Repatriation of disused sealed sources from Peru to the United States

Mario Mallaupoma[1,*], Raymond Greenberg Jr.[2], Cristy Abeyta[3], Jim Matzke[3]

[1] Dirección de Servicios, Instituto Peruano de Energía Nuclear, Av. Canadá 1470, Lima 41, Perú
[2] Global Threat Reduction Initiative (GTRI), Washington, D.C.
[3] Off-Site Source Recovery Project (OSRP), Los Alamos National Laboratory (LANL), P.O. Box 1663, Los Alamos, NM, 87545, U.S.A.

Abstract

Disused sealed radioactive sources are piled in Peru due to the peaceful use of them in medicine, industry and research for a wide range of applications. The sources may contain a broad spectrum of radionuclides, exhibiting a wide range of activity levels and radioactive half-lives. At the end of their useful lives they are defined as 'spent' or 'disused'. However, the residual level of radioactivity in some sources can remain high, representing a significant radiological hazard. At this point, a decision must be made on how to properly manage the end-of-life cycle of the sources that are now disused. This paper describes technical actions developed by the specialized technical teams of IPEN and the Los Alamos National Laboratory for the repatriation of disused sources from Peru to the United States.

Resumen

Las fuentes selladas en desuso se acumulan en el Perú debido a la utilización pacífica de ellos en medicina, industria e investigación para una amplia gama de aplicaciones. Las fuentes pueden contener una serie de espectros de radionucleidos, que exhiben una variedad de niveles de actividad y vidas medias radiactivas. Al final de su vida útil se define como "gastado" o "en desuso". Sin embargo, el nivel de radiactividad residual en algunas fuentes puede seguir siendo alto, lo que representa un riesgo radiológico significativo. En este punto, debe tomarse una decisión sobre el modo de gestionar adecuadamente el ciclo de fin de vida de las fuentes en desuso. En este trabajo se describen las medidas técnicas desarrolladas por los equipos técnicos especializados de IPEN y el Laboratorio Nacional Los Álamos para la repatriación de fuentes en desuso de Perú a los Estados Unidos.

1. Introduction

Sealed radioactive sources are used worldwide in medicine, industry and research for a wide range of applications. The sources can contain a broad spectrum of radionuclides, exhibiting a wide range of activity levels and radioactive half-lives. At the end of their useful lives they are defined as 'spent' or 'disused'. However, the residual level of radioactivity in some sources can remain high, representing a significant radiological hazard. At this point, a decision must be made on how to properly manage the end-of-life cycle of the sources that are now disused. Owners and operators typically work with their national regulators to make end-of-life arrangements for sources they no longer need. They basically have three options to consider: 1) Transport the source(s) to a national storage facility where the sources will be safe and secure; 2) Return the source(s) and/or entire device(s) to the manufacturer; and 3) Repatriate the source(s) and/or entire device(s) to their country of origin. The first option is the most widely used. The second option is also widely used, but return costs for owners can be prohibitive. The third option of repatriation has become steadily available, thanks in part to government-sponsored programs of supplier countries to accept sources they previously exported for use. One example of such a program is the Global Threat Reduction Initiative's (GTRI) Off-site Source Recovery Program (OSRP), which is managed by the United States Department of Energy. GTRI works to recover disused sources in the U.S. and the program has now evolved to recovery of certain U.S.-origin sources from international locations. One such operation was completed in Peru in December 2010, where GTRI collaborated with the Instituto Peruano de Energía Nuclear to package and repatriate disused sealed sources stored at the Nuclear Research Center outside of Lima.

* Corresponding author: mmallaupoma@ipen.gob.pe

2. Experimental

2.1 Joint Work Plan Development and Execution

A work plan was developed between the IPEN and OSRP technical teams. This work plan considered all technical aspects related to safety and security considerations, packaging configuration, and the preparation for the transportation of shipments of radioactive material from Peru to the United States of America.

As part of the joint work plan, a pre-work meeting was conducted to ensure both teams understood the safety and technical aspects of the work to be conducted. Also, daily meetings were held in order to discuss the work expected to be completed during that day and review previously conducted work to see what improvements could be made to prepare for activities. Both technical teams developed activities according to the joint program needs (1). See Figures 1 and 2.

Figure 1. Coordinated work between IPEN and LANL teams.

Figure 2. IPEN and LANL working groups.

2.2 General work activity process

– Pre Job/Daily/Site Safety Meeting: Prior to start the work, daily safety meetings were conducted by the joint team leaders to discuss what work was expected that day and any improvements in the work and safety for the processes already conducted.

– Radiological Monitoring: Radiological surveys, beta/gamma/neutron area survey and contamination checks in work areas, were conducted by radiological protection personnel from both teams before, during, and after each work day. Radiological protection personnel identified sources of radiation and designated low dose, safe waiting areas. During source/device identification and packaging radiological protection personnel monitored the process to help personnel minimize radiation dose received. See calibrated radiation protection equipment used which was provided by the LANL team (Figure 3).

Figure 3. Measurement of dose-rate.

– Stage containers and equipment for work activities: In preparation for the day's expected work, each team would stage the equipment and containers to be used.

– Perform container inspections prior to use:

- Complete and document external inspection.
- Open and complete internal inspection.

– Establish Work Area:

• Coordinate with site representatives to exclude unnecessary personnel.

• Coordinate removal of unnecessary sources of radiation located in or near the work area (Figure 4).

Figure 4. Removal of disused sealed sources.

• Establish a buffer area that restricts personnel entry during source movement.

• Establish a low dose work area for non-source handling activities.

• Minimize number of personnel used during source movement or manipulator operations.

– IPEN team and source/device deconditioning and movements:

• Previously, IPEN had followed the recommendation of the International Atomic Energy Agency (IAEA) to condition sources/devices in concrete to minimize access and place in long term storage. The sources had to be de-conditioned prior to packaging them. IPEN and OSRP teams developed several options on how to de-condition the sources from the concrete. IPEN determined which option was best and de-conditioned the sources/devices from the conditioned containers.

• Once the sources/devices were de-conditioned from the containers, IPEN moved the sources/devices to be packaged by OSRP.

– OSRP Team and source/device verification prior to packaging:

• Inspect and verify information of sources/devices.

• Validate origin of sources/devices

• Determine if sources were special form or not. If the sources were not special form and could not be shipped in a Type-A container due to activity limits unless special form, the sources were encapsulated into the field sealable special form capsules IAEA Certificate of Competent Authority No. USA/0695/S-96 and USA/0696/S-96 [2].

– End of work activity

• An end of work activity radiological surveys, beta/gamma/neutron area survey and contamination checks in work areas, were conducted by radiological protection personnel from both teams.

• Contamination checks conducted on all tools and tools packed for shipment back to the U.S.

• Record final personnel dosimetry results on for each team member.

• Exit work area.

• Conducted a closeout interview with IPEN and OSRP representatives to determine improvement in the process.

• Establish tentative schedule for shipment of packaged material.

2.3 *Packaging configuration*

– Development of packaging plan

With each source checked for surface contamination and information verified by OSRP staff a packaging plan was created. Several different Type-A containers were sent by the OSRP team from a tentative packaging plan developed from the original sources/devices information provided by IPEN. Additional sources/devices of U.S.-origin had been received at IPEN between the time the original trip was planned and the actual trip. This required modification of the packaging plan.

Loading each Type-A container the following must be considered:

The activity limits for A1 (special form activity level) or A2 (non-special form activity level).

Maximum weight allowed in the Type-A container. Each source/device had been weighed during the inspection process to ensure not to exceed maximum weight allowed for the Type-A container being used during loading process.

External dose-rate of the container after loading.

After determining what part of the current inventory could be packaged in each container using the criteria above:

Determined if any sources required to be special formed in capsules.

Sources/devices were loaded into the Type-A containers and braced as needed.

External dose-rates were taken to prior to closing to ensure not to exceed limits.

The container was closed.

The container is prepared for shipment and sealed with a tamper-indicating device.

Final external dose-rates and contamination conducted for shipment.

After each container was completed, it was labeled for shipment and then moved out of work area to reduce dosage and storage until shipment [3].

3. Results and discussions

542 disused sealed sources were repatriated. The amount and type of sealed sources can be seen in Figure 5.

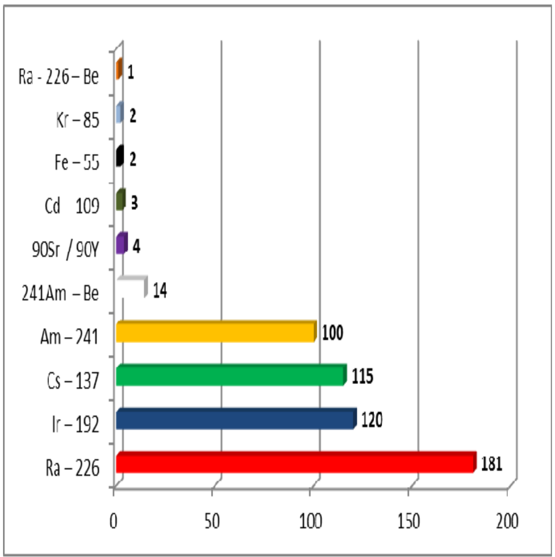

Figure 5. Inventory of repatriated disused sealed sources.

Disused sealed sources were put into eleven certified containers. The characteristic of all packages are shown in Table 1.

One of the main problems was the original attempt for transportation of the shipment by sea; however, no maritime company was willing to accept the cargo. After three months, it was determined that transportation was to be changed to air. An airline accepted and transportation was conducted successfully in accordance with regulation of the IAEA and International Air Transport Association.

Table 1. Category and transport index of packages.

Package / Drum	Weight (kg)	Volume (m^3)	Code	Index Transport
B-25, Box 1	3042	3,2	UN 2915	4,4
B-25, Box 2	3020	3,2	UN 2915	0,4
B – 1	363	0,055	UN 3332	0,4
B – 2	363	0,055	UN 3332	0,3
B – 3	363	0,055	UN 3332	1,3
B – 4	363	0,055	UN 3332	0,4
B – 5	363	0,055	UN 3332	1,3
Drum 1 ,Type-A	125	0,2	UN 2915	3,3
Drum 2, Type-A	300	0,2	UN 2915	1,2
Drum 699 ,S100	225	0,2	UN 3332	1
Drum 724, S100	225	0,2	UN 3332	1,1

One of the main problems was the original attempt for transportation of the shipment by sea; however, no maritime company was willing to accept the cargo. After three months, it was determined that transportation was to be changed to air. An airline accepted and transportation was conducted successfully in accordance with regulation of the IAEA and International Air Transport Association.

4. Conclusions

The joint work plan and meetings conducted ensured both teams understood the safety and technical aspects of the work to be conducted. All activities were implemented in a safe, compliant, and successful manner.

There was a permanent bond built between two technical teams of IPEN and LANL. Also this endeavor helped foster a stronger relationship between IPEN and DOE-GTRI.

The end-of-life management of disused sealed sources is important to address public health and safety concerns, as well as to ensure that dangerous radioactive materials are not used for malicious purposes. To further its mission of securing and removing nuclear and radiological material worldwide, DOE-GTRI will continue to consider requests for the repatriation of disused U.S.-origin sealed sources, and will continue to work with partner countries to ensure that both in-use and disused radioactive sources remain adequately protected.

5. Acknowledgements

Our special thanks to all members of the technical team of IPEN-LANL, people from Radioactive Waste Management Plant, Direction of Production, Division of General Services, Direction of International Cooperation, Direction of Training for their invaluable cooperation for making possible the first successful repatriation of disused sealed radioactive sources, to the United States of America.

6. Bibliography

[1] Los Alamos National Laboratory - LANL. OSR-OP-130 Work Plans for Source Recovery Operations at Off-site Locations.

[2] CCP-TP-069, Sealed Source Visual Examination and Packaging. 2010.

[3] International Atomic Energy Agency. Handling, conditioning and storage of spent sealed radioactive sources. IAEA-TECDOC-1145. Vienna: IAEA; 2000.