Off-Site Source Recovery Project Case Study: Disposal of High Activity Cobalt 60 Sources at the Nevada Test Site 2008 - #10509

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ABSTRACT

The Off-Site Source Recovery Project (OSRP) has been operating at Los Alamos National Laboratory (LANL) since 1998 to address the U.S. Department of Energy (DOE), responsibility for collection and management of orphaned or disused radioactive sealed sources which may represent a risk to public health and national security if not properly managed. Since 2004, OSRP subcontractors have packaged high activity Co-60 sources from sites throughout the U.S. and shipped them to an interim storage facility in Texas, pending final disposition at the Nevada Test Site (NTS). Profiling this waste stream for NTS disposal required collaboration between personnel from OSRP, OSRP subcontractors, Idaho National Laboratory (INL) and Lawrence Livermore National Laboratory (LLNL). In October 2008, 155 Co-60 sources totaling 119.72 TBq were packaged into a spent irradiator shield, which was sealed and over-packed in a Type B container for shipment to NTS. The packaged sources were disposed of at NTS on October 24th, 2008. This successful project is an example of responsible end-of-life sealed source management and a positive threat reduction effort put forth by the DOE.

INTRODUCTION

The events of September 11, 2001 (9/11) have forced us to evaluate the management of radioactive materials in our environment. In the wrong hands, these materials can potentially be used as weapons in terrorist attacks, and as such, their vigilant control is a matter of national security. The use of radioactive materials has benefited society for decades and will continue to do so for decades to come. Production and distribution of sealed sources for industrial, research, and medical purposes is still in high gear in the U.S. This paper discusses a successful case where many such disused sources, which may otherwise present a risk to national security and public health, were responsibly collected and disposed of.

OSRP

The Off-Site Source Recovery Project (OSRP or the Project) has been operating at Los Alamos National Laboratory (LANL) since 1998 to address the U.S. Department of Energy (DOE) responsibility for collection and management of orphaned or disused radioactive sealed sources. Management of these sources includes collection, storage, and/or disposition when a disposal pathway is available or can be created. Since the inception of the Project, more than 21,000 sealed sources, representing over 28,000 TBq of radioactive material have been recovered. The initial scope of the Project included recovery of all sealed sources meeting the definition of Greater than Class C (GTCC) [1] LLRW, most notably the transuranic actinides Pu-238, Pu-239, and Am-241.

In response to the events of 9/11 the Nuclear Regulatory Commission (NRC) led a risk-based evaluation of potential vulnerabilities to terrorist threats involving NRC licensed nuclear facilities and materials. The evaluation concluded that the possession or storage of disused radioactive sealed sources with no disposal outlet presents a potential risk to public safety and national security [2]. As a result of these factors, the Project was shifted to management under NNSA, which expanded the scope to include the recovery of any radioactive sealed source that presents a security risk.

SOURCE COLLECTION

Since 2004, OSRP has orchestrated the recoveries of several hundred beta/gamma emitting sealed sources, primarily Co-60 and Cs-137. In most cases, the sources were contained in self-shielding devices that held up to tens of thousands of curies of material. The sources were either orphaned and brought to OSRP's attention by NRC agreement state radiation safety officials, or registered with the program at http://osrp.lanl.gov by licensees as disused material. These sources have been recovered from high schools, universities, hospitals, blood banks, and industrial sites throughout the country. Generally, the shields that house these types of sources are large in both physical size and weight; therefore, the shields are packaged and shipped by OSRP subcontractors equipped to handle operations of this magnitude. The vast number of sources and, in general, their high individual activities, made individual disposal at commercial sites cost prohibitive, and thus not a viable option. Most of these sources are therefore transported to a secure interim storage facility in Texas for consolidation and repackaging for final disposal.

DISPOSAL OF 60CO SOURCES AT NEVADA TEST SITE

Out of several hundred sources, 155 60Co sources (approximately 119.72 TBq) from 18 irradiators and calibrators collected from various sites around the U.S. were selected for disposal at the Nevada Test Site (NTS) (see Table I). The waste generator for this shipment was Lawrence Livermore National Laboratory (LLNL) who has a well established program for disposal at NTS. The LLNL personnel created a waste profile for this waste stream of 155 sources. Within a waste profile each sealed source must be individually identified with documentation on the sources as well as a description of manufacturing and all materials used in source construction [3]. This verifies the make, manufacturer, activity, and isotope of the source inventory and to document whether Resource Conservation and Recovery Act (RCRA) constituents (i.e. Lead, Silver, Cadmium, etc..) were used in source construction and thus present in the waste stream [3]. RCRA constituents or other hazardous materials used for shielding purposes (lead, depleted uranium) or non-waste shielding, are accepted on the condition they are being used for ALARA purposes to protect personnel from high radiation exposure[3]. To fulfill this verification requirement, manufacturer certificates supplied by the source owners or manufactures to were used verify the isotope, activity and manufacture dates for the devices/sources. Documents from the Sealed Sources & Device Registry (SSDR) for each device/source model were used to describe source construction. In addition to documentation on the sources, a NTS Waste Certification Official (WCO) must be present to visually verify the constituents of the package. LLNL personnel were present at the packaging of the sources to witness source packaging and to apply LLNL tamper indicating devices (TIDs) to the packaging. This ensured that the approved source inventory was not changed after initial packaging.

Table 1: Inventory of the 155 Co60 sources packaged within the J.L. Shepherd 109C shield.

Iso.	Original Activity/ Date	Current Activity/ Date	Number of Sources	Source Mfg.	Source Model	Device Mfg.	Device Model
Co-60	148 TBq 09/13/1993	22.72 TBq 12/11/07	18	JLS	7810	JLS	JLS Model 109-C
Co-60	37 TBq 04/17/1997	9.10 TBq 12/11/07	10 of 30	GE for JLS	7810	JLS	JLS Model 109
Co-60	127.47 TBq 02/10/1997	30.66 TBq 12/11/07	10 of 30	GE for JLS	7810	JLS	JLS Model 109
Co-60	16.28 TBq 04/17/1997	4 TBq 12/11/07	10 of 30	JLS	7810	JLS	JLS Model 109
Co-60	148 TBq 02/12/1993	21.01 TBq 12/11/07	12	JLS	7810	JLS	JLS Model 109-C
Co-60	863.21 TBq 08/01/1966	3.74 TBq 12/11/07	48	AECL	C-166 or C-167	AECL	GC 220
Co-60	4.65 TBq 11/11/2006	4.03 TBq 12/11/07	8	AECL	C-200	AECL	GC 200
Co-60	19.26 TBq 09/19/2006	16.4 TBq 12/11/07	18	AECL	C-198	AECL	GC 220
Co-60	0.28 TBq 12/05/2006	0.25 TBq 12/11/07	7 of 12	AECL	C-166 or C-167	AECL	GC 220
Co-60	0.24 TBq 12/05/2006	0.21 TBq 12/11/07	5 of 12	AECL	C-166 or C-167	AECL	GC 220
Co-60	1.29 TBq 07/11/1995	0.25 TBq 12/11/07	1	Amersham	92802	Amersham	1006A
Co-60	1.85 TBq 03/15/1986	0.11 TBq 12/11/07	1	Gamma Ind.	"A" Series	Gamma Ind.	Gammatron 100
Co-60	0.29 TBq 11/03/2006	0.25 TBq 12/11/07	1	Gamma Ind.	"A" Series	Gamma Ind.	Gammatron 100
Co-60	1.67 TBq 09/11/1986	0.02 TBq 12/11/07	1	Gamma Ind.	"A" Series	Gamma Ind.	Gammatron 100
Co-60	185 TBq 07/31/1977	3.40 TBq 12/11/07	1	JLS	7810	JLS	81-24A
Co-60	9.62 TBq 07/31/1977	0.18 TBq 12/11/07	2	JLS	7810	JLS	81-18B
Co-60	2.92 TBq 09/08/2006	2.48 TBq 12/11/07	1	NPI	NPI-20-800W	Keleket-Barnes	Flexaray
Co-60	1.05 TBq 11/03/2006	0.91 TBq 12/11/07	1	Amersham	A424-8	Unknown	Unknown

PACKAGING

In order to ship the high activity of 60Co selected for disposal a large shield was required to provide adequate shielding to keep the contact dose rate below 200mr/hr which is the threshold between contact handled and remote handled waste at NTS. An unloaded and disused J.L. Shepherd and Associates (JLS) model 109C irradiator shield collected from one of the recovery sites was utilized as a shield. Consisting of lead and depleted uranium cladding, the shield was chosen due to its rating to hold 177.6 TBq of 60Co with $\leq$4.0mr/hr dose rate at 5cm. In addition, the irradiation chamber within the shield of the 109C is 198 cubic inches, providing enough volume to house the 155 sources selected for disposition. The sources were moved in the hot cell at the OSRP interim storage facility in Texas. All of the 155 sources were unloaded from the 18 device shields, the sources verified by OSRP and LLNL personnel, and placed

within the JLS 109C shield. Upon packaging, contact dose rates were measured on the shield loaded with the 119.72 TBq and were well below the 200 mr/hr required for remote handled packages.

TRANSPORTATION/DISPOSAL

A Department of Transportation (DOT) compliant Type A shipment of 60Co would be limited to only 0.407 TBq of material, therefore this shipment of 119.72 TBq needed to be shipped in a Type B overpack [4]. A subcontractor, highly trained and experienced in large radioactive material transport, was hired by OSRP to be the shipper of record for the shipment of the loaded JLS 109C shield from the interim storage facility in Texas to NTS. This subcontractor handled all shipping paperwork and arranged scheduling between the packaging location and NTS. In addition, this subcontractor provided trained personnel to package the loaded shield into the Type B overpack used for shipping. A second subcontractor provided all equipment and personnel for the shipment as well as a Department of Transportation (DOT) / Nuclear Regulatory Commission (NRC) compliant Type B overpack for the shipment. Once reaching NTS, the loaded JLS 109C shield was removed from the Type B overpack and disposed of on October 24th 2008.

CONCLUSION

This successful project is an example of responsible end-of-life radioactive sealed source management and a positive threat reduction effort put forth by the DOE. Irradiators, Teletherapy Heads, and Calibrators like these are still in use in the US and abroad. Like the units discussed in this paper, these units contain large amounts of high activity beta-gamma emitting radioactive sources and present a risk to national security and public health. Many more of these units will become disused in the future requiring continued management and disposal efforts.

REFERENCES

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4. U.S. Department of Transportation. 49 CFR Hazardous Materials Regulations; HazMat Transportation. Parts 105-180