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Packaging Options for Materials Processed Through the SRNL Mobile Plutonium Facility

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Abstract:

The Savannah River National Laboratory's Mobile Plutonium Facility (MPF) is a deployable facility to characterize, stabilize, and package at-risk, weapons-grade nuclear materials. The MPF packaging program consists of three main parts; 1) primary packaging, 2) packaging for residual materials, and 3) packaging unique materials. The MPF utilizes DOE certified Type-B packages for the bulk of the materials that are processed through the facility. The residual materials are packaged into drums and/or specially designed bags that are qualified for confining these materials. Finally, special and unique materials are packaged into modified containers and are then certified to be within the DOE, DOT, and IAEA regulations for transport of nuclear materials. This paper discusses the process for the selection, the use, and the shipment of these packagings.

Background:

Upon design of the MPF, it was determined that a suite of packages must be selected that will ensure any recovered plutonium is returned in a safe, compliant manner. This requires packages that are both robust and have flexibility to contain multiple content types and forms. The packages are divided into categories for the MPF mission phases by contents that they will contain.

Primary Packaging:

Plutonium Oxides and Samples—9975 Shipping Packages

The 9975 Shipping Package was chosen as the package for all Plutonium Oxide Materials that are processed within the MPF. The 9975s can package up to five (5) kilograms of plutonium oxide. Up to 4.4 kg of fissile gram equivalent plutonium-239 oxide can be packaged in the respective container when meeting content requirements of the 9975 Safety Analysis Report for Packaging, Table 1.2, "Contents". The 9975 is a certified DOT Type B package and is approved for shipment via land/sea.

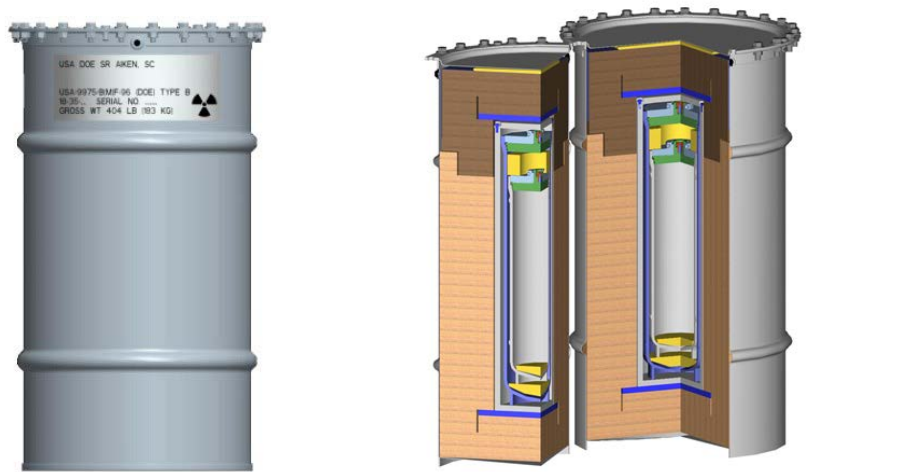


Figure 1—9975 Shipping Package Figure 2—9975 Shipping Package Cut-away

The 9975 Shipping Package will also be utilized for shipping plutonium samples collected during the processing of materials through the MPF. Pu samples from various processed containers will be placed into an inner engineering food-pack can and packaged into a 9975. The physical size and mass quantity in each sample will be determined by the entity that is requesting the samples and by the MPF procedures for maintaining the initial characteristics from the feed materials into the MPF.

9975 containers that will be utilized by the MPF will be made available by the respective design agency program office. Agreements will be made to allocate the minimum inventory of packages necessary for initial deployment. Currently, the 9975 shipping packages are owned by DOE-EM and are earmarked for ongoing disposition missions. If current package inventory is not available, the MPF can initiate a purchase/procurement cycle for new 9975 containers.

Plutonium Metals—FL and 9975 Shipping Packages

Large metal items that are recovered in MPF processing will be packaged into either a 9975 or a FL Shipping Package, depending on the size of the metal item. Up to 4.4 kg (9975) of Pu metal can be packaged in the 9975 when meeting content requirements of the SARP Table 1.2, "*Contents*". The FL Shipping Package will be used for plutonium metal items that are too large for the 9975 and must meet the content limits within the FL SARP. The FL Shipping Package is a Type B Shipping Package approved for domestic shipment of plutonium, however, it is a robust container that could be used for either land or sea shipments. Necessary documentation will be developed to allow the FL to be used outside of its current certification.



Figure 3—FL Package

FL containers that will be utilized by the MPF will be made available through the National Nuclear Security Administration-Defense Programs (NNSA DP) upon request. If used, new packages will be procured through NNSA and upon negotiation with NNSA DP.

Packaging for Residual Materials:

Plutonium Residual Material (RM) is defined as the materials that are not part of the MPF product stream that may contain or be contaminated by nuclear materials. Residual Materials are typically bagged, contaminated items from the MPF glovebox operations such as contaminated job control

material and associated glovebox operations items. Packaging for these materials will include but is not limited to the following:

- DOT 7A Type A Shipping Packages (55-gallon drums) with contents < 0.435 g Pu-239 (less than 1A2)
- A specially designed IP-1 Bag with contents based on the volumetric loading of the bag. Per the RM strategic plan, this bag will be used for any materials that will not be shipped back to a DOE Facility (Leave In Place Strategy).



Figure 4—DOT 7A Type A

The characterization criteria for these materials is defined in the MPF RM Strategy Guide. Prior to MPF deployment, pre-mission negotiations will identify radionuclides of concern for the source materials that will be used in the overall characterization of the RM. The RM will be tracked in the MPF to ensure that the levels of RM in any single package do not exceed the limits for Type A shipping. Additionally, the MPF will utilize the digital radiography systems in the X-Ray unit at the MPF to ensure that all packaged items do not contain any articles that are prohibited for the final shipping location for the materials.

Packaging for Unique Materials:

There are some materials that may not fit into any of the categories previously discussed. Examples include large contaminated items such as a blower fan or a piece of processing equipment, such as a furnace, that was replaced during MPF operations. These items will be decontaminated to the greatest extent possible and then packaged into a large-cavity package. MPF has acquired a JPSP package that previously shipped large plates of uranium. This package could be modified to carry contaminated items that may contain up to 1A2 of radioactive materials.

Additionally, MPF is set-up to have capability to package tritium, heavy water, and deuterium oxide. One of the packages necessary for these items includes a specially-designed tritium package designated as the Bulk Tritium Shipping Package (BTSP). The BTSP can transfer tritium in multiple configurations providing wide flexibility. 55-Gallon UN1A1 drums will be used for heavy water and deuterium oxide loading and shipping.

Additional Considerations for Packaging and Shipping:

Package Staging:

Due to the potential uniqueness of the materials processed by the MPF, if it is deemed necessary, a pre-determined domestic staging facility will be utilized by the MPF until the material is delivered to the

final receiving facility. MPF personnel will provide continuous support for staging activities (e.g., maintaining container compliance, tracking environmental conditions, verifying safeguards and security requirements) during the staging period. There is also a potential that the Residual Materials will need to be repacked and/or certified at an interim storage and/or processing facility for ultimate disposition at a DOE Geological Repository.

Alternate Packages:

MPF Shipping and Packaging Subject Matter Experts have developed a list of other packagings that could potentially have merit within the MPF fleet. Although there is not a current plan to utilize any of these packagings in the MPF, the following have been considered:

- DPP2—A Defense Programs Package intended for in-commerce shipment of Pu Metal items utilized within the NNSA nuclear weapons complex. The DPP-2 is currently certified though not being used for NNSA shipments.
- MD-2—Defense Programs Package intended for in-commerce shipment of Pu Metal items utilized within the NNSA nuclear weapons complex. The MD-2 is not currently certified and is not scheduled for use for NNSA shipments until 2022.
- AL-R8—Historical Package used for in-commerce shipment of Pu Metal items within the NNSA nuclear weapons complex. The AL-R8 is not currently certified and is not being used for NNSA shipments.
- DPP-3—Defense Programs Package intended for in-commerce shipment of Pu Metal items utilized within the NNSA nuclear weapons complex. The DPP-3 is currently not certified and is not available for use for NNSA shipments.
- ES-3100—NNSA Package intended for in-commerce shipment of Uranium contents utilized within the NNSA and DOE complex. The ES-3100 has certification from the DOE, NNSA, and the NRC.
- DT-22 and DT-23—Historical Packages used for in-commerce shipment of Pu and U Metal items within the NNSA nuclear weapons complex. The DT-22 is not currently certified and is not being used for NNSA shipments.
- 9977—NNSA Package intended for in-commerce shipment of Plutonium and Uranium contents utilized within the DOE complex. The 9977 has certification from NNSA.

Transportation Logistics:

Cargo Restraint Transporters (CRT) will be used to stabilize the 9975 Shipping Packages during transport when three or more are being transported at one time. If the mission plan requires 9975 Shipping Packages to be transported as single units or in pairs, these will be stabilized on a case by case basis depending on the method of transport. Single/pairs of 9975 Packages or CRTs could be further arranged and loaded into modified ISO containers for vessel transport. MPF Subject Matter Experts will coordinate transportation and loading operations to and from both the USG port and the agreed upon final receipt facility. Packages not transported as single units or in pairs will be transferred in MPF ISO Containers. Figures 5-9 below show representations of potential configurations that will be utilized by the MPF for shipment of the packages.

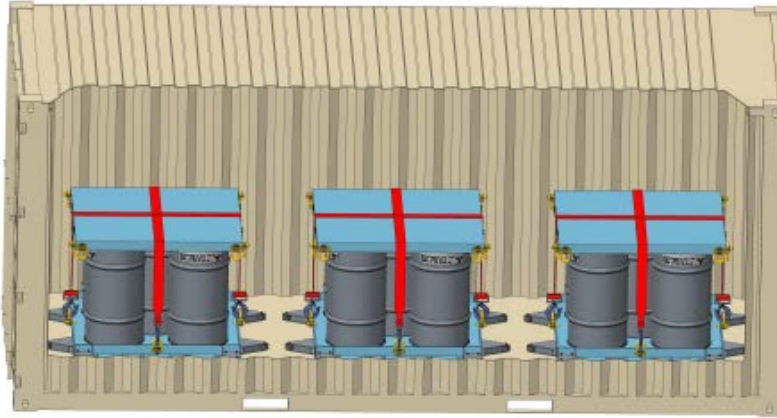


Figure 5—MPF ISO Loaded with 9975 Shipping Packages in Cargo Restraint Transporters

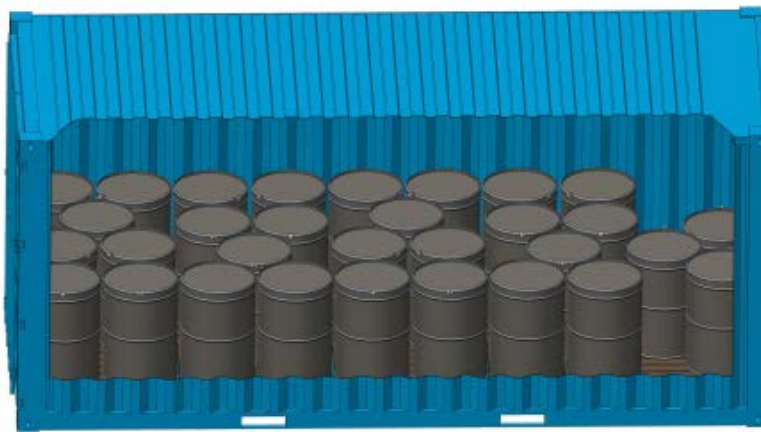


Figure 6—MPF ISO Loaded with 55-Gallon DOT 7A Type A or UN1A2 Drums

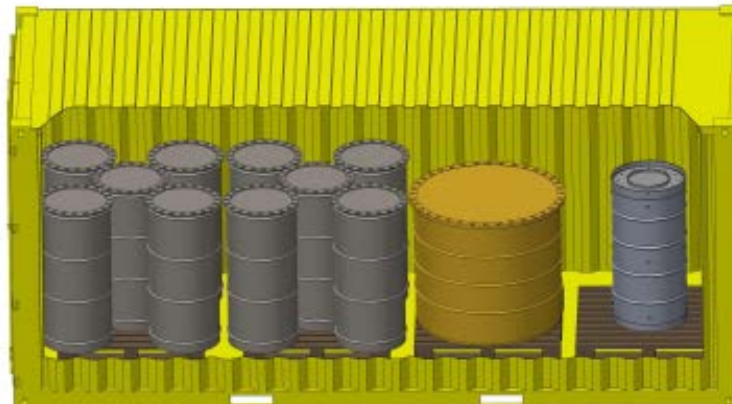


Figure 7—MPF ISO Loaded with FL, JPSP, and BTSP Shipping Packages

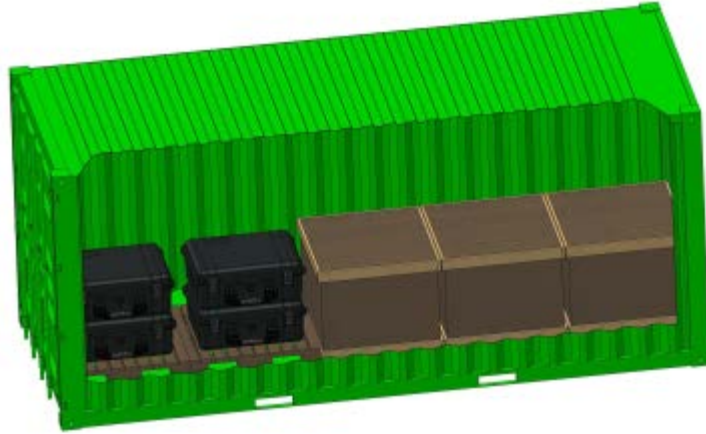


Figure 8—MPF ISO with Various Large Items and Boxes

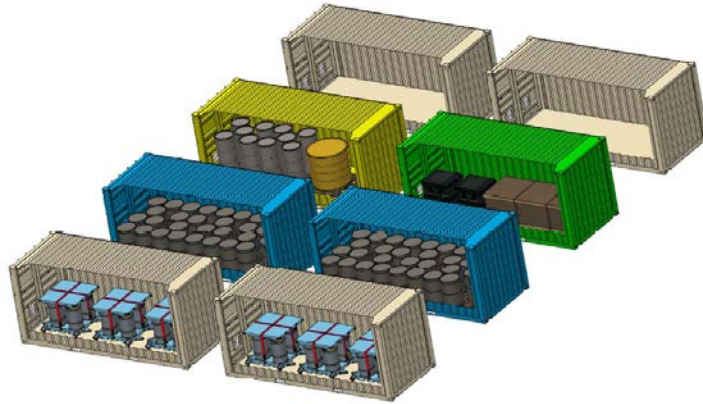


Figure 9—Potential Suite of MPF ISO Containers

Conclusions:

The MPF incorporates a wide variety of packaging options for the various materials it may be requested to process. Each of those materials has been assessed and the best packaging developed and/or chosen for eventual packaging and transportation. The logistics for the processing and transportation of MPF packages are being streamlined so that an effective and efficient process is realized when the MPF is directed on a mission to recover plutonium and/or other radioactive materials.