TRU isotopes and the requirement for a CH waste dose rate limit of less than 200mrem/h on contact [2].

The self-ship recovery option is based on the idea of the licensee packaging and shipping the sources to OSRP's interim staging site where OSRP consolidates them with other recovered sources for final disposition. This option is ideal for those licensees who have not reached the top priority list but want to expedite the removal of their disused sources. OSRP can provide Type A, 5-gallon PSI drums to allow licensees to ship their sources. To qualify for this option, the site must have an individual trained per DOT requirements to package and ship the sources. All AK must be approved by OSRP before shipping. For self-ship, the sources must be either special form per DOT regulation, or normal form with an activity under A<sub>2</sub> DOT shipping limit per 49 CFR Part 173.435 [3].

## PACKAGING AND SHIPMENT OF HIGH-ACTIVITY BETA GAMMA SOURCES

Whereas the majority of TRU sealed sources typically can be transported using Type A Containers, transportation of sealed sources containing higher activities of beta-gamma emitting isotopes (typically Co-60, Cs-137, and Sr-90) is more logistically complicated and costly due to the required use of a certified Type B container. These sealed sources commonly have activities in the hundreds to thousands of curies. Table I shows the A<sub>1</sub>/A<sub>2</sub> limits for Cs-137, Co-60, and Sr-90. Shipment of normal form sources above A<sub>2</sub> limits and special form sources above A<sub>1</sub> limit require a Type B container. The A values represent the limit in Ci allowed to be transported in Type A package for normal form (A<sub>2</sub>) and special form (A<sub>1</sub>) sources.

TABLE I. A<sub>1</sub> and A<sub>2</sub> Values for Co-60, Cs-137, and Sr-90 (from 49 CFR Part 173.435)

Isotope	A <sub>1</sub> Limit (TBq)	A <sub>1</sub> Limit (Ci)	A <sub>2</sub> Limit (TBq)	A <sub>2</sub> Limit (Ci)
Co-60	0.4	11	0.4	11
Cs-137	2	54	0.6	16
Sr-90	0.3	8.1	0.3	8.1

Currently OSRP contracts with qualified and licensed vendors to prepare these devices for shipment and transport them in a certified Type B container. Another approach is to contract a commercial company to remove the devices from the facility and prepare them for shipment using a Type B container owned and operated through NNSA.

In order to expedite removal of high-activity sources that have not reached the top of the OSRP priority list, licensees may choose the self-ship option, just as with TRU sources. However, in the case of high-activity beta gamma devices, the facility must contract a qualified and licensed vendor for the removal and transport of the device to an OSRP staging facility. As with TRU sources, OSRP can assist licensees with the preparation for the self-ship option of these types of devices.

## RECOVERY AND DISPOSITION

OSRP has averaged over 70 source recoveries per year for the past 4 years. Based on time limitations and economics, field recoveries can be directed to a single-site recovery with a large number of sources or to a multi-site source round-up type of recovery. Figure 4 presents the number of TRU and beta-gamma recoveries and the total number of sources collected in the past 4 fiscal years.



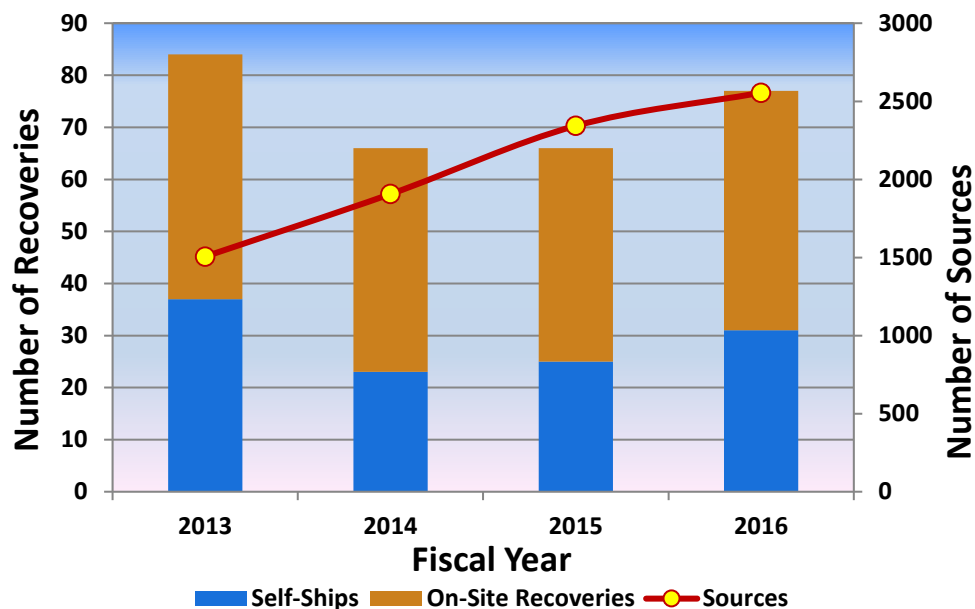


Fig. 4 Number of Total Recoveries and Source Collected by OSRP per Fiscal Year

This plot shows that the number of self-ships constitute between 35-45% of total recoveries per year and that this program has a steady output of total recoveries per year. The data used for this plot indicated that the majority of self-ships involve TRU sources. Although the number of sources recovered in FY13 was almost 1000 fewer than in FY16, the number of recoveries in FY13 was a little higher. This made the recoveries less economical in FY13 when considering the cost per source recovered. The trend for the past few years is to recover more sources in each recovery, thus improving the economics of source recoveries. A study of the number of sources recovered versus the number of recoveries by fiscal year shows a consistent trend for the past 6 years of an average of 30 to 40 sources per recovery with the exception of FY13.

At the time of recovery, or when a self-ship is received, OSRP takes ownership of the sources on behalf of the DOE, under the DOE license exemption. This transfer occurs through a process known as the Authorization to Transfer/Relinquishment of Ownership, or "ATRO." Following the ATRO process, OSRP informs the appropriate regulator that the sources have been transferred to DOE ownership.

Regardless of whether OSRP conducts a field recovery or assists with a self-ship, and regardless of whether the recovery involves TRU or large beta/gamma sources, the packaged sources are shipped to an OSRP secure staging area to await final disposition. In the case of TRU sources, OSRP works closely with the WIPP Central Characterization Program (CCP) in characterizing and qualifying the packaged TRU drums for WIPP disposal.

## **FUTURE WORK**

OSRP's mission in helping licensees in the disposition of their excess radioactive sealed sources has proven to be very successful. Both self-ship and field recoveries can be used to assist licensees for removing their sources. The need for OSRP recoveries will continue as long as licensees are using devices containing radioactive sealed sources and non-radioisotopic alternatives are not yet developed or fully adopted by users. Many challenges lay ahead with qualifying more types of sources for disposal and with operational re-certification for resuming WIPP disposal.

## **REFERENCES**

1. 49 CFR Part 173.476 Subpart I-Class 7 Radioactive Materials, Approval of Special Form Class 7 (radioactive) Materials.
2. *Transuranic Waste Acceptance Criteria for the Waste Isolation Plant*, Rev. 8.0 DOE/WIPP-02-3122.
3. 49 CFR Part 173.435 Subpart I-Class 7 Radioactive Materials, Table of A<sub>1</sub> and A<sub>2</sub> values for radionuclides