

**IDENTIFYING OPPORTUNITIES FOR PROCESS IMPROVEMENTS IN ADDRESSING
TRANSPORTATION SAFETY AND COMPLIANCE ISSUES**

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ABSTRACT

In 1989, the U.S. Department of Energy (DOE) established the Office of Environmental Management to mitigate the risks and hazards posed by the legacy of nuclear weapons production and research. Many issues associated with these activities are unique, including the transportation of a considerable amount of contaminated waste, soil, and structural debris. As the transportation of radioactive material increases, so does the potential of a transportation incident involving radioactive material. The challenge for DOE is ensure that thousands of its shipments annually are made in a safe and compliant manner.

The DOE recognizes the importance of radiological characterization for ensuring radioactive materials are shipped in compliance with national regulations promulgated by the U.S. Department of Transportation (DOT) in the Hazardous Materials Regulations. In December 2009, DOE became aware that certain radioactive materials were not properly meeting hazard communication requirements for shipment and were therefore potentially noncompliant with DOT regulations. In response, DOE formed a working group to identify the source of the problem and develop solutions. This working group consists of waste characterization and transportation personnel involved with DOE radioactive material shipments. This group of subject matter experts is examining the multitude of requirements related to shipments, in particular: (1) waste acceptance criteria for the receiving site of the materials, and (2) transportation regulatory requirements. The group is reviewing existing documents, plans, procedures, and processes used in preparing DOE-owned radioactive material for shipment, and is identifying areas for improvement. The group members seek to identify best practices, opportunities for improvement, and obstacles encountered by waste characterization and transportation personnel.

The working group findings and recommendations are being used by DOE to develop the necessary steps to ensure all radioactive materials are properly characterized and shipped in compliance with applicable requirements and regulations.

INTRODUCTION

The Department of Energy transports various types of radioactive waste stemming from the clean-up and deactivation of World War II and Cold War era nuclear processing and weapons support operations. In 1989, the Department of Energy established the Office of Environmental Management to mitigate the risks and hazards posed by the legacy of nuclear weapons production and research. The mission of the Office of Environmental Management is to complete the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research. The Office of Environmental Management has made significant progress in shifting away from risk management to embracing a mission completion philosophy based on reducing risk and reducing environmental liability. The Office is focused on the mission that includes transporting and disposing of low-level wastes in a safe and cost effective manner to reduce risk. Many issues associated with these activities are unique, including the transportation of considerable amounts of contaminated waste, soil, and structural debris. As the number of radioactive waste shipments increases to support

ongoing cleanup activities, the Office of Environmental Management has taken steps to ensure that shipments are made in a safe and compliant manner.

REQUIREMENTS FOR WASTE ACCEPTANCE AND TRANSPORT

Hazardous Materials Regulations for Transport

The U.S. Department of Transportation has the mission to protect people and the environment from the risks inherent in transportation of hazardous materials. The Department of Transportation develops and enforces regulations for the safe, reliable, and environmentally sound operation of the transportation system used to complete shipments of hazardous materials by land, sea, and air. The Department issues the Hazardous Materials Regulations, including the Hazardous Materials Table which is used to assign a hazard class.¹

Facilities operated for the Department of Energy must conduct operations in compliance with all applicable international, Federal, State, local, and Tribal laws, rules, and regulations governing materials transportation that are not inconsistent with Federal regulations. It is DOE policy that low-level waste shipments will comply with the Hazardous Materials Regulations.

Meeting Waste Acceptance Criteria

The Department of Energy issued the *Radioactive Waste Management Manual* which requires using direct or indirect methods to characterize low-level waste. The departmental facilities implement a waste certification program to ensure that the waste acceptance requirements of facilities receiving low-level waste for storage, treatment, and disposal are met. The waste certification programs designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, and certification. The program provides requirements for auditability, retrievability, and storage of required documentation and specifies the records retention period.

The waste characterization must be documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste. In most cases, the facility's waste acceptance criteria for treatment, storage, and disposal is based on the activity/mass of the waste without consideration of how the radionuclides are distributed within the matrix, or the configuration of objects in the waste and radioactive contamination distribution on their surfaces.

ENSURING COMPLIANCE WITH REGULATIONS

Identifying and Understanding Concerns with Shipments

The Office of Environmental Management relies on the Office of Packaging and Transportation to provide assistance to facilities by performing assessments of transportation-related activities. Over the past year, findings during the internal assessments echoed concerns presented by the Department of Transportation that some shipments had been completed without meeting hazard communication requirements. To reduce the possibility of additional shipments being made in noncompliance with the Hazardous Materials Regulations, the Office of Packaging and Transportation assigned staff to review the various concerns and the assessment findings. The staff members consulted with transportation

managers who noted the primary concern as being low-level waste shipments with insufficient documentation to support identification of the waste as low-specific activity (LSA) material or surface contaminated objects (SCO). Documentation is required by the Hazardous Materials Regulations in order to make clear compliance with the packaging and hazard communication requirements associated with LSA material and SCO. The shipments had adequate information to meet the waste acceptance criteria determined by the receiving facility; however, additional data were needed to comply with the Hazardous Material Regulations.

Working Group Formed to Address Data Gap

Recognizing the importance of documenting the data needed to ensure radioactive materials are shipped in compliance with the Hazardous Materials Regulations, the Office of Packaging and Transportation formed a working group to develop a solution that could be used at the various departmental facilities with differing waste volumes and waste types. The working group consisted of waste certification and transportation experts involved with the Department's radioactive material shipments. The group examined the multitude of requirements related to shipments, in particular: (1) waste acceptance criteria for the receiving site of the materials, and (2) transportation regulatory requirements. The group established a charter which limited their discussion to low-level waste shipments and acknowledged the varying types and quantities of low-level waste being shipped by the different facilities. The group reviewed existing documents, plans, procedures, and processes used in preparing DOE-owned radioactive material for shipment. The group members noted areas of improvement as well as obstacles encountered by waste characterization and transportation personnel.

Supplementing Waste Acceptance Criteria Data to Support Identification as LSA or SCO

Documenting the waste characterization process and the information used to complete the hazard classification as required in the Hazardous Materials Regulations is essential. The documentation should include data collected to support assumptions. The criteria identified in the Hazardous Materials Regulations and the provisions of the Hazardous Materials Table are used to assign a hazard class for the hazardous material. Most low-level waste shipments from nuclear fuel cycle facilities and cleanup, remediation, and decontamination projects may be further grouped as LSA material or SCO shipments. The requirements for LSA material are based on the assumption that the radionuclides are distributed within the waste matrix. The criteria for SCO are based on the assumption that the radionuclides are distributed on the surfaces of a non-radioactive object. To meet the waste acceptance criteria, the collected data are compiled and documented, then certified. For LSA and/or SCO determinations, the documentation must provide information on radioactivity distribution within and/or on items. When the data collected to meet the waste acceptance criteria do not support hazard classification as LSA material or SCO, a decision must be made as to the feasibility of collecting additional data to support such a determination.

The working group also discussed how the waste acceptance criteria usually focus on the total fissile mass in the waste. The Hazardous Materials Regulations require that the low-level waste meets the criteria for "fissile excepted" before it can be identified as LSA material or SCO. Thus, in some instances, the data collected to meet the waste acceptance criteria has to be supplemented with the information on how the fissile mass is distributed.

Characterization data to meet the waste acceptance criteria and to satisfy the Hazardous Materials Regulations for hazard classification should be clearly and completely documented, including a record

of the methodologies used. An independent review of the documentation should result in the same outcome. The emphasis on documenting data used to determine the appropriate hazard classification reiterates the requirement for ensuring availability of relevant data, including transportation information, when transferring responsibility for management of low-level waste.

Emphasized Early Project Coordination

The importance of early coordination and proper preparation before and during waste cleanup processes cannot be overstated. Thorough preparation helps minimize cost, time, personnel exposure (radiological and/or chemical), ruined equipment, and other unwanted consequences associated with a mismanaged project. Accordingly, many sites use an interdisciplinary team, such as an Integrated Project Team, of environmental, safety and health, facility, and security subject matter experts and health physicists to identify needs and requirements, review proposed projects and activities, and identify and resolve potential issues before and during the commencement of a project. Experts knowledgeable in Hazardous Materials Regulations must plainly communicate anticipated complexities in identifying LSA material and SCO, as well as packaging and shipping logistics during project coordination.

The *Radioactive Waste Management Manual* outlines the DOE-complex-wide system to characterize waste for proper management, facility acceptance, and packaging. At each DOE facility, the waste generation activity must be examined and a waste characterization methodology prepared to adequately address chemical, radiological, and physical parameters of what may be expected. The characterization methodology must be able to consider waste anomalies that may arise during waste characterization. Thus, varying methodologies may be needed to perform characterization based on the waste being considered. Because of these variables, early project coordination is essential for the characterization and hazard classification of waste.

Properly Trained Personnel Needed

Waste generated from DOE activities often contains contaminants regulated by varying Federal and State regulations. Characterization has to consider the various requirements and regulations as well as the treatment, storage, and disposal facility's waste acceptance criteria, when applicable. To identify waste as LSA material or SCO, accurate radiological waste characterization is necessary and must provide information on the radionuclide activity distribution within and/or on materials. Personnel trained in meeting the requirements of the waste acceptance criteria and those trained in meeting the Hazardous Materials Regulations and identifying LSA material and SCO are needed to ensure compliance with both sets of requirements.

The operations during the generation and preparation of waste for eventual transport to a treatment, storage, or disposal facility affect the full characterization process. Some waste operations rely on the Waste Certification Official to verify the complete characterization to meet the waste acceptance criteria of the destined receiving facility, including the classification requirements in the Hazardous Materials Regulations. Other waste operations assign the Department of Transportation hazard classification responsibility to an independent group responsible for shipping-related activities. The management system defined at each site will affect how waste characterization and hazard classification is performed and who has the responsibility for each regulatory or facility requirement. For example, a waste generator may characterize waste to facility requirements then use in-field operations to package the waste based on the established profile. The information about the packaged waste is given to a group responsible for offsite shipping. In this case, management must determine if the waste generator or field

operations personnel are responsible for ensuring all Hazardous Materials Regulations including packaging requirements are met before the waste is packaged. Because the waste is packaged for offsite shipment before the personnel in the shipping group have performed hazard classification, the waste generator, the Waste Certification Official, or field operations group is responsible for hazard classification. For waste subject to the Hazardous Materials Regulations, proper waste characterization to the waste acceptance criteria is needed and subsequent hazard classification is required before the waste can be properly packaged. When the waste generator or other field operations personnel rely on the waste profile to separate wastes into containers for eventual shipment, the individual is performing duties required by the Hazardous Materials Regulations and, in turn, may be determining the packaging. Before assigning responsibility for hazard classification of waste, creating a flowchart of the complete waste characterization and Department of Transportation hazard classification process may be a prudent approach, from initial point of generation of waste to final release for transport. Assignment of responsibilities for completing actions identified in the flowchart should include the identification of the person(s) who performs the hazard classification as defined in the Hazardous Materials Regulations, selects the appropriate packaging for storage and/or transport, and fills, then closes, the packaging. Each entity performing an activity in this process (e.g., classification of waste, packaging selection, filling, and closing) must be a hazardous materials employee who is subject to the training and testing requirements of Hazardous Materials Regulations.

HIGHLIGHTED CONCERNS

Pre-Containerized Waste

Meeting the Hazardous Materials Regulations may be challenging, especially when characterization must be performed on wastes already containerized. Programs such as ALARA (as low as reasonably achievable) are incorporated to provide radiological protection to the low-level waste worker. The technical, economic, practical, and safety aspects such as time, cost, radiological exposure, and chemical exposure must be considered when determining at which point additional measurements for detailed characterization will jeopardize ALARA or impose unacceptable costs. With the data collected to meet the waste acceptance criteria, that is the total activity of the waste and the identification of the radionuclides, the project team may use conservative packaging (e.g., Type A or Type B packaging) when additional characterization or hazard classification is too problematic for a project. The project team may have to make a choice: incur a potential cost increase in packaging or obtain additional waste characterization data to satisfy the Hazardous Materials Regulations.

Combining LSA and SCO

A packaging may contain both LSA material and SCO. The Hazardous Materials Regulations do not address this situation. Department of Transportation and NRC recognized how frequently this occurs and provided the means by which mixed LSA material and SCO content can continue to be shipped in one packaging.ⁱⁱ As noted previously, early project planning is needed to ensure adequate smears are obtained before surface contaminated objects are packaged with LSA. First, when placing LSA material and SCO into one packaging, both the object(s) and the LSA material(s) must meet their respective definitions, including activity limits, before being placed into the same waste container. Any acceptable determination methodology, or combination of methodologies, may be employed to document and reach these determinations. The desire for efficient operation at a demolition site requires adequate identification of the material before it is loaded into a container for transport.

GUIDANCE FOR COMMUNICATING WASTE CHARACTERIZATION AND HAZARD CLASSIFICATION REQUIREMENTS FOR LSA MATERIALS AND SCO

The working group compiled recommendations which addressed the concerns noted by the Department of Transportation and the findings resulting from internal assessments. The recommendations were used to draft guidance that incorporates existing regulatory requirements and interpretations provided through letters to the Department of Transportation. The guidance outlines the importance of ensuring the low-level waste meets the waste acceptance criteria as well as the requirements listed in the Hazardous Materials Regulations in order to be properly characterized and shipped in compliance with applicable requirements and regulations.

This guidance acknowledges the importance of understanding the Hazardous Materials Regulations and the Department of Transportation/U.S. Nuclear Regulatory Commission (NRC) jointly published guidance, "Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects." The joint guidance addresses areas of uncertainty arising from revised regulations that separated SCO from LSA materials and provides insight into methods of demonstrating compliance that are acceptable to the Department of Transportation and NRC. Department of Transportation hazard classification methods, other than those stated in the guidance, may be found acceptable with adequate justification and supporting documentation.

CONCLUSIONS

The Department of Energy has taken steps to ensure shipments of low-level waste are being characterized to meet waste acceptance criteria and Department of Transportation requirements for transporting hazardous materials as LSA material or SCO. The importance of early project coordination, use of properly trained personnel to perform characterization and hazard classification steps, and clear documentation of methodologies used has been highlighted in a Departmental guidance document.

The guidance was developed to provide a uniform, standard methodology for ensuring appropriate collection and documentation of information necessary to properly characterize, classify and identify candidate LSA material and SCO for shipping operations in accordance with DOT regulations. The draft guidance highlights how the information gathered to complete the waste characterization/certification process may be supplemented by providing additional properties of low-level waste to complete the DOT hazard classification.

The guidance was distributed for review by appropriate, technical personnel in September 2010. The Office of Packaging and Transportation plans to finalize the guidance for dissemination by November 2010.

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REFERENCES

ⁱ Hazardous Materials Regulations are the regulations at 49 CFR parts 171 through 180

ⁱⁱ Research and Special Programs Administration, U.S. Department of Transportation, and Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission. Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects. NUREG-1608, RAMREG-003. Washington, DC, 1998.