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TYPE AF CERTIFICATE FOR TRANSPORTATION OF LOW ENRICHED URANIUM OXIDE (LEUO) FOR DISPOSAL

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ABSTRACT

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Washington Savannah River Company (WSRC) operates the Savannah River Site (SRS) in Aiken, SC under contract with the U.S. Department of Energy (DOE). SRS had the need to ship 227 drums of low enriched uranium oxide (LEUO) to a disposal site. The LEUO had been packaged nearly 25 years ago in U.S. Department of Transportation (DOT) 17C 55-gallon drums and stored in a warehouse. Since the ^{235}U enrichment was just above 1 percent by weight (wt%) the material did not qualify for the fissile material exceptions in 49 CFR 173.453, and therefore was categorized as "fissile material" for shipping purposes. WSRC evaluated all existing Type AF packages and did not identify any feasible packaging. Applying for a new Type AF certificate of compliance was considered too costly for a one-time/one-way shipment for disposal. Down-blending the material with depleted uranium (to reduce enrichment below 1 wt% and enable shipment as low specific activity (LSA) radioactive material) was considered, but appropriate blending facilities do not exist at SRS. After reviewing all options, WSRC concluded that seeking a DOT Special Permit was the best option to enable shipment of the material for permanent disposal. WSRC submitted the Special Permit application to the DOT, and after one request-for-additional-information (RAI) the permit was considered acceptable. However, in an interesting development that resulted from the DOT Special Permit application process, it was determined that it was more appropriate for the DOE to issue a Type AF certificate [Ref. 1] for this shipping campaign. This paper will outline the DOT Special Permit application and Type AF considerations, and will discuss the issuance of the new DOE Type AF certificate of compliance.

INTRODUCTION

Savannah River Site's (SRS) inventory of legacy low-enriched uranium oxide (LEUO) packaged in 55-gallon galvanized steel drums (see Figure 1) was destined for permanent disposal. Since the material was enriched in ^{235}U slightly greater than 1 wt% it was classified as *fissile material* with less than A2 Curies per package. Under the DOT regulations [Ref. 2] this material would have to be shipped in accordance with the Type AF fissile material packaging and transportation regulations. Packaging for Type AF material as well as associated documentation was not available for this material so SRS chose to seek a Special Permit (SP) from the DOT. The rational for seeking the SP was that the LEUO would have no disposition path and the material would remain at SRS indefinitely. Shipment of the material, without a SP, would require the material to be 1) repackaged or 2) down-blended to reduce the enrichment, neither of which were considered prudent or viable.

Figure 1. Array of 55 Gallon LEUO drums.

SRS evaluated all known Type AF packages and could not identify any packagings that were feasible for this application. The evaluation of Type AF package designs identified a total of 65 Type AF container designs, 53 of which were not approved for powder/oxide (approvals were for fuel, pellets, overpacks, import/export only, and liquids). Of the 12 remaining designs, 9 were evaluated in detail. Evaluation of the 9 designs concluded that 4 could no longer be fabricated, 3 were too small (22 lbs payload, requiring ~7800 packages), and 2 were high cost reusable containers that were not amenable for handling/disposal, and would have cost in excess of $2M to fabricate. Additionally, use of any of the 9 container designs would have required extensive material handling with associated industrial hygiene and radiation/contamination hazard control. Based on this, SRS concluded that there were no viable Type AF packaging options that could be readily used.

Since alternative packages were not identified, SRS concluded that seeking a DOT Special Permit was the best option to achieve the permanent disposal of the material.

DOT SPECIAL PERMIT APPLICATION

The requirements for a DOT Special Permit application are given in 49 CFR 107.105 and require the following information.

- Applicants name and address.
- Description of SP proposal.
    - A citation of the specific regulation from which the applicant seeks relief.
    - Proposed mode of transportation.
    - A detailed description of the proposed special permit, such as alternative packaging, or special procedural controls with written descriptions and supporting documentation.
    - A statement outlining the applicant's basis for seeking relief from the specific regulations.
    - Identification and description of the hazardous materials planned for transportation under the SP.
    - For alternative packaging, documentation of the quality assurance controls, package design, manufacture, performance test criteria, in-service performance and service-life limitations.
- Justification of SP proposal.
    - Information describing all relevant shipping and incident experience that relates to the application.
    - A statement identifying any increased risk to safety or property that may result if the special permit is granted, and a description of the measures to be taken to address that risk; and
    - Substantiation, with applicable analyses, data or test results, that the proposed alternative will achieve a level of safety that is at least equal to that required by the regulation from which the SP is sought.

SRS Special Permit Strategy. Since the SRS LEUO material was classified as *fissile*, criticality evaluations had to be carried out to determine safe mass limits under 10 CFR 71.55 [Ref. 3] normal and accident conditions. The strategy used in the SP application was to 1) determine the amount of LEUO material that would remain subcritical (safe) when formed into an optimally moderated, fully reflected sphere (worst case for criticality evaluation) and, 2) request exemption from the *173.453(d) requirement that limits uranium-235 enrichment to a maximum of 1%*; specifically, "Uranium enriched in U-235 to a maximum of 1 percent by weight." Determination of the worst case safe critical mass of LEUO material was then imposed as a conveyance mass limit to ensure subcriticality safety. This strategy simplified the application because the package structure and configuration did not have to be defended under accident conditions. Requesting exemption from the 1 wt% limit would allow shipment as LSA material with the requirement for an IP-1 packaging for domestic transport. As will be noted below, the request for exemption from the 1 wt% limit was changed to a request for a *packaging exemption* as a result of one round of Nuclear Regulatory Commission (NRC) questions.

The SRS SP application was completed and submitted to the DOT in accordance with the Department of Energy (DOE) Order 460.1B, "Packaging and Transportation Safety" [Ref. 4] that governs SP applications. This necessitated submittal of the application to the DOE Environmental Management (EM) Packaging Certification Program (PCP) Office for review. Upon completion of their review, the PCP forwarded the application to the DOT for the 49 CFR review, and DOT forwarded the application to the NRC for review of the criticality analysis.

Request for Additional Information Changes SP Strategy. As a result of the SP review, the DOT/NRC issued SRS a request-for-additional-information (RAI) in the form of questions. SRS successfully provided the additional information and NRC recommended approval of the SP application. However, one significant change was made to the application as a result of the RAIs; the NRC recommended that SRS request exemption from the *packaging requirements for fissile materials* rather than requesting exemption from the 1 wt% fissile limit. SRS agreed with the NRC recommendation and modified the SP to request exemption from the fissile material packaging requirements.

> Specifically, "exemption was requested from the fissile materials packaging requirements in 173.417(a)(1)(ii); specifically, "*Except as provided in 173.453, fissile materials containing not more than A1 or A2 as appropriate, must be packaged in one of the following packagings: (ii) Any Type AF, Type B(U)F, or Type B(M)F packaging that meets the applicable standards for fissile material packages in 10 CFR part 71.*" The exemption is sought from only the packaging requirements. All other requirements for fissile material shipments will be met (e.g. shipping papers, marking, labeling, and placarding).

The Special Permit modification to request a “packaging exception” strategy rather than a “1 wt% fissile material exception” strategy resulted in the need to provide additional drum packaging details as required by 49 CFR 107.105(c)(9). Included in this information was the fact that the DOT 17C drums met the DOT 7A Type A performance requirements. Previously the application did not include the fact that the drums met DOT 7A criteria because the IP-1 packaging category was all that was required to ship the material as LSA. Hence the SP application now demonstrated criticality safety under normal and accident conditions and the packaging documentation now justified DOT 7A Type A performance.

The DOT and NRC accepted the SRS RAI responses, and technically approved the SP application. As DOT was reviewing the documentation in preparation for issuing the Special Permit they recognized that sufficient information had been provided to justify a Type AF certificate of compliance. The packaging met DOT 7A Type A criteria and subcriticality had been demonstrated under 10 CFR 71.55 normal and accident conditions.

TYPE AF CERTIFICATE OF COMPLIANCE

The DOT recommended to SRS and the DOE EM Packaging Certification Program that consideration be given to issuance of a Type AF COC. The EM PCP reviewed the approval documentation from the DOT and NRC and agreed that the requirements for a Type AF COC had been met. Subsequently EM PCP then summarized all of the DOT/NRC approval documentation in concert with their Safety Evaluation Report (SER), and certificate USA/9976/AF (DOE) was issued on September 16, 2006.

The overall time from submittal of the SP application to the DOT to the issuance of the COC by EM PCP was 14 months. Approximately 4 man-months of engineering effort were required for the SRS Special Permit and related Type AF documentation (1-2 man-years). Since the LEUO drums were in storage at SRS, the majority of criticality work had already been completed for Facility Safety purposes. Hence the SP application was able to benefit from existing analysis and therefore was a relatively low cost effort. Shortly after issuance of the certificate, SRS successfully completed the shipments and disposition of all of the LEUO drums. The packaging, transportation and disposition effort was successful.

CONCLUSIONS

The SRS decision to seek a DOT Special Permit resulted in successful completion of the LEUO shipping and disposition campaign. During the course of obtaining the Special Permit the SRS application was modified sufficiently to eventually justify issuance of a Type AF Certificate of Compliance rather than a DOT Special Permit. The overall time from submittal of the initial SP application to DOT to the issuance of the COC by the DOE EM Packaging Certification Program was 14 months. The cost of obtaining the approval was relatively low as compared to the effort required to develop a new Type AF packaging and associated SARP documentation.

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REFERENCES

1. Department of Energy Type AF Certificate of Compliance number USA/9976/AF (DOE) issued September 16, 2006.
2. Code of Federal Regulations, Title 49 Parts 100 to 185, October 2004.
3. Code of Federal Regulations, Title 10 Part 71, October 2004.
4. United States Department of Energy Order 460.1B, “Packaging and Transportation Safety”, April 4, 2004.