PACKAGING AND TRANSPORTATION OF DEPLETED, NATURAL, AND LOW ENRICHED URANIUM FOR DISPOSITION FROM THE SAVANNAH RIVER SITE

D. L. Gillas
U. S. Department of Energy, Savannah River Operations Office
P. O. Box A, Aiken, SC 29802

ABSTRACT

The Savannah River Site (SRS) has several inventories of depleted, natural, and low enriched uranium (DU/NU/LEU) that require final disposition. Fiscal Year 2003 (FY03) saw the beginning of disposition actions for these inventories. This poster shows these inventories from storage, through preparation for shipping, through packaging and transportation (P&T) steps, and finally disposal of each material stream.

In FY03, SRS completed a pilot project to dispose of 3,270 drums of depleted uranium oxide (DUO) between May and July 2003. The shipping method was 110-ton mill gondola rail cars with a polypropylene-coated fabric liner ("wrapper") as the DOT "strong, tight" package. These rail cars were shipped to Envirocare of Utah for final disposition of the DUO as low level waste.

The disposition project for the remaining inventory began in February 2004. Since there were issues with the wrapper during the pilot, shipping of the remaining drums will be accomplished using boxcars for drums that are already overpacked into 85-gallon drums or gondola cars with hard tops for the remaining 55-gallon drums.

The SRS inventories of DU and NU metal were also dispositioned in FY03. These inventories were shipped by commercial tractor/trailer truck to Envirocare of Utah.

Many universities have inventories of NU metal that are on loan from DOE. Through September 2003, SR shipped the material from five universities directly to the Nevada Test Site for disposal. The material was never physically returned to SRS thus saving a shipping step. These five universities provided the pilot to develop this program that is planned to continue until the material from all of the universities is dispositioned.

Depleted uranyl nitrate (DUN) is being shipped as a radioactive acid solution to a treatment vendor and is being treated before disposal. The low enriched uranium oxide (LEUO) seems to be the stream with the least P&T issues but has yet to be shipped. Plans are to ship this material by commercial tractor/trailer truck to NTS for disposal.

INTRODUCTION

SRS has begun the process of dispositioning excess materials including large inventories of DU/NU/LEU. The DU/NU/LEU streams include trioxide, metal, and solutions with varying concentrations of contaminants including, in one case, hazardous constituents. The packaging varies, from the original packaging, to individual overpacks, to large overpacks, to tankers

depending on the material stream and the destination. The transportation mode is truck or train also depending on the stream and destination.

Actions to prepare for disposition actually began in FY02 for the DU trioxide (DUO) and the first material was sent to disposal in FY03. The disposal actions for the DU/NU metal began and were completed in FY03. The disposal planning, as well as initial activities, for the LEU trioxide (LEUO) and the DUN began in FY03. The disposal actions for the university NU on loan also began in FY03.

The materials that will be covered in this paper include: DUO, DU/NU metal, LEUO, DUN, and university NU metal.

BACKGROUND

The DU/NU/LEU inventories at SRS were accumulated during the decades of nuclear weapons production and are a direct result of weapons production activities. These inventories were stored in any available space on site and have been, and continue to be, managed as accountable nuclear material.

DEPLETED URANIUM OXIDE (DUO)

DUO Background

The DUO inventory consisted of ~36,000 55-gallon (212 liter) drums, a significant portion (<30%) of which were overpacked into 85-gallon (327 liter) drums. This inventory was stored in seven facilities at SRS. The inventory is a byproduct from weapons production activities and was accumulated from the early 1970's through 1989.

In FY02, two of the storage facilities were determined to be in sufficiently poor condition such that the decision was made to disposition these drums as waste as opposed to upgrading the facilities for continued storage. The material could be disposed at either the Nevada Test Site (NTS) or Envirocare as low level waste and the DUO met the Department of Transportation (DOT) definition of Low Specific Activity (LSA) 1, unirradiated material; thus it could be shipped in a "strong, tight" container.

The drums were typically stacked three high in the storage facilities. The two facilities in question allowed rain water and mud to accumulate on the floors such that the bottom layer of drums was standing in water during portions of the three-decade storage period. This caused significant corrosion in some of the drums in the bottom tier such that the integrity of the drums was in question. Drums in the other two tiers also exhibited significant surface corrosion but drum integrity was not generally in question. Because, the drums averaged ~1,650 pounds (750 kg) each, coupled with the degraded integrity, the drums could not be used as the "strong, tight" container. For these reasons, the drums could not be used as the shipping containers for this waste stream.

DUO Disposition Pilot

The drums in these two facilities were ~9% of the entire DUO inventory and were representative of the worst case condition for the entire inventory. Therefore, since the decision was made to dispose of the entire inventory, this 9% was used as a pilot project to determine the appropriate P&T methods, and the disposal site and method.

The drums were transported by rail to Envirocare. Envirocare requested that the drums be placed four on a pallet and banded together to reduce the amount of handling at their site. The transportation method was 66-foot (~20 m) long, 110-ton (100 MT) mill gondola cars with tarps as rain covers as the conveyance. The car was lined with a polypropylene-coated fabric liner ("wrapper") as the strong, tight package. Compliant and functional blocking and bracing (B&B) was developed which included modifications to the gondola car to allow for straps to be attached to the car.

The remaining 55-gallon drums will be shipped in gondola cars with hard tops because of issues with the wrapper. Otherwise, loading, B&B, and shipping are very similar to that used in the pilot.

DUO Drums in Overpacks

Of the ~33,000 remaining DUO drums, ~10,000 (or less) were historically overpacked (overpacked because of storage and drum condition issues not related to P&T of the drums) into 85-gallon drums. These drums are wider than the 55-gallon drums such that four overpacks would not fit across the width of a standard railcar. Therefore, other options were needed. The overpacks are relatively new and in excellent condition but the weight exceeds the DOT limits for a non-bulk, strong, tight package. Since there is a significant quantity of drums, SRS decided to perform a drop test to assure the drums meet the requirements of a Industrial Package 1 (IP-1) package. The drums passed the testing and thus do not require additional packaging. In February 2004, SRS began to ship these drums in wider-than-standard boxcars to Envirocare with the drum as the shipping package and the boxcar as the conveyance.

DEPLETED AND NATURAL URANIUM METAL

DU/NU Metal Background

Historically, DU metal was provided by Fernald in the form of solid and hollow right cylinders (depending on design requirements) weighing between six and 14 kgs each (commonly referred to as "slugs"). When the last of the reactors were shut down in the late 1980's, target production halted with slugs still in the target fabrication process. Approximately 35% of the remaining slug inventory was bare (never entered the process) and ~65% of the slugs were processed to some extent. The process did not change the chemical form or nucleonics of the uranium, only the nickel and aluminum were added to the exterior of the slugs. Therefore, the waste profile was able to be consistent for the entire inventory. Also, Fernald had already shipped a significant quantity of bare slugs to NTS for disposal so SRS was able to use their characterization without repeating the analyses.

DU/NU Metal Disposal

Due to the relatively small quantity of material (~2,700 metric tons) and the unavailability of rail infrastructure near the storage area, shipment by truck was selected. Four trucks per day were loaded and shipped, four days per week from mid-March through May 2003.

The portion of the material (~35%) that never entered the process remained in storage in the original wooden crates that Fernald used to ship them to SRS. These crates were lined with aluminum sheeting and were determined to be acceptable packages for the material form (metal slugs). The remaining material (~65%) that came out of the process was stored in various containers. Some was stored in reused wooden crates, some in metal boxes, and a large portion was stored in fiberboard containers. The fiberboard containers presented a problem in that they were not entirely closed. However, since the material was in the form of metal slugs that were very difficult to disperse, wrapping the containers in heavy plastic solved the problem and they were accepted as the shipping packages.

This material was shipped by tractor/trailier truck to Envirocare for disposal. However, because of operational constraints at Envirocare, the truck was not allowed to be used as the strong, tight container which was the reason to assure each of the container types were approved shipping packages.

LOW ENRICHED URANIUM OXIDE

LEUO Background

The LEUO resulted from one experimental reactor core that was used at SRS in the mid-1980's. The resultant material from this core averaged slightly higher than 1% enrichment. Because the process to convert to trioxide initially included mixing the material with a depleted uranium stream, each of the first 33 drum has a different enrichment ranging from 0.24% to 0.711%; the remaining drums are relatively consistent at just over 1% enrichment. When all drums were averaged by weight (including a few drums that were at or below 0.711%), the average enrichment was ~0.94%.

LEUO Disposition

The LEUO was packaged with future shipment in mind. Galvanized steel drums were filled so that they met the requirements for a non-bulk, strong, tight package for LSA-1 material as defined by DOT. Since there are only 381 drums, shipment by rail is not necessary or desirable. This material is planned be shipped by truck to NTS in FY04.

DEPLETED URANYL NITRATE SOLUTIONS

DUN Background

The DUN is the result of the same process that generated the DUO except that the last step, reduction to oxide, was not performed. The uranyl nitrate has been stored at SRS since it was produced in the 1990's.

The DUN concentration is in the range of 350 to 400 grams of uranium per liter of solution and the average uranium enrichment is ~0.25%. The DUN also contains mercury and chromium above Resource Conservation and Recovery Act (RCRA) limits for land disposal so that it requires treatment to meet Land Disposal Restrictions (LDR). A feasibility study has verified the feasibility of treating this material such that it meets LDR.

DUN Disposition

The material is being treated by an off-site vendor and disposed as low level waste. The final waste form meets the NTS WAC.

The solutions are being transported in IP-2 containers because of contaminant levels. SRS purchased six 4,600-gallon (17,500 liter) IP-2 intermodal tankers from a foreign source (only three are planned to be used for this waste stream). These tankers are being used to transport the solutions to the treatment facility. The treated waste will then be transported by truck to NTS for disposal as low level waste.

NATURAL URANIUM METAL FROM UNIVERSITIES

University NU Background

From the late 1950's and into the 1960's, DOE's predecessor, the Atomic Energy Commission (AEC), loaned NU to universities for teaching nuclear physics and engineering. The NU originated as rejected fuel slugs from the SRS reactor fuel fabrication processes. The slugs were similar in form to the DU metal slugs in that they were solid or hollow, right cylinders of uranium metal that were clad in aluminum. In FY03, DOE Savannah River Operations Office (DOE/SR) began a pilot to collect and disposition a portion of this material. The universities are responsible to package and ship the material to a DOE designated location.

University NU Disposition

The NU metal was characterized using dose-to-Curie calculations. The dose ranged between one and five millirems on contact. The universities' inventories averaged ~2.5 MTU each. The decision was made to package the material at the university for direct shipment to the NTS thus saving a shipping step and saving both DOE and the universities money. DOE provided the drums to the universities due to the NTS packaging requirements being more stringent than DOT's. SRS personnel who are NTS Waste Certification Officials traveled to each university to actually package and ship the material. Standard tractor/trailer trucks were used as the strong,

tight packaging and the conveyance. All five universities schedule for the pilot were successfully completed in FY03. The program will continue with seven universities scheduled for FY04. As many as seventy universities have loan agreements through DOE/SR.

SUMMARY

SRS has initiated plans or actions for all of the legacy inventories of DU/NU/LEU at SRS. Per EM-1 guidance, the disposition actions for all of these inventories will be complete by November 2007. No issues are expected to prevent the accomplishment of this goal.