Operating Experience Summary

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Inside This Issue

Mishandling Radioactive Sources and Samples

Introduction and Background

The onsite or offsite mishandling of radioactive sources and samples from the Department of Energy (DOE) presents health, safety, environmental, and security risks. DOE manages these risks through strict implementation of regulatory requirements pertaining to radioactive materials, which mandate that physical control of the materials be maintained by authorized personnel. When physical control of radioactive materials is lost, the risks of resultant harm increase significantly.

Regulations contained in Title 10 of the United States Code of Federal Regulations (CFR), Part 835 establish requirements for Radiation Protection Programs (RPP) to protect individuals from ionizing radiation resulting from DOE activities. DOE Guide 441.1-1C, *Radiation Protection Programs Guide*, provides guidance on the development and implementation of radiation protection programs. DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety*, "establishes safety requirements for the proper packaging and transportation of offsite shipments and onsite transfers of hazardous materials, including radioactive materials." There are other DOE orders that pertain to national security interests.[1] Together, these orders, along with Department of Transportation (DOT) and Environmental Protection Agency requirements, comprise the main regulatory requirements that control the handling of radioactive sources and samples. These regulatory requirements are implemented through site-specific procedures.

[1] DOE Order 461.1C: *Packaging and Transportation for Offsite Shipment of Materials of National Security Interest*, and DOE Order 461.2: *Onsite Packaging and Transfer of Materials of National Security Interest*

This *Operating Experience Summary* article discusses four incidents in 2017 that involved the mishandling of radioactive sources and samples. Although none of these incidents resulted in a major release or exposure, consequences may be significant when regulatory and/or procedural requirements are not followed. In such cases, a careful examination of the programs and procedures that failed is warranted, and continuous improvement initiatives should be undertaken to address the failures or inadequacies of the program.

Occurrence Reports

Management Concern: Rad Sample Sent to DUS (Building 619)

On August 9, 2017, personnel at Lawrence Livermore National Laboratory (LLNL) Donation, Utilization and Sales (DUS) discovered an item in a sealed plastic bag, labeled "Caution Radioactive Material" (see Figure 1 for an example) in a scrap metal bin. A meter survey performed by DUS personnel showed activity above background. The item contained a metal sample in a cylindrical epoxy case, which was determined by a Health Physicist to be depleted uranium. Removable contamination survey results of the metal surface were 238 disintegrations per minute/swipe (alpha). The sample was returned to Physical and Life Sciences, who investigated where the item came from and how it got into the scrap metal hopper that went to DUS. (ORPS Report NA--LSO-LLNL-LLNL-2017-0032)

Figure 1. Example of bag labeled "Caution Radioactive Materials," like that discovered in the waste bin at LLNL

A causal analysis found that the worker requesting pickup of excess equipment did not perform a final check of the materials to ensure that

the items in the box matched the pickup request form inventory, and a delay occurred between filling out the request form and the pickup, during which time additional and inappropriate items were placed in the box, including the sample. The facility stated that employees shipping excess equipment to DUS should do a final check of the contents of shipping containers to ensure that additional or inappropriate items have not been added while the container is pending shipment.

Additionally, this incident emphasizes the importance of training provided to personnel on proper disposal techniques and the importance of quality assurance checks for radioactive waste disposition. Authorized users must maintain inventory control and situational awareness as part of their responsibilities for workplace safety. Other workers should be trained to recognize radioactive materials and alert an authorized user per procedure if radioactive materials are found unattended. While there were minimal impacts to operations from this incident, it illustrates the importance of effective controls and preventing improper, potentially hazardous transport of radioactive samples and waste.

Improper Air Shipments of Plutonium

On June 16, 2017, a Los Alamos National Laboratory (LANL) Materials Management shipper improperly made multiple shipments of plutonium via FedEx air freight, contrary to DOE Order 460.1D and 10 CFR 71.64, which prohibit the transport of fissile material by air. One package, consisting of 100 grams of plutonium in a 9975 Type B package, was shipped to LLNL, while the other shipment, consisting of two 9977 Type B pack-ages of 12 grams each, went to the Savannah River Site. On June 21, 2017, LLNL personnel notified the LANL Packaging and Transportation Operations Manager that they had received the shipment via air freight, and the LANL Packaging and Transportation Operations Manager identified the second shipment on June 23 during an extent of condition review. (ORPS Reports NA--LASO-LANL-MATWAREHS-2017-0001 and NA--LASO-LANL-MATWAREHS-2017-0002)

The direct cause of the incidents was the failure of the shipper to select the proper mode of transport. The shipper did not demonstrate knowledge of the applicable regulations governing air transport of radiological materials, or follow site procedures. Lack of management engagement and perceived time pressure were also contributing factors to the event. Perceived time pressure is never an acceptable reason to perform work unsafely.

These two shipment incidents also emphasize the importance of training, including adequacy of training materials, content and performance standards, and practice or hands-on experience.

Corrective actions included a revision to the procedures to mandate a "Use Every Time" checklist for Authorized Shippers, and a daily review of the checklist by a peer and by management (see Figure 2). Training was revised to incorporate

Figure 2. Using a checklist, with review by peers and managers, can reduce the likelihood of shipping errors.

error-likely situations in table-top exercises. Revised training was provided to Authorized Shippers and managers, and a coaching and mentoring program was developed and implemented for all shippers, which included management engagement. Other actions were taken to increase communication between shippers and with managers. In addition, two-person key control methodology was implemented over air-shipment labels.

Unauthorized Personnel Transported Radioactive Gallium

On May 9, 2017, a Jefferson Lab employee attempted to use United Parcel Service's (UPS) tracking number to confirm the delivery status of a sample of irradiated gallium metal and was unsuccessful. The shipper then called the local UPS office and was unable to get any information on the shipment. The Property Manager (PM) took his personal vehicle (POV) to the UPS office to investigate and discovered the package was not entered into the UPS system and had not been shipped out. The PM retrieved the package and placed it on the front floor area of his car to bring back to Jefferson Lab. This POV did not have valid DOT markings, nor was the PM appropriately trained to handle the package. The PM decided to personally transport the package to Virginia Commonwealth University (VCU). The shipper advised the PM that transport of the package was not allowed per DOT regulations, but the advice was ignored. The PM then requested a government vehicle to transport the package. The PM contacted the VCU Radiation Safety Officer (RSO) while en route and was told that the RSO would have left for the day by the time he arrived. The PM took the vehicle home to attempt delivery in the morning. Recognizing that he was not DOT trained, he requested another worker (whose DOT training was later found to be expired) to accompany him. Upon confirmation of the PM's plan to transport the package the next day, Facilities Management and the Logistics Director instructed him to return the package to Jefferson Lab immediately. (ORPS Report SC--TJSO-JSA-TJNAF-2017-0003)

This event signifies the need to perform work within the controls established to mitigate risks of exposure to people and the environment specified by the Radiation Protection Program. Requirements for training/certification were not adhered to, nor were regulations governing placarding of vehicles.

Radiological Equipment and Sealed Check Sources Stolen from Vehicle

On March 21, 2017, personnel discovered that equipment had been stolen from a rental vehicle parked in a hotel parking lot in San Antonio, Texas. The equipment was stored in two locked, unmarked Pelican brand cases. One case contained two Ludlum 3030 alpha/beta sample counters, one plutonium 239 check source, and one cesium 137 check source. The second case contained two Ludlum Model 2224 scale rate meters, two Eberline R020-AA dose rate meters, one Ludlum Model 3 count rate meter, and one Thermo Scientific Micro Rem AOED dose rate meter. Figures 3 and 4 show an example of a sealed radioactive source and a dose rate meter, respectively. The vehicle was parked in a location that was deemed to provide adequate security, with high walls on two sides limiting access to the vehicle, and was parked within line of sight of the hotel front doors. The hotel also had security personnel that performed parking lot foot patrols. The San Antonio Police and the Federal Bureau of Investigation were notified of the incident. (ORPS Report NE-ID--BEA-INLLABS-2017-0001)

This event presented a safety and security concern associated with the loss of physical control of the radioactive sources. It was reported by management to bring awareness to the potential for theft from vehicles in areas trafficked by high numbers of transient individuals, such as hotel parking lots, park-and-rides, and metro stations. In these environments, increased vigilance is a necessity for anyone transporting radiological materials that may be a target for theft. Radiological materials should be kept secured and out of sight or within the physical control of the authorized user. If the movement of radiological

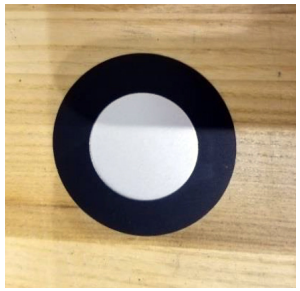


Figure 3. Sealed radioactive source

Figure 4. Dose rate meter

materials offsite is a common occurrence, alternative transportation measures that allow for stricter control of the materials should be considered, for safety and security reasons. Training should address the appropriate measures to take when transporting radiological materials offsite.

Discussion: The Value of Training

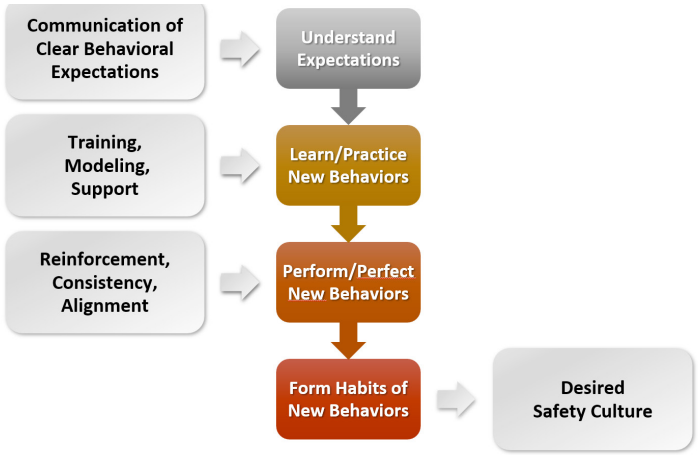
Each of these incidents presents an opportunity to improve the training that is part of a standard Radiation Protection Program (RPP). Sites can incorporate lessons learned from each of these events into their RPP training programs. It is important to not only train on the material but to evaluate the effectiveness of that training. This can be accomplished by observing trainees' practical application of the information during hands-on drills or table-top exercises and during actual job performance. Management and peers with RPP expertise should be involved in the evaluation of an individual's competence as a shipper.

The air shipment events and the "Rad Sample Sent to DUS" occurrence indicate failures of training material to adequately cover the work scope of trainees, or to ensure that trainees knew how to address uncertainties. Reports on the plutonium shipments noted, "A gap in training on implementing procedures and processes allowed for confusion and lack of direction on how to proceed when unexpected or challenging events occurred. Workers were not formally trained to the tasks they were engaged in; rather, they were trained and qualified only to the regulations for the purposes of qualification with one exception." The exception was noted to be a practical graded demonstration of ten shipping packages, which added value to the training. However, the specific package type involved in these incidents was not demonstrated; nor was the package type used with frequency to allow the shipper to practice the task, or to enable management to determine that workers were competent to perform the task. Eliciting feedback from trainees on the value of training to their actual work performance is a component of the feedback and improvement Integrated Safety Management System core function. This feedback can assist trainers with creating material that is directly applicable to the work environment and scope, and that goes above and beyond simple regulatory compliance.

In addition to being trained on adherence to RPP handling protocols, workers must be trained to identify nonconformances and to raise concerns or violations to management, like the receivers of the air shipment did at LLNL. Effective safety culture relies on employees' abilities and willingness to notice and report violations, nonconformances, and observations of atypical occurrences.

Frequent training, re-training, and evaluation of the effectiveness of training can guard against complacency or the normalization of deviance, both of which can cause workers to undervalue the risks or dangers of their work, including work with hazardous radiological materials. The handling practices evident in these examples above indicate a deviation from acceptable procedures per the RPP. Work was not performed within the established controls, and it is important to evaluate the safety culture in which those practices were deemed acceptable by the individuals who chose to undertake them. Training is one of the key processes for changing behaviors and changing culture to be more safety-conscious. See Figure 5.

Figure 5. Process for Changing Behaviors to Change Culture



Source: https://energy.gov/safety-culture/training

Conclusion

Ensuring that workers are adequately trained to the contents and application of an RPP is necessary to mitigate the risks of harm to workers, the public, and environment that are by posed by working with radiological materials. Effective training on how to perform work within RPP-established controls should cover the importance of these controls, provide details on their applicability during work, establish clear communication about expectations of adherence to the RPP, and direct workers on how to proceed in the face of uncertainty. Incorporating lessons learned and feedback from workers on the quality of training programs and their application to real-work scenarios can help to ensure that the training programs are successful in promoting safe behaviors and supporting an effective safety culture throughout DOE.

The Office of Environment, Health, Safety and Security (AU), Office of ES&H Reporting and Analysis publishes the *Operating Experience Summary* to promote safety throughout the Department of Energy (DOE) Complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, AU relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Ms. Ashley Ruocco, (301) 903-7010, or e-mail address ashley.ruocco@hq.doe.gov, so we may issue a correction. We would like to hear from you regarding how we can make our products better and more useful. Please send any comments to Ms. Ruocco at the e-mail address above.