

**Contract No:**

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy.

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Elucidating the Differences between Onsite and Offsite Shipment of Radioactive Materials  
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## ABSTRACT

Federal regulations stipulate how radioactive materials are transported within the United States. However, the Department of Energy, under Department of Energy Order, has the authority to operate, within the boundaries of their physical site, to other stipulations. In many cases the DOE sites have internal reviews for onsite transfers that rival reviews performed by the regulatory authorities for offsite shipments. Most of the differences are in the level or type of packaging that is required, but in some cases it may be in the amount and type of material that is allowed to be transferred. This paper will describe and discuss those differences and it will discuss ways to effectively align the onsite rules for transferring materials with those for offsite shipment.

## BACKGROUND

The main focus of this paper will be to show how onsite shipments, called transfers, at the Savannah River Site (SRS) differ from offsite shipments received or sent from the SRS. The focus will be on quantities of nuclear materials allowed to be shipped within Type A and Type B packages as defined in 10 CFR 71. All shipments, either within the boundaries of the SRS or offsite meet the applicable requirements found in 49 CFR Parts 171-180 or applicable Department of Energy (DOE) Orders. Additionally, the radioactive materials that are discussed in this paper are of DOE origin and are not spent commercial nuclear fuels. Although this paper does not specifically discuss it, security of nuclear materials is also paramount to the DOE and appropriate measures are taken at the SRS to ensure that the security of nuclear materials is not compromised.

## REGULATORY DIFFERENCES

The hazardous material regulations within 49 CFR Parts 171-177 define how Class 7, radioactive, materials must be shipped within the United States. DOE Order 460.1C enforces this requirement on DOE sites for offsite shipments which are shipments that leave the physical boundaries of a DOE site. Onsite shipments, called transfers, in contrast, stay within the physical boundaries of a DOE site. Shipments outside of the DOE site are known as “in commerce” shipments. Public interaction with shipments offsite is assumed and guarded against by incorporating barriers between the public and the nuclear materials (e.g., robust packages and limiting quantities of nuclear materials). Regulations are relaxed for onsite transfers mainly due to the fact that public access to the site is restricted. Regular access to DOE sites is exclusive to trained and authorized personnel.

As stated in the SRS Transportation Safety Document, “DOE Order 460.1C specifies that onsite transfers either be in accordance with the [Hazardous Materials Regulations] HMR, or be justified through demonstration of safety equivalence to the HMR. The Order and the associated Guide DOE G 460.1-1, *Implementation Guide for Use with DOE O 460.1A, Packaging and*

*Transportation Safety*, stipulate that the equivalence can be established through a combination of packaging and other factors, such as communications and control measures. The Guide further allows for a graded approach, in which materials representing a greater hazard are subject to greater containment, communications, and control requirements.” (Reference 1)

Federal Regulations define the type of packaging that is necessary for offsite shipments of nuclear material based on the total curies present within the package. Two of the common types of packaging for nuclear materials are Type A and Type B packages. This discussion will focus on Type A and Type B packages. The design requirements and testing requirements for Type A packages are stipulated in 49 CFR 178. The requirements for in commerce shipment of Type A packages is found in 49 CFR 173. The design and testing requirements for Type B packages are stipulated in 10 CFR 71. The requirements for shipment of Type B packages are found in 10 CFR 71 and 49 CFR 173. These regulations do not allow additional control measures in lieu of compliance and do not allow the use of a graded approach when shipping nuclear materials in commerce. As stated previously, DOE Order 460.1C allows for increased control measures and greater communications as well as allowing a graded approach when transferring materials onsite. To this end, at the SRS, Onsite Safety Analyses (OSAs) are written for specific materials or for specific campaigns that will transfer materials from one area onsite to other areas onsite.

These OSAs require the transferring organization to follow a set of controls lined out within the OSA. These controls require certain types of packagings to be utilized for the transfer, but often the packagings have not passed the stringent requirements necessary for offsite shipment. One example is the continued use of the DOT Specification 6M shipping package at the SRS for transfers of Type B quantities of nuclear materials. The 6M includes a single-ring drum closure on its outermost drum. This closure has, under extreme conditions, failed hypothetical accident condition (HAC) tests required in 10 CFR 71.73. Thus, the 6M would not be able to be used for in commerce shipments. (The DOT removed the 6M as an approved specification package from the Code of Federal Regulations in 2004) At the SRS, the 6M is allowed to be transferred with Type B quantities of nuclear materials with specific closure instructions per 6M manuals and historical documentation. Another example is the use of open-bodied trucks with non-rigid closures to transport low level radioactive waste. Only covered bodied vehicles are utilized for in commerce shipments of radioactive material. For the onsite transfer of low level contaminated soils an open body truck is utilized in which the material is completely confined within the trucks dump body, skid pad, or roll off container. Controls (with explanations in parentheses) exist for these types of containers including:

- The packaging to be used for transfer shall meet the requirements, at a minimum, of a SRS-1 packaging (a SRS-1 meets requirements for packaging per 49 CFR 178).
- Closure instructions, from InSite or facility procedures and/or manuals, for the selected package shall be followed (InSite is a SRS internal web server utility).
- The conveyance shall remain more than 670 meters from the SRS boundary at all times.
- Transfers shall not be initiated during National Weather Service Warnings applicable to SRS.
- The vehicle speed shall be limited to  $\leq 30$  miles per hour when using a regulated speed DEC limit from Table 1.1 or Table 1.2 (Tables 1.1 and 1.2 provide Curie limits based on a dose equivalent curie to plutonium-239 or DEC).

- Transfers consisting of either the HLW Agitator Cask or the HLW Feed Pump Cask shall not exceed 20 miles per hour, shall be considered a combustible solid payload with a conveyance DEC limit at regulated speed, and must remain on paved roads at all times (HLW=High Level Waste, these two casks are only operated at the SRS).
- All transfers shall be performed in accordance with Manual 5Q (Manual 5Q is the SRS Radiological Control Manual).
- All transfers shall be performed in accordance with Manual 19Q (Manual 19Q is the SRS Transportation Manual).

Having these controls allows the site to meet the requirements for a graded approach as specified in the DOE Order. Although some of the packages approved for use at the SRS would not be approved for offsite shipments, there is no reduction in the overall safety to the public or to the site workers.

## REGULATORY REVIEW DIFFERENCES

Another difference between offsite shipments and onsite transfers is in the review cycle for the transportation safety bases. Typically, for Type B shipments, a Safety Analysis Report for Packaging is developed and submitted for a regulatory review. This review is performed by the DOE and follows guidance set forth by the Nuclear Regulatory Commission. These reviews are extensive and ensure that both public and worker safety are not compromised by the shipment of the nuclear materials. Completion of the review results in the generation of a Certificate of Compliance (CoC). The CoC allows registered users to operate and ship packagings according to the requirements within the certificate. At the SRS, a similar review is conducted. In the past, the operating contractor performed their own reviews, but recently the Department of Energy Savannah River Field Office (DOE-SR) has taken responsibility for the reviews. DOE-SR compiles a team of knowledgeable individuals to review the various aspects of the transportation safety bases (i.e., Onsite Safety Assessments). This review is as thorough as those performed by the DOE for offsite shipments and addresses the same concerns (e.g., Structural, Thermal, Containment, Shielding, & Criticality and/or use of risk-based methodology). The outcome is a safety evaluation report (SER) that authorizes onsite facilities to transfer materials to other facilities at the SRS. This authorization does not allow shipments offsite.

## PACKAGING DIFFERENCES

One of the most noticeable differences between offsite and onsite shipments/transfers is the type of packaging used for the shipment/transfer. As mentioned previously, some types of packagings and transport vehicles are allowed onsite that would not be allowed offsite where the public has close access to the materials. The use of these packagings and transport vehicles is safe and is reviewed, as mentioned, by the DOE. This approach often utilizes a risk-based methodology. This risk-based approach is outlined in the SRS TSD. This method was discussed in two previous papers at INMM Annual Meetings. Watkins, et. al., in a 2012 INMM paper (**Onsite Transportation Authorization Challenges at the Savannah River Site, Abstract 329**), writes,

Risk based TSBs assumed some release of content during an onsite transportation accident. Any release of the contents was determined to be within the allowed site limits at the time – 5 rem at the site boundary, although it should be noted that there has never been a release of radioactive contents during onsite

transfers at the SRS. The risk based TSBs applied a graded approach to package survivability during an accident depending on certification of the package or structural robustness. In other words, an ordinary metal box was not credited for as much survivability as a DOT Specification 7A Type A 55 gallon drum.

Additionally, in a previous INMM paper from 2010 (**Using a Risk-Based Methodology for the Transfer of Radioactive Material within the Savannah River Site Boundary (Onsite Transfers), Abstract 123**), Loftin, et.al., writes,

The use of risk-based methodology in the development of onsite safety assessments allows for maximum flexibility in the packaging of materials and wastes for transfer between areas at the SRS. This flexibility ensures that the SRS is operated safely, efficiently, and economically while ensuring safety for both the offsite individual as well as the onsite worker. The risk-based methodology allows for the facilities to maximize the content loading per conveyance to decrease the number of transfers at the SRS and eliminating the need for expensive packages that are over-engineered for the applications at the SRS.

This approach allows the SRS to transfer materials that would otherwise have to either be left in place or would have to utilize extraordinary measures to transfer.

## CONTENT DIFFERENCES

Finally the last of the major differences between offsite shipments and onsite transfers are the amount and type of materials that are allowed to be shipped/transferred. Materials shipped in Type A and Type B packages are typically well defined and characterized. Materials at the SRS may not be as well characterized and must be transferred to a facility that can perform characterization. Without the flexibility provided by the graded approach in the DOE Order, these materials would have to be left in their current locations or expensive and labor intensive methods would have to be employed at each individual facility. In many cases at the SRS the materials are loaded into containers based only on a known curie loading. The limits are based on a plutonium equivalent curie or PEC and can also be related to a dose equivalent curie, or DEC, that is based on Plutonium-239 as mentioned above in the controls for one of the OSAs at SRS. The use of these equivalent measures allows the SRS to transfer quantities of materials based on the “worst case” possible content ensuring that if there were to be a release that the public and the site workers would not be exposed to dangerous levels of radiation and/or contamination. Additionally, all transfers of nuclear materials onsite must follow all of the applicable site procedures. This includes procedures specifically for radiation monitoring and contamination limits. The limits for offsite shipments, in some cases, are more restrictive than those within the procedures at the SRS, again allowing more flexibility onsite.

## CONCLUSION

Overall, the seemingly simple task of moving radioactive materials is well regulated and highly safe. And it would seem that there would be very little difference between shipping materials across the country and shipping materials within the boundaries of a DOE facility or site. Although many similarities do exist between the two, there are also many differences. These differences allow DOE sites to operate in a manner that gives flexibility while ensuring that public safety, worker safety, and material security are not compromised.