EXCESS AND UNWANTED RADIOACTIVE SEALED SOURCE DISPOSITION BY THE U.S. DEPARTMENT OF ENERGY OFFSITE SOURCE RECOVERY PROGRAM

J. P. Grimm
United States Department of Energy

ABSTRACT

The U.S. Department of Energy now considers excess and orphaned radioactive sealed sources a national security threat. Many long-lived radioactive sealed sources are excess, unwanted, and orphaned in the United States. This presents a growing problem because these sources are not suitable for disposal in shallow land burial facilities. For two decades, the U.S. Department of Energy (DOE) has recovered excess radioactive sealed sources. Initially this activity was limited to plutonium-239 sources. Beginning in 1999, the DOE expanded this activity to include additional sealed sources including plutonium-238 and americium-241. Since 1999, the OSR Program has recovered more than 7,700 domestic radioactive sealed sources. This includes plutonium-238 cardiac pacemakers, americium-241 portable gauge sources, larger americium-241 well-logging neutron sources, and additional plutonium-239 neutron sources. The DOE is now funded to recover most known excess sources during 2003 and 2004. Owing to the need for interim storage at federal facilities, the DOE has developed new nuclear material containers specifically for long-lived neutron sources. The first of these is a special-form overpack capsule for individual sources. The second is a multi-function container capable of providing safe shielded storage, transportation, and ultimately disposal. The OSR Program's scope is narrowly defined to certain radioisotopes, and deals only with domestic sealed sources. Future mission expansion will require establishing new government policy, funding, and ultimately a disposal path for these materials.

INTRODUCTION

Many long-lived radioactive sealed sources are excess, unwanted, and orphaned in the United States industrial, medical, academic, and government sectors. This presents a growing problem because these sources are not suitable for disposal in shallow land burial facilities. Other appropriate disposal options are not yet available.

The Off-Site Source Recovery (OSR) Program, managed by the US Department of Energy (DOE) at the Los Alamos National Laboratory (LANL), is the only government activity that proactively addresses this problem. In one form or another this activity has been under way for more than 20 years. It started out by accepting only plutonium-239 neutron sources owned by the government, and loaned to colleges and universities for education and research. In the 1990s, the OSR Program began answering requests from regulators to accept certain other sources, mainly actinide-bearing sources exceeding the criteria for class C low-level radioactive waste (LLW). Late in 2000, the OSR Program established the capability to proactively recover excess and unwanted sources in greater numbers. The first isotope added to the DOE's list for acceptance was plutonum-238. Americium-241 recovery got under way in 2001. The first large strontium-90 sources were recovered in January 2004.

DISCUSSION

The OSR Program underwent substantial changes in 2003. In the aftermath of the September 11, 2001, terrorist attacks the Department of Energy determined that the OSR Program should no longer be managed as a waste management activity, but rather as a national security activity. This decision resulted in the Program's transition out of the environmental management program, and into the National Nuclear Security Administration (NNSA). Specifically, the OSR Program is included as one of several programmatic activities under NNSA's newly created Office of Nuclear and Radiological Threat Reduction.

Equally important, The U.S. Congress determined in 2002 the activity required supplemental funding. An additional $10 million was allocated to the program with a specific goal to recover several thousand excess sources through fiscal years 2003 and 2004. Through 2003, nearly 7,700 excess sealed sources have been recovered from domestic licensees. Progress from developing new capabilities and addition funding are displayed in Fig. 1.

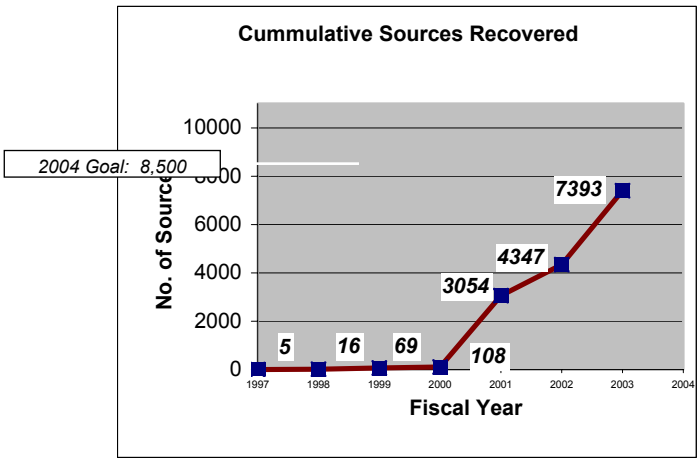

Fig. 1 Cumulative numbers of radioactive sealed sources recovered by the Offsite Source Recovery Program

This government program addresses the safety and security risks posed by unwanted long-lived sealed sources. One of the most common isotopes used is americium-241. Many of these are used in oil and gas well-logging activities. Small firms lacking the physical capability and financial resources to provide safe storage commonly own these neutron sources.

Considerable numbers of heat sources containing plutonium-238 once were used in manufacturing cardiac pacemakers. These pacemakers and plutonium-238 batteries became obsolete in the 1970s with the onset of long life chemical battery technology. The OSR Program has recovered approximately 2,000 excess and unwanted pacemakers to date. The most prolific domestic use of long-lived sealed sources is in portable and fixed industrial gauges. Approximately 9,000 such sources, chiefly containing americium-241, are found in manufacturing and general commerce. Recovering these sources is particularly important because many are excess and unwanted, and commonly are lost, stolen or inadvertently discarded.

Late in 2003, the OSR Program resumed recovering excess government owned plutonium-239 neutron sources. These sources are found at numerous colleges and universities, and are derived from the former Atomic Energy Commission's special nuclear material loan/lease program. The OSR Program has established these sources meet the criteria for transuranic (TRU) waste disposal at WIPP. However, while they are consolidated at DOE sites, they require storage in secure facilities owing to the attractiveness and considerable quantities of special nuclear material involved.

Most recently, the OSR Program added strontium-90 source to its list of recovery capabilities. Strontium-90 is typically found in radioisotope thermoelectric generators (RTGs), once used in remote terrestrial applications requiring low-wattage electrical power supplies. These excess sources are now chiefly found in storage at government site and military bases. Large strontium-90 sources in radioisotope thermoelectric generators (RTG) exceed the class C LLW criteria. The first four RTGs were recovered from a commercial firm in Texas. An additional two RTGs are slated for removal in California in 2004.

RECOVERY AND STORAGE OPERATIONS

Beginning in the late 1990s, the DOE greatly expanded its sealed source handling capacity at LANL to accommodate thousands of excess sealed sources from the licensed sector. Initially, neutron sources were chemically processed to eliminate neutron generation. However, this was determined to be unnecessary. Instead, excess and unwanted sources are simply stored as radioactive waste at government nuclear facilities.

This strategy required developing new nuclear material containers specifically for long-lived neutron sources. The first of these is a special-form overpack capsule for individual sources. The second is a multi-function container capable of providing safe storage, transportation, and ultimately disposal. The special form capsule has been designed, tested, and certified in several configurations.

Composed of thick walled stainless steel, the special-form capsule safely stores and ships damaged sealed sources or sources that for other reasons cannot be certified for transportation. Once closed, a special form capsule cannot be reopened. DOE and LANL continue to modify and fabricate these capsules to accommodate unique sources as they appear, especially from government nuclear research and development laboratories. These capsules are available for both government and commercial radioactive waste management activities.

Fig. 2 Plutonium-239 neutron source being re-encapsulated in the field using the special-form overpack capsule.

The multi-function container evolved from containers used by DOE for transportation and disposal of transuranic waste. The container incorporates neutron shielding and accommodates considerable quantities of neutron sources without special handling requirements. The pipe overpack concept was modified to provide a narrow diameter (15 cm) inner payload container, within a standard 208-liter (55-gallon) drum. The annular space is filled with neutron shielding material. This multi-function container has been evaluated and approved by the government's transuranic waste certification program at the Waste Isolation Pilot Plant (WIPP), and is now acceptable for field recovery, transportation, storage, and disposal in the government's waste repository.

Fig. 3 Excess americium-241 neutron source prepared for loading in the S-100 multifunction container.

Cost, Capacity, and Schedule

The OSR Program expects to store more than 14,000 long-lived radioactive sources by 2010. More than 7,700 radioactive sources are already in storage at LANL. Another 3,000 sources are

known to be excess and unwanted and are slated for recovery through 2005. Subsequent radioactive source recovery will occur at a pace depending upon numbers of sources declared excess and upon funding levels.

Current operating costs for sealed source recovery and management average less than $3,000 per source. This cost includes project management activities, recovery operations, storage facilities, and container procurements. This figure excludes the costs to site, design, and build a suitable disposal facility in the future.

Ultimate Disposition

The US has not established a disposition path for most long-lived sealed sources. Currently, the only suitable disposal site is the WIPP, found in southeastern New Mexico. WIPP, however, is restricted to transuranic waste generated from the U.S. Government's nuclear defense programs. A large share of waste from the OSR Program will be generated by the commercial and academic sector. These waste streams cannot be disposed with US Government waste at WIPP. Therefore, the OSR Program will develop and provide storage capacity until a disposal pathway is developed. OSR Program projections indicate less than 500 cubic meters of waste in shielded containers will require storage for an, as yet, unspecified time. The next step for the US Government is to examine disposal options.

Future Activities

Other sealed sources exceeding class C LLW criteria include large sources containing cesium 137. The commercial sector has traditionally handled excess cesium with demand for recycle and reuse. However, as large irradiators are replaced with newer technologies, more and more large excess cesium-137 source might require government action. More significantly, the commercial LLW disposal industry maintains restrictive waste acceptance criteria for cesium-137 sources. Many sources do not exceed the class C LLW criteria, and yet are not acceptable for commercial disposal.

Owing to the radiological threat posed by excess and unwanted radioactive materials, the DOE is considering whether the OSR Program should address an expanded scope. New work will involve sealed sources containing the same isotopes already addressed, but in concentrations qualifying as class B or C LLW. The OSR Program will also expand its activities to isotopes that never exceed class C LLW criteria, but are seen to present radiological threats to national security. These isotopes include californium-252, cobalt-60, radium-226, and iridium-192.

CONCLUSION

The OSR Program manages large numbers of excess and unwanted long lived sealed sources and addresses substantial safety and security risks, recovers sealed sources from the commercial and academic sector at an increased rate, and provides safe storage pending the availability of a suitable repository.