PREPARATION TO SHIP RADIOACTIVE SEALED SOURCES FROM LANL TO WIPP

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LA-UR-01-0365

INTRODUCTION

The Low-Level Radioactive Waste Policy Amendments Act of 1985, PL 99-240, (1) assigned the United States (U.S.) Department of Energy (DOE) an obligation to dispose of radioactive wastes that include several thousand radioactive sealed sources containing transuranic (TRU) isotopes. When excess and unwanted, these sources pose a potential threat to human health and the environment until they are recovered, safely stored, and eventually disposed. These sources have high visibility due to their broad distribution around the U.S. and the expressed need to properly manage these potentially dangerous radioactive materials. On an international basis, instances of improper handling of radioactive sealed sources have caused disasters that have produced radioactive contamination and even the loss of human life.

The Los Alamos National Laboratory (LANL) previously recovered sealed sources in limited numbers for years, chemically separated the radioisotopes from the sources, and stored the actinide materials as impure oxides. In 1999, the recovery effort at the LANL was reorganized to provide for future management of recovered sealed sources as waste if they were not to be recycled or reused.

The LANL Off-Site Source Recovery (OSR) Project has the charter to recover sealed sources that are no longer wanted or are excess (2). In addition to providing interim storage of recovered sources, the OSR Project seeks disposition paths for the radioactive materials. Sealed sources containing TRU isotopes that are defense-related are candidates for disposal at the Waste Isolation Pilot Plant (WIPP). As one disposition path, the LANL OSR Project has been working to prepare the first sealed source waste stream shipment to the WIPP. This paper includes OSR Project accomplishments as well as two options for preparing this unique waste stream for disposal at the WIPP.

BRIEF DESCRIPTION OF SEALED SOURCES

To date, the LANL OSR Project has catalogued about 5,000 excess and unwanted radioactive sealed sources in the U.S. Eventually, this number may rise to 18,000. The sealed sources are simple, well defined, manufactured products that typically consist of chemically-pure actinide materials completely sealed in metal jackets. They range in size from that of a pencil eraser to that of a soup can and contain quantities of radioactivity ranging from a few milliCuries to tens of Curies. The actinides may be americium (Am) or plutonium (Pu) metals or oxides. In a large number of the sources, the actinides are in contact with beryllium (Be) to generate neutrons for various applications.

Excellent acceptable knowledge (AK) documentation is available for most of the sources. This includes documentation on defense applications of appropriate sealed sources (3). While some of the sources are owned by the Department of Defense (DOD) or the Department of Energy (DOE), the majority of them are in the public domain and were used for Nuclear Regulatory Commission (NRC) and state licensed activities. In some cases, sealed sources that are eligible for disposal at the WIPP are identical in physical and radiological characteristics to those that are barred from the WIPP by the WIPP Land Withdrawal Act, and only differ in whether their historical application was defense or non-defense. Sources without a defense pedigree currently have no disposal path.

DISCUSSION

PL 99-240 made the DOE responsible for disposal of defense and non-defense Low-Level Radioactive Wastes (LLW) which meet the definition of both transuranic (TRU) wastes and LLW resulting from licensed activity that exceeds the limits established for Class-C in 10CFR61.55. The DOE accelerated its plan to recover sealed sources, and now has a goal of retrieving the known backlog by 2004. Since the only identified disposal facility with a Waste Acceptance Criteria (WAC) permitting sealed sources containing TRU radiosotopes is the WIPP, a priority focus is disposal of defense related materials.

Two options exist for preparing this waste stream for disposal at the WIPP. The first would utilize the established LANL TRU waste method for characterizing and certifying sealed sources after they have been recovered to the LANL. The second would utilize the DOE Carlsbad Field Office's (CBFO) central characterization effort to accelerate removal of TRU wastes from numerous small quantity sites (SQS) throughout the DOE Complex. In this latter option, packaged sealed sources would be shipped directly to the WIPP for final characterization and certification for disposal.

USE OF LANL CHARACTERIZATION / CERTIFICATION PROCESS

The OSR Project's near term focus is to use the LANL characterization / certification process while preparing to implement the CBFO central characterization in Carlsbad when that option becomes available in the future.

OSR Project challenges to prepare for shipments to the WIPP using the LANL process included:

- Developing procedures to meet the WIPP WAC and Waste Analysis Plan (WAP)
- Developing compliant containerization for TRU waste storage and TRUPACT II transport, and
- Meeting the requirements of the LANL Transuranic Waste Characterization / Certification Program (TWCP).

Preparing to meet these procedurally-based requirements proved to be a rigorous and sometimes frustrating experience. Many of the prescriptive requirements for preparing TRU wastes for shipment to the WIPP were based on the broad universe of widely divergent TRU wastes in existence throughout the DOE Complex. In contrast, the sealed sources consist of very simple,

well known, manufactured items that are robustly containerized (e.g., doubly sealed within metal jackets).

As one example of the prescriptive requirements, the headspace gas analysis (HGAS) requirement had to be met even though the sealed sources were inorganic actinides doubly sealed within metal jackets to be packaged within a robust pipe overpack component (POC). For another example, the rigorous visual examination procedure (VE) developed was very detailed to meet the WIPP WAP requirements and included all required multiple overchecks. Yet, for this simple and unique waste stream there was primarily only one variable (estimating the sealed source weight) when the sealed sources were to be packaged. For the broad universe of divergent TRU wastes, the VE overchecks required by the WIPP WAP provide some value added by assuring that volume to weight (or vice versa) conversions of waste material parameters were done correctly. However, no such conversions were needed for the sealed sources.

In all cases, all of the OSR procedures using the LANL characterization / certification process were developed to meet the strict and prescriptive requirements of the WIPP WAP.

USE OF CBFO SQS PROCESS IN CARLSBAD

Use of the CBFO central characterization initiative for future shipments of sealed sources as an SQS waste stream is appealing. Defense sealed sources can be recovered from their field locations in WIPP approved pipe component overpack containers (POCs) under an acceptable visual examination (VE) procedure and shipped to LANL or another site, including the WIPP. After they are prepared for transportation and meet the requirements in the CBFO SQS program; the POCs are ready for shipment to the CBFO SQS characterization facility for disposal certification. For several reasons, the sealed sources constitute an ideal waste stream for early CBFO central characterization at the WIPP site.

Since the sources are completely sealed in metal jackets (most of which meet U.S. DOT Special Form requirements and/or ANSI specifications for sealed sources), the radionuclides are fully encapsulated and cannot contaminate the CBFO processing system (4). A leak test certification of the sources is completed to verify their integrity before packaging in the POC assemblies. This unique characteristic of the sealed sources may allow them to be processed by the CBFO SQS initiative prior to the testing / acceptance of glovebox systems in Carlsbad. This could expedite SQS waste processing in Carlsbad.

Gas issues related to the sealed sources are minimal. Since the actinides are completely sealed in metal jackets, the first contact of the radionuclides is with the metal jacket. This is considered to be material type II-2 with no radiolytic hydrogen production. Further, since the materials encapsulated in the metal jackets are inorganic, there are no VOCs in the waste stream to cause flammability issues. Even if there were VOCs, they would be fully contained by the metal jackets. Experiments are in progress at LANL to determine if minor amounts of hydrogen or VOCs are generated from neutron absorption in the proposed shielding of the packaging. Potential for gas generation in the shielding is a major criteria in selection of shield materials.

While all regulations equally apply to the sealed sources as they would to other waste streams, characteristics of the sealed sources assure fewer constraints in complying with the regulations. As an example, there is abundant documentation (5 - 10) that the sealed sources are heterogeneous, debris that is non mixed waste. Consequently, it is unnecessary to chemically sample and analyze portions of these materials.

Additionally, because of the simple nature of the sealed sources, the required visual examination (VE) process should be quite easy to perform while meeting the RCRA Permit, Part B Waste Analysis Plan (WAP) VE requirements. The waste material parameters are constant and known from excellent AK documentation. The only variable in the VE process is the estimation of the weight of the sealed sources. This weight is insignificant compared to the waste material parameter weights of the packaging materials.

Further, again attributable to the known and simple nature of the sealed sources, there should be no issues on the certifiability and potential subsequent rejection of the sealed sources. VE will verify the absence of prohibited items as the sealed sources are packaged in the POCs.

RISK REDUCTION BY WIPP DISPOSAL OF SEALED SOURCES

Currently, the primary risk from sealed sources exists in the public sector. It will be greatly decreased as sources are recovered and placed in storage or disposed at a DOE site. A transfer of risk occurs when the recovered sources are added to DOE inventories. This is a smaller and second order effect, but is a real risk that is eliminated only when final disposal of the sources is achieved.

The OSR Project recovers sealed sources based on a prioritization that is established by the DOE. Reduction of the potential risk posed by a source is part of the basis for prioritization. The more rapidly the sources are removed from the public domain, the more quickly the risk is decreased. Preliminary estimates of risk posed by sealed sources for various scenarios have been developed (11). Figure 1 presents a curve that shows a historical pattern of increasing relative risk to the public and the environment beginning with the early 1980's due to the rapid increase in the population of unwanted sources in that time frame. By the mid-1980's, Congress was aware of the excess source problem and legislatively passed the responsibility to the DOE in the Low-Level Radioactive Waste Amendments Act of 1985. Starting in 1993, the DOE's recovery of problematic sources slowed the rate of increasing risk to the general population but did not markedly change the trend. The current plan of the OSR Project is to reverse the trend of increasing risk to the public and the environment by rapidly recovering significant numbers of unwanted sources beginning in FY-2001. The DOE's plan is to continue with aggressive recovery through FY-2004 to eliminate the currently known backlog of sources. Recovery by the OSR Project of, as yet, unidentified sources would continue through FY-2006, until a viable disposal path becomes available for all future needs.

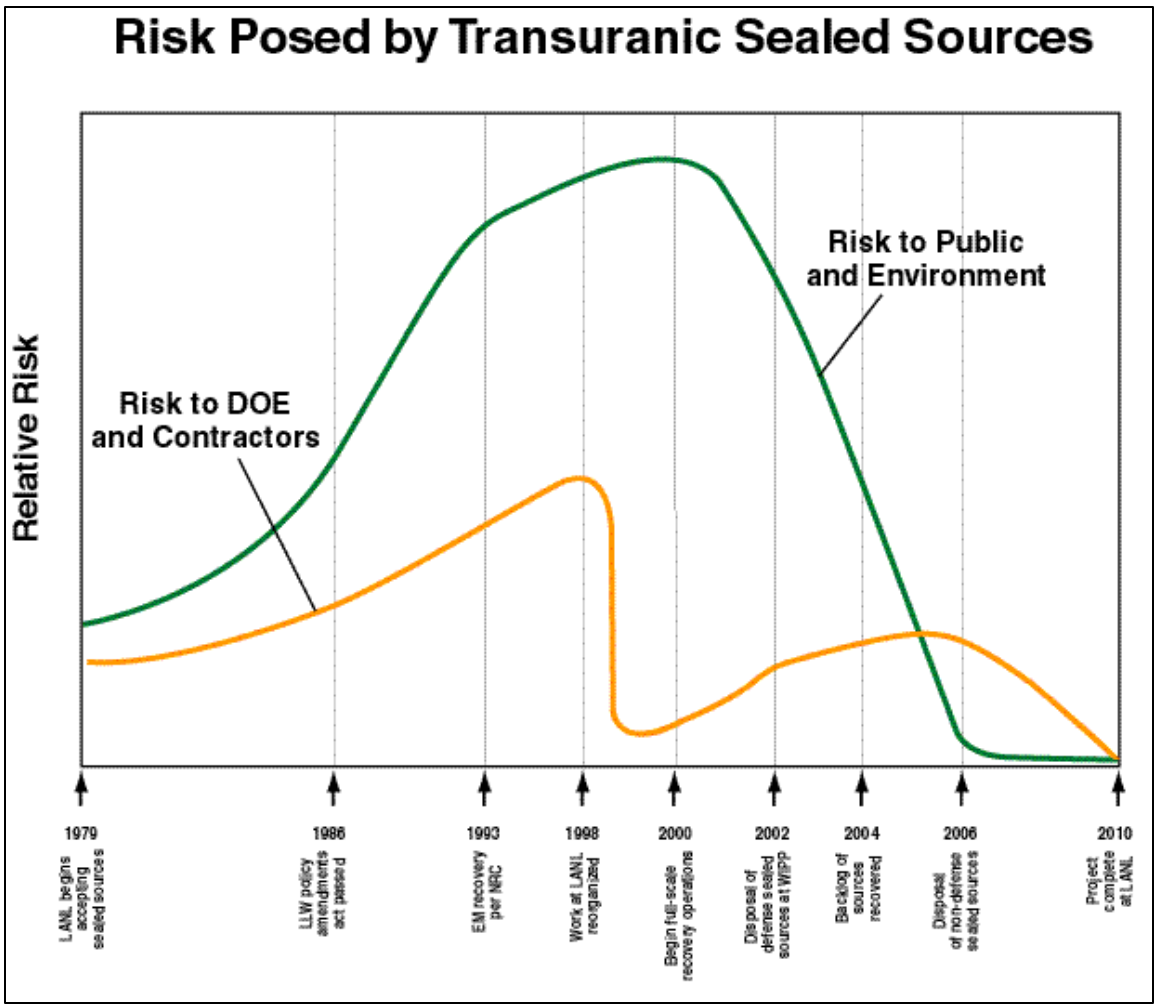

Fig. 1. Risk Posed by Transuranic Sealed Sources

The second curve in Figure 1 shows the history of risk to DOE and contractor personnel resulting from the government's efforts in unwanted source management beginning in 1979. This is a lower risk in absolute terms, but is still important to the overall problem. Under Defense Programs; LANL accepted unwanted Pu-239-bearing radioactive sources, disassembled the sources, and chemically processed the contents to recover the contained plutonium. Although the process was effective in removing this single type of unwanted sealed source from the environment, the rate of recovery was insufficient to make a significant impact on the rapidly increasing inventory of unwanted sources. In addition, the chemical processing method increased radiation risk to exposed workers while producing a significant secondary transuranic waste stream. Some of the increased risk was attributable to the increased concentration of the sources and their isotopes at one storage location. In 1998, the DOE re-evaluated the processing management method and concluded that it was counter productive from a cost and risk basis. It was also clear that since the rate of recovery was limited by the chemical processing step; this management method would not result in timely removal of all of the backlogged sealed sources that required recovery. A decision was made to end chemical processing.

This decision eliminated significant radiation exposure to workers who previously performed the chemical separations. It decreased the risk to only that incurred during the continued storage and maintenance of the low-purity actinide materials. As a result of the 1998 decision, this curve in Figure 1 shows a sharp decrease in risk to DOE and contractor personnel.

Beginning in 1998, the DOE management philosophy shifted from chemical processing to waste management. From that year forward, sealed sources would be recovered and managed as waste if they were not to be recycled. The risk to DOE and contractor personnel begins to increase in this period as recovery of sources accelerates from the vulnerable public domain and they are placed in DOE or commercial storage. This risk, though significant, is still considerably lower than when sources were being chemically processed and far lower than the risk of leaving the sources in the public domain. Concurrently, the LANL OSR Project addressed compliance issues to allow direct recovery to the more controlled DOE environment. With compliance issues resolved, significant numbers of sources will be recovered rapidly directly to LANL in FY-2001 to begin the final push to eliminate the highest levels of risk.

In 2002, the lower curve of Figure 1 illustrates a slowing in the rate of increase of the relative risk. This occurs as sources of defense origin begin to be disposed at the WIPP, and the defense-related source inventory in storage is reduced.

Figure 2 provides more detail on the relative risk beyond the year 2000. As discussed above, only sources from defense applications have an identified disposal path, disposal at the WIPP starting in early FY- 2001 or FY - 2002. The solid curve continues to show increased risk through FY-2005 as non-defense source inventories in storage continue to increase. Then, in FY-2006, the OSR Project plan calls for some, as yet, undefined disposal path to be approved. If this is accomplished on schedule, then all forms of risk will begin to decrease until all significant risk is eliminated by 2010. If the, as yet, unidentified "silver bullet" disposal option for non-defense sources is not found, and an operational disposal pathway is not yet developed by 2006, then, risk to DOE personnel will not decrease. Instead, as shown by the dashed curve of Figure

2, risk to DOE and contractor personnel will continue indefinitely with storage and maintenance of the inventory of sealed sources.

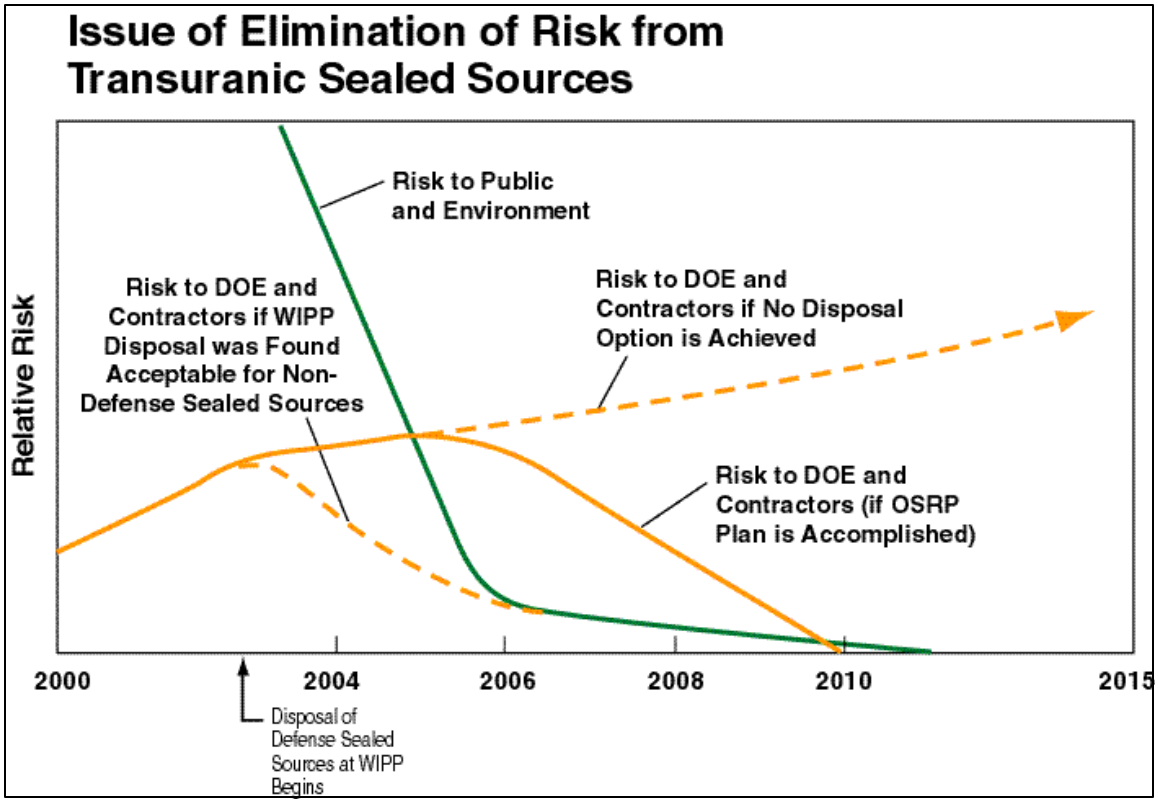

Fig. 2. Issue of Elimination of Risk from Transuranic Sealed Sources

Currently, the OSR Project expends about $2M annually to seek a disposal path for the non-defense sources. If these sources could be more rapidly disposed from interim storage, e.g., at the WIPP, and if that process could begin in the 2002 time frame, this funding could be expended on source disposal. Then, all of the relative risk would drop dramatically and the elimination of all risk would be achieved more rapidly with substantial savings.

As stated above, there are about 5,000 radioactive sources currently catalogued by the OSR Project with an eventual projection of 18,000 to be recovered. Depending upon how these sources are packaged, approximately 1,000 disposal containers are projected. Approximately 5% of the sources are estimated to be from defense applications. The defense-related sources could be packaged into 5-10% of the 1,000 projected containers. The remaining 900 containers of non-defense sources would require extended, interim storage. As previously stated, if these containers of non-defense sources could be disposed at the WIPP, the risks posed to DOE and contractor personnel could be decreased rapidly.

The WIPP is anticipated to receive the equivalent of 850,000 drums of transuranic waste during its operational phase. Consequently, the disposal of 900 drums of non-defense origin sources would not be expected to have a significant impact on either the capacity or the performance

assessment of the WIPP. However, it would have a significant effect on risk reduction to the public, the environment, and to DOE and contractor personnel.

PUBLIC SUPPORT

Two recent newspaper articles (12,13) show that public support exists not only for the OSR Project, but also for disposal of the sources at the WIPP. The latter newspaper editorial suggests that it makes good sense for sealed sources from non-defense applications to be disposed in the WIPP. This is a favorable position for this newspaper to take since it has often been critical of the DOE and the WIPP in the past. Public support will be a very important asset if the DOE requests a change in the LWA to allow WIPP disposal of non-defense sources.

CONCLUSIONS

By the time of the WM'01 conference, it is anticipated that the LANL OSR Project will have developed all the necessary procedures and documents required to generate the first certified TRU waste form of defense, sealed sources. The first containers are awaiting transport to the WIPP under the LANL program.

Removal of sealed sources from the public domain decreases, but does not completely eliminate their risk. If non-defense sealed sources could be disposed at the WIPP, the risks posed to DOE and contractor personnel could be decreased rapidly.

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