LA-UR-01-3702
Approved for public release; distribution is unlimited.

Title: **Transfer of Excess Nuclear Material from Los Alamos to Savannah River Site for Long-Term Disposition**

Author(s): **Carl W. Hoth, Tresa F. Yarbro, Lynn A. Foster**

Submitted to:

http://lib-www.lanl.gov/la-pubs/00796200.pdf

Transfer of Excess Nuclear Material from Los Alamos to Savannah River Site for Long-Term Disposition

Carl W. Hoth, Tresa F. Yarbro, Lynn A. Foster
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, New Mexico, 87545, USA, 505-667-0645

ABSTRACT
Los Alamos National Laboratory is preparing excess nuclear material for shipment to Savannah River Site (SRS) for final disposition. Prior to shipment the nuclear material will be stabilized and packaged to meet strict criteria. The criterion that must be met include: 1) the DOE stabilization, packaging and storage requirements for plutonium bearing materials, DOE-STD-3013, 2) shipping container packaging requirements, 3) SRS packaging and storage criteria, and 4) DOE Material Disposition criteria for either immobilization or MOX reactor fuel. Another issue in preparing for this transfer is the DOE certification of shipping containers and the availability of shipping containers. This transfer of the nuclear material is fully supported by the EM, DP and NN Sections of the DOE, as well as, by LANL and SRS, yet a strong collaboration is needed to meet all established requirements relating to stabilization, packaging, shipment, storage and final disposition. This paper will present the overall objectives, the issues and the planned strategy to accomplish this nuclear material transfer.

INTRODUCTION
The Los Alamos nuclear material inventory has been evaluated to determine which material has programmatic application and which material is excess to programmatic needs. The excess nuclear material can present a serious storage problem because it has been in storage for long times, often exceeding twenty years. There are two objectives in processing and packaging excess material to ship offsite, first the DOE has a commitment to the Defense Nuclear Facility Safety Board to properly package and disposition excess nuclear material and second the Los Alamos Plutonium Facility needs the vault storage space for active programs.

PROCESSING NUCLEAR MATERIAL
The nuclear material that is categorized as “excess” consists of thousands of containers in many different forms. An evaluation was conducted on the containers stored in the Los Alamos Plutonium Facility nuclear material vault and some materials revealed a higher frequency of at-risk packaging. An objective of the transfer of excess Pu is to process and repackage the “at-risk”items first to improve safety conditions in the vault. One of the higher risk categories was the “sweepings” category; material left over when a process was completed or discontinued. These items range from 80% Pu to less than 1% Pu and include an unknown and large cross-section of impurities. In order to process the sweepings, a blend plan was established to combine up to 30 containers into a master blend. This material will be blended to a homogeneous free-flowing powder, exposed to a pretreatment and then high-fired for at least 2 hours at 950 C (as required by the DOE-STD-3013 Standard). Samples will be sent for moisture content, elemental analysis and

archives, prior to packaging in the 3013 storage containers. This process will be repeated for the other categories of excess holdings, which include impure oxides, salts, incinerator ash, various residues and other materials.

In order to meet long-term storage requirements, excess nuclear material must be processed to meet the DOE Standard, DOE-STD-3013. The Standard was revised in 1998 to permit Pu bearing materials that have 30% or more of a combination of plutonium and uranium. This revision expanded the use of the long-term packaging criteria to include Pu bearing materials with higher levels of impurities. In addition, material shipped to Savannah River Site must meet criteria established for interim storage at SRS and for final disposition. The initial DOE plan for disposition of the bulk of the excess nuclear material was immobilization. The immobilization option imposed strict limits on the chemical impurities in the material to be packaged to ensure it would dissolve in the glass to provide a stable long-term storage media. Last March, the DOE announced the immobilization activities would be postponed for at least two years and funding would be terminated for current activities. This decision leaves the plans for Pu disposition unclear. The existing SRS acceptance criteria still requires the immobilization specification yet it is understood that other options may prevail. One possibility is for the excess Pu to be used as feed for the disposition option of mixed Pu-U oxide (MOX) reactor fuel. The MOX feed would also have strict composition requirements and a final specification has not been established. In order to process and package to meet the SRS acceptance the current requirement is still for immobilization, so the approach at Los Alamos is currently to process and characterize several selected batches and review the acceptability of this initial material with SRS.

CHARACTERIZATION REQUIREMENTS

In order to meet the requirements of DOE-STD-3013 all packaged Pu bearing materials must be characterized. The Standard requires basic quality assurance records of the chemical form, isotopic analysis and mass quantities. The Standard also requires that packaged material be evaluated by the DOE Material Identification and Surveillance (MIS) program to ensure that material be packaged for long-term (up to fifty years) does not present unexpected storage problems. A key analysis requirement is to conduct a measurement to determine the moisture content of the treated materials. This DOE- STD-3013 requirement states the Stabilization Acceptance Criterion as “The moisture content of oxide to be packaged in any type of sealed container shall be less than 0.5 wt% at the time of packaging”. The moisture content must be measured by approved methods and the reference method is the loss-on-ignition (LOI). This measurement of LOI is simply the ratio of the weight loss from thermal treatment to the initial net weight. For example, if the net weight was 4.0 kg and item lost 20 grams from the thermal treatment, it would have a 0.5% LOI. It has been determined that this measurement is valid for pure Pu oxide, but problems are observed when this technique is used to evaluate impure Pu bearing materials, such as salts and hydroxides. The heat treatment removes the moisture but vaporization of the Pu bearing material “impurities” requires a longer time and this directly affects the results of the LOI test. Also, the intent was to remove elements that might undergo radiolysis and generate gases within the sealed container not to drive off all volatiles released at high temperature. The DOE MIS program is currently conducting

an evaluation of the moisture measurement techniques to ensure the moisture content is accurately measured on the treated material. While this evaluation is underway, the processing activities are focused on pure Pu oxides and Pu metal or conducted with the risk that the LOI measured moisture content may not be accurate. The current approach at Los Alamos is to heat treat the impure Pu bearing material for longer time (up to 6 hours) then withdraw representative samples and immediately package the bulk material in sealed containers. The verification of acceptable moisture content will be established with representative samples of the material using all available moisture measurement techniques that have been approved by the MIS program.

PACKAGING ISSUES

The packaging configuration specified in the DOE-STD-3013 Standard consists of two nested containers, an inner container that is enclosed in an outer container. Both containers are designed to provide pressure containment and both are welded and leak tested. The DOE has specified that the DOE sites all use the same outer 3013 container that was designed by British Nuclear Fuels Limited (BNFL). The container outer dimensions are 126-mm diameter with a 255-mm height. The DOE sites can use inner container designs of their own design but they must be tested to ensure they meet all drop test and other requirements. Los Alamos will use the inner container developed for the ARIES program. The ARIES program has been packaging plutonium from the pit disassembly program for two years.

SRS also has issued an acceptance criteria for the 3013 packaging, which requires weld qualification based on the ASME Boiler and Pressure Vessel Code, Sections VIII and IX. The weld qualification, specifically for the outer 3013 BNFL type outer container, requires welder qualification, quality assurance, weld development and weld demonstration with nondestructive and metallographic examinations of the weld samples. The weld design is a circumferential weld on thick section stainless steel. The weld can be accomplished by several methods including gas tungsten arc (GTA) method and laser welding. Other DOE sites are using these techniques: Hanford and Savannah River are using the GTA weld and LLNL and Rocky Flats are using the laser weld. Los Alamos has performed weld trials with the GTA method and is evaluating the laser weld option and both an autogenous GTA (no filler metal) and a filler metal GTA method. Planning is underway to install the welding capability in the Los Alamos packaging line and proceed with 3013 type packaging with the BNFL outer container in early 2002.

SHIPPING ISSUES

The shipment of 3013 containers from Los Alamos to Savannah River will be done using either the 9975 shipping container or the SAFKEG shipping container. Both containers are currently under certification review and are not available for shipping plutonium oxide. The 9975 container was approved for shipping plutonium metal in March 2001. The 9975 container is being licensed by Savannah River and is under review directed by DOE-EM using an Lawrence Livermore National Laboratory review team. The SAFKEG is being licensed by Los Alamos and is under review directed by DOE-DP using an Oak Ridge / Y-12 Plant review team. The SAFKEG shipping container is shown in Figure 1.

Figure 1. The various components of the SAFKEG shipping container

Current schedules call for the 9975 container to be approved for Pu oxides in Fall 2001 and for the SAFKEG to be approved for both Pu metal and oxides in Spring 2002.

The availability of shipping containers is also a concern in conducting this shipment. The DOE complex has over 1000 of the 9975 containers but they are committed to shipping operations at Rocky Flats. Plans are to purchase at least 25 of the SAFKEG containers prior to the issuance of the certificate of compliance. The estimated time required to fabricate this quantity of the SAFKEG containers is six months. DOE is currently establishing the priority and the funding to support this purchase. It is intended to have sufficient SAFKEG containers fabricated and available when the certificate of compliance issued.

Obviously, the SNM shipment to SRS will not occur until a shipping container is certified for use and sufficient quantities of the containers are available to schedule an SST shipment. The availability of a certified shipping container is one the essential elements in conducting this nuclear material shipment. In the past, typically the shipping container review process has taken longer than predicted, and thereby could be the pacing factor in conducting the transfer.

CONCLUSION

The goal of processing, characterization, packaging and shipping excess nuclear material from Los Alamos to Savannah River involves concurrent challenges. Each of these four key steps involves factors that could delay the transfer. In order to complete this offsite shipment, a considerable effort is ongoing to monitor and coordinate the required activities, address the issues and establish effective solutions.