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CURRENT ONSITE EQUIVALENCY STATE AT SRS

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ABSTRACT

The Savannah River Site (SRS) Transportation Safety Document (TSD) demonstrates compliance to the safety basis requirements of DOE O 460.1D for offsite shipments and onsite transfers of hazardous materials. SRS employs an integrated approach to onsite transfers to ensure equivalent DOT safety is met using both deterministic and risk-based methodologies described in DOE Guide 460.1-1. Analyses and controls establishing safety equivalency for transfers of radioactive material within the site boundaries are provided in Transportation Safety Basis (TSB) documents (i.e. Onsite Safety Assessments (OSAs)). Non-radioactive hazardous materials are transferred onsite as either DOT compliant packages or through an equivalency. SRS methodologies employed to comply with federal transportation requirements and to demonstrate equivalent safety will be discussed.

INTRODUCTION

The U.S. Department of Transportation (DOT) governs the safe and secure transport of hazardous materials in commerce under the Pipeline and Hazardous Materials Safety Administration (PHMSA). In conjunction with DOT regulations, the Nuclear Regulatory Commission (NRC) imparts special packaging requirements to protect the public and the environment when a package contains higher-level quantities of radioactive materials.

The Atomic Energy Act of 1954 (AEA), amended, gave the U.S. Department of Energy (DOE) the ability to regulate activities involving hazardous materials (including radioactive materials) on sites within the DOE complex. DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety*, establishes packaging and transportation safety requirements for hazardous materials, including radioactive materials and is applicable to DOE and departmental contractor personnel conducting packaging and transportation activities at DOE facilities. Savannah River Site (SRS) is part of the DOE Complex and has been required to develop and maintain a DOE approved packaging and transportation safety program in accordance with DOE Order 460.1D.

SRS BACKGROUND

Savannah River Site (SRS) is a 310 square-mile federal facility located near Aiken, SC. SRS was constructed in the early 1950s to support of our nation's defense programs during the Cold War. The mission of SRS was primarily to supply tritium and plutonium-239 for the production of nuclear weapons. In order to produce these materials, five reactors, two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility, a tritium extraction facility and waste management facilities were built on site. Today, SRS continues to support the U.S. national defense program and nuclear nonproliferation efforts by processing and storing nuclear materials. SRS is also an environmental steward focusing on the treatment of solid and liquid nuclear hazardous waste remaining from the Cold War.

DOE ORDER 460.1D

DOE and Departmental Contractors' packaging and transportation activities performed under DOE Order 460.1D must comply with all applicable DOT and NRC regulations for hazardous materials entered in commerce. This includes compliance with DOT Hazardous Material Regulations (HMR) (49 CFR 171-180) and NRC special packaging requirements for Type B or Fissile Material certified packagings. Any deviation from federal regulation governing hazardous materials in commerce must be granted by the DOT through a Special Permit and/or the NRC as an exemption. For onsite safety, DOE Order 460.1D also requires compliance with 10 CFR 830, *Nuclear Safety Management* and a DOE-approved Transportation Safety Document (TSD). A TSD describes the methodology and compliance process used by DOE/DOE Contractors when conducting packaging and transportation activities on DOE sites using an equivalent level of safety to demonstrate the risk is equal to or less than that accepted by DOT/NRC for offsite transport.

DOE G 460.1-1

Early on, DOE recognized that a comprehensive "Onsite Transportation Safety Document" to be used across the DOE complex would be insufficient in meeting diverse site-specific requirements. Instead, TSD guidance for required format, content, and approval was provided in DOE G 460.1-1, *The Implementation Guide for Use with DOE Order 460.1A Packaging and Transportation Safety*. While the TSDs from various DOE sites are developed using the same guidance, most were developed largely independent of each other and tend to differ according to complexity of operations, site conditions, and categorization of material. All TSDs, however, are expected to have the following basic information as defined in DOE G 460.1-1:

- a. *identification of responsibilities, lines of authority, and program approval procedures;*
- b. *definition of minimum safe packaging requirements including necessary design, fabrication, and quality assurance elements, using appropriate codes and standards;*
- c. *description of transportation systems and operational controls utilized to restrict personnel and public access and minimize the probability and consequence of credible accidents;*

- d. *a description of the process and analysis is used to ensure that equivalent safety requirements are established. This should include a technically justified basis for equivalency. For example, this could include a hazards analysis associated with the transfer, an assessment of the risks associated with the transfer, and a discussion of the mitigating measures proposed to ensure the equivalent safety requirements will be employed. This analysis would be performed for each deviation from the Hazardous Materials Regulations;*
- e. *site description, including maps identifying boundaries, railways, and roadways, which clearly delineates offsite and onsite areas, and procedures for clearing and establishing access control for any area having occasional public access;*
- f. *provisions for effective emergency response and recovery under credible accident conditions; and*
- g. *process for accomplishing nonroutine packaging and transportation activities*

In accordance with DOE Order 460.1D, *“The TSD must describe the methodology and compliance process to meet equivalent safety for any deviation from 49 CFR...”*

When possible, SRS utilizes a deterministic methodology as recommended by DOE Guide 460.1-1. As SRS is a relatively large site, spanning over 310 square miles, with most of its facilities centrally located away from the site boundary; a risk-based methodology is also considered a suitable alternative. The SRS TSD describes the methodologies used to establish safety equivalency below:

Deterministic

For Type B radioactive material quantities, the transport system is expected to prevent loss of containment for both normal handling and for site-specific credible abnormal conditions (CAC). For Type A or lesser radioactive material quantities, the HMRs assume that the packaging fails under abnormal conditions, and the quantities of material transported are limited such that no offsite receptor at the site boundary would receive more than 5 rem exposure from an accident.

Risk-Based

DOE Guide 460.1-1 allows use of risk-based methodologies to demonstrate safety equivalency and requires that those methodologies be described in the TSD. However, the guide does not specify nor restrict the methodologies to be used or the conditions for acceptability. SRS evaluated the risk accepted by DOT to be 15E-2 rem/yr. and uses a conservative risk criterion of 5E-2 rem/yr. for onsite transfers. The SRS risk criterion assumes that onsite transfers are restricted in areas that are within 670 meters from the site boundary. Packages containing higher levels of activity may be restricted up to 2000 meters from the site boundary.

SRS TSD METHODOLOGY

The Savannah River Site (SRS) TSD demonstrates onsite compliance with DOE transportation safety requirements including DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety*, DOE Order 461.2, *Onsite Packaging and Transfer of Materials of National Security Interest*, and 10 CFR 830, *Nuclear Safety Management (Subpart B)* using risk-

based methodologies described in DOE Guide 460.1-1 to meet equivalent safety measures and ensure the degree of risk to the public and the environment, in the event of a hazardous material release, is less than or equal to that accepted by the DOT for offsite shipments.

The scope of the SRS TSD encompasses all packaging and transportation activities associated with hazardous materials/waste on and off site. The primary focus of the TSD, however, is the onsite transfers of non-radioactive and radioactive hazardous materials, substances, and wastes at SRS. The term “onsite” refers to transfers via transport vehicle (including rail) within the physical SRS boundary but external to the boundaries of the SRS originating and receiving facilities’ documented safety analysis (DSA). Intra-facility movements of hazardous materials are covered within the facility’s DSA and not considered an onsite transfer. Onsite transfers at SRS occur between the originating and receiving facility DSA boundaries. Transfers may begin as early as securement of the package onto the conveyance and generally end when the conveyance arrives at the destination and is accepted by the receiving facility. Onsite transfers take place within the contiguous fenced, access controlled, outer perimeter of SRS and do not cross or travel along a public access road. All transport outside of the SRS boundary is considered “in commerce” and must comply with applicable DOT/NRC regulations.

Multiple-tenant DOE/NNSA sites such as SRS are permitted to have a TSD for each contractor in accordance with DOE Order 460.1D. Contractor organizations at SRS, however, have agreed to operate under a single TSD. The SRS TSD is applicable to the performing entities of the Management and Operations (M&O) and Liquid Waste Operations (LWO) contracts at SRS and to subcontractors for any member of the performing entities involved in the transfer of SRS hazardous materials, when required by subcontract or applicable law.

ONSITE TRANSFER REQUIREMENTS

The TSD defines onsite transfer requirements for both non-radioactive hazardous materials/wastes and radioactive materials/wastes. Non-radioactive packages containing hazardous materials can be transferred onsite using the following methods:

1. Packages are fully compliant with DOT HMRs.
2. Packagings and content are compliant per the DOT HMRs, but safety equivalencies are utilized for hazard communications (i.e. marking, labeling, placarding, shipping papers).
3. Packages are non-compliant with DOT HMRs (a safety evaluation is performed on a case-by-case basis to ensure risk is less than or equal to what DOT has excepted for in commerce shipments).

Radioactive materials, including mixed waste, are transferred onsite using one of the following options:

1. Packages (i.e., contents and packaging) are fully compliant with DOT HMRs.
2. Packaging and content are DOT compliant, but safety equivalencies are utilized for hazard communications (i.e., marking, labeling, placarding, shipping papers).
3. Packages/transfers containing greater than or equal to Hazard Category (HC)-3 quantities of radioactive materials, as defined in DOE STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety*

Analysis Reports, can be transferred under a DOE-Savannah River (DOE-SR) approved Transportation Safety Basis (TSB) document (i.e., Onsite Safety Assessment [OSA] or Non-Routine Transfer [NRT]).

4. Packages/transfers containing less than HC-3 quantities of radioactive materials can be transferred under a Savannah River Nuclear Solutions (SRNS) approved TSB document (i.e., Onsite Transportation Report [OTR]).

10 CFR 830

SRS performs onsite transfers with greater than or equal to HC-3 quantities of radioactive materials and therefore, is subject to the requirements of 10 CFR 830 Subpart B, *Safety Basis Requirements*. A typical safety basis meeting the requirements of 10 CFR 830 consists of three primary components: (1) Documented Safety Analysis (DSA), (2) Technical Safety Requirements (TSRs), and (3) Unreviewed Safety Question (USQ) process. 10 CFR 830 allows safety basis requirements, pertaining to onsite transportation activities, to be addressed in a TSD prepared in accordance with DOE Guide 460.1-1.

The SRS TSD functions as the documented safety analysis (DSA) for transportation activities onsite and serves as the interfacing safety document between facility DSAs during transport. TSRs address the hazards associated with transportation activities and establish the limits, controls, and related actions necessary for safe operations. TSRs are incorporated into separate SRS Transportation Safety Basis (TSB) documents in the form of OSAs or NRTs. OSAs/NRTs describe administrative controls and design features for a defined package and/or transportation activity. SRS employs the Unreviewed Safety Question (USQ) process (known at SRS as the Transportation (Unreviewed) Safety Question [TSQ] process) through the evaluation of a proposed activity against the governing OSA or NRT document. This allows SRS to make physical, procedural and operational changes to transportation activities without prior DOE approval, as long as the proposed activity is within the bounds of the DOE-approved transportation safety basis (TSB) document. The TSQ process also defines specific actions to be taken should a Potential Inadequacy in the Safety Analysis (PISA) be identified.

TRANSPORTATION SAFETY BASIS (TSB)

The SRS TSB documents for radioactive materials exist primarily as Onsite Safety Assessments (OSAs). Non-Routine Transfers (NRT) are also included in the SRS TSB and have historically been used for both non-radioactive and radioactive hazardous material transfers when special circumstances have required an exception from routine transfer requirements. NRTs, however, are not commonly used at SRS (none currently active) and will be excluded in further TSB discussion.

An OSA is the principle packaging and transportation safety document for onsite transfers of radioactive materials and waste. The OSA evaluates and documents the engineering (packaging) and administrative controls (procedure and personnel) to ensure equivalent safety to the applicable federal packaging regulations, DOE Orders, and site radiological controls.

The OSA identifies the authorized content of the onsite package and assesses the containment, shielding, and subcriticality of the radioactive content for normal and credible accident

conditions with respect to the packaging performance and administrative controls. In addition, the OSA specifies procedural requirements for operational activities (e.g. loading and closing the packaging, inspections, and lifting/handling). The OSA also establishes limits (e.g. content weight, activity, isotopic concentrations, decay heat, transfer vehicle speed and route controls).

All TSB documents (including the TSD and OSAs) used at SRS have been reviewed and approved by Department of Energy- Savannah River (DOE-SR). This includes any revisions made to these documents after the initial approval. In addition, DOE-SR is provided an annual review performed on the TSD and all active DOE approved OSAs. Annual reviews include an assessment of all TSQ activity done against the OSA and evaluate the need for future revisions.

OSA METHODOLOGY

OSAs evaluate packaging and transportation activities to determine if the associated risk is equal to or less than the risk accepted by DOT for in commerce shipments, therefore, providing equivalent safety to the public and the environment under normal transport conditions and credible SRS accident conditions. The DOE guide allows for two types of TSB methodologies: deterministic and risk-based.

SRS Deterministic OSA – the packaging is evaluated and determined to provide the primary safety function under SRS transport conditions. The packaging must provide (1) containment, (2) shielding, and (3) sub-criticality under normal and credible SRS accident conditions. This approach is similar to that used by DOT and NRC to regulate packages in commerce.

SRS Risk-Based OSA – the contents are limited in the packaging based on consequence analysis and transfer frequency to ensure the accepted level of risk is not exceeded. While the risk-based OSAs ensure the packaging provides confinement during normal conditions of transport, it assumes the packaging fails during an accident and all content is released.

NUCLEAR CRITICALITY SAFETY METHODOLOGY

Nuclear Criticality Safety Evaluations (NCSEs) are developed in conjunction with each OSA to address both normal or routine and credible abnormal conditions. NCSEs demonstrate criticality safety for the use of shipping packages containing fissile material in accordance with DOE Order 420.1C Chg 2, *Facility Safety*. While facility NCSEs cover all facility handling operations, including loading/unloading, closing/opening, and storage coincident with transfer, onsite transportation NCSEs address the physical transfer of fissile shipping packages, from the time they leave the boundary of the originating facility's DSA, until they arrive within the bounds of the DSA of the receiving facility. Onsite transportation NCSE limits and controls are incorporated into the OSAs. Each facility conducting onsite transfers has the responsibility to implement OSA limits and controls into facility packaging and transportation procedures.

OSA CONTROLS AND PROGRAMMATIC ATTRIBUTES

OSAs manage risk through the use of controls and programmatic attributes. Controls discussed in site OSAs are credited with protecting the bounding accident consequences and frequencies

and are considered necessary to ensure the package contents remain subcritical under CAC. Failure to satisfy a control could result in a discrete and/or quantifiable exceedance of the accepted risk. Controls are identified by a [C] in the site OSAs.

Programmatic attributes discussed in site OSAs contribute to the multiple layers of defense in depth necessary to ensure the safety of onsite transfers. Failure to comply with a programmatic attribute could result in qualitatively exceeding the accepted risk related to the transfer when the noncompliance arises due to repeated neglect or a single gross failure of the program. Programmatic attributes may be implemented by various methods including Safety Management Programs, site/facility level programs/manuals, controlled databases, and/or facility procedures. Continuing implementation of the programmatic attribute is typically verified through continuing assessment and performance monitoring (trend analysis). Programmatic attributes are identified by a [P] in the site OSAs.

TRANSPORTATION UNREVIEWED SAFETY QUESTION (TSQ) PROCESS

The TSQ process implements the requirements of Code of Federal Regulations (CFR) 10 CFR 830.203, *Unreviewed Safety Question Process* for Unreviewed Safety Questions (USQ) applicable to onsite transfers of radioactive material (RAM), in quantities of Hazard Category (HC)-3 or greater, in packaging that is not in full compliance with DOT or NRC regulations. The TSQ process includes packages that are authorized by Onsite Safety Assessments (OSAs).

The TSQ process is performed to determine whether or not the proposed activity is within the bounds of the DOE-Savannah River (DOE-SR) accepted risk. A positive TSQ evaluation exists when a proposed change involves assuming additional risk beyond that already approved by DOE-SR in the existing TSB. Additional risk must be approved by DOE-SR prior to implementing the proposed activity.

For onsite transfers at SRS, the TSQ process is applied for any of the following conditions:

1. A physical change to any of the packaging used to transport radioactive material. Maintenance activities (e.g., replacement of worn bolts or gaskets) are not considered a physical change.
2. A change in packaging operations or maintenance requirements.
3. A change in package contents or closure requirements.
4. A change in packaging design.
5. A change to any of the credited routing, controls, or transportation communications associated with a package.
6. A change to any of the procedures which implement OSA or NRT requirements.
7. A change that adds a new packaging design (e.g., 55-gal drum, 90 ft³ box) to an already approved facility evolution in compliance with an OSA/NRT.
8. Following revision to a Transportation Safety Basis (TSB), the Shipping/Transferring Facility or Organization (STFO) shall carry out a TSQ review of all procedures listed on the RPAL for that TSB document.
9. Any identified Potential Inadequacy in the Safety Analysis (PISA).

OSA IMPLEMENTATION PROCESS

Once an OSA has been approved by DOE-SR and a DOE -issued Safety Evaluation Report (SER) has been received by SRS, the approved OSA is placed into document control and facilities are notified. OSA revisions are given a 90-day implementation period to afford facilities time to initiate facility procedure reviews and subsequent actions to fully implement any new controls and requirements of the OSA. During this 90-day period, continued use of the previous OSA revision is allowed to provide for uninterrupted facility operations. At the end of the 90-day period, the old OSA revision is superseded. Facilities not compliant with the current OSA revision after 90-days will not be authorized to transfer on site until all procedures implementing the OSA have been reviewed and all required changes have been incorporated.

SRS AUTHORIZATION FOR TRANSPORT

The Package Review Committee (PRC) is the Site Transportation Regulatory Authority responsible for reviewing and authorizing the use of radioactive packages at SRS. The PRC formally reviews each facility's initial packaging and transportation procedures to ensure all applicable Transportation Safety Basis (TSB) requirements are met for both in commerce shipments and onsite transfers. Once initial approval is obtained revisions to the approved procedures may be evaluated through the TSQ process without need to return to the PRC. If approval of a procedure(s) should lapse (e.g., 90-day implementation date is not met after an OSA revision) the procedure will have to be re-approved by the PRC. All packages reviewed and approved for use at SRS by the PRC are listed on the Radioactive Packaging Approval Log (RPAL). Each RPAL entry contains the following information.

1. **Packaging Name** – Identifies the packaging name or category (e.g., Roll-off Pan, Sealand, IP-2)
2. **Content Description** – Identifies the physical description of the authorized content of the packaging (e.g., solid, liquid, gas)
3. **Approval Type** – Identifies the applicable TSB document or package category (e.g., OSA, DOT Compliant, Type A)
4. **Packaging Owner** – Identifies the organization that owns the packaging hardware
5. **HMTR Approval** – Identifies if HMTR approval is required for onsite transfers. (HMTR approval is required for all offsite shipments)
6. **Package Use Requirements** – Identifies requirements and conditions that must be followed by the STFO. Lists site procedures necessary for TSB compliance
7. **PDAT Assignment** – Identifies the person that is cognizant of the packaging (i.e., Packaging Design Authority)
8. **PRC Tracking Number** – Unique identifier for the RPAL entry assigned by the PRC
9. **Original Approval Date** – Identifies the date of the PRC approved authorization form
10. **Date of Latest Entry**

CONCLUSION

SRS missions require a multi-facet packaging and transportation safety program to address and mitigate risk associated with various onsite transfers and offsite shipments of hazardous materials and waste products. The SRS Transportation Safety document (TSD) defines the packaging and transportation safety program in accordance with DOE Order 460.1D. While the offsite shipments are fully compliant with applicable DOT/NRC regulations, SRS employs an integrated approach to onsite transfers to ensure equivalent DOT safety is met using both deterministic and risk-based methodologies described in DOE Guide 460.1-1. While the TSD addresses the hazards and controls necessary to protect the public, workers, and environment, the limits, controls and related actions necessary for safe operations are established in the Transportation Safety Basis (TSB) documents. TSB documents (i.e., Onsite Safety Assessments [OSAs] and Non-Routine Transfers [NRTs]) identifying the controls and programmatic attributes are written and approved separately from the TSD. This approach allows for flexibility in the development and revision of each TSB document and simplifies the DOE-SR reviewing and approval process.

REFERENCE

1. DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety*, U.S. Department of Energy, Washington DC, December 2016.
2. DOE Order 461.2, *Onsite Packaging and Transfer of Materials of National Security Interest*, U.S. Department of Energy, Washington DC, November 2010.
3. DOE Order 420.1C Chg 2, *Facility Safety*, U.S. Department of Energy, Washington DC, December 2012.
4. DOE G 460.1-1, *The Implementation Guide for Use with DOE Order 460.1A Packaging and Transportation Safety*, U.S. Department of Energy, Washington DC, June 1997.
5. 10 CFR 830 Subpart B, *Safety Basis Requirements*, U.S. Department of Energy, Washington DC, January 2011.
6. SRNS-SA-2008-00004, Rev. 10, *Savannah River Site Transportation Safety Document*, Savannah River Nuclear Solutions, Aiken, SC, February 2016.