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CONVERSION OF 9978 PACKAGINGS TO 9977s

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ABSTRACT

The Model 9977 (9977) is a packaging designed to ship radioactive material content compliant with Title 10 of the Code of Federal Regulations, Part 71. Package contents include actinide metals and oxides in Type B quantities. The Model 9978 (9978) is a similarly designed and certified packaging used to ship Type B quantities of radioactive contents. There are thirty 9978s that have no identified mission needs. There is a desire to convert those 9978s into 9977s for which there are mission needs. The comprehensive plan for the conversion will be discussed in this paper.

INTRODUCTION

The Model 9977 (9977) is a packaging designed to ship radioactive material content compliant with Title 10 of the Code of Federal Regulations, Part 71. The 9977 Safety Analysis Report for Packaging (SARP) documents the compliance of the package to the regulatory safety requirements for a Type B(M)F-96 package. Package contents include actinide metals and oxides in Type B quantities. The Model 9978 (9978) is a similarly designed and certified packaging used to ship Type B quantities of radioactive contents. As designed and manufactured, the Drum Body, Drum Lid, Closure Bolts, and washers are identical for the 9977 and 9978. There are forty-three 9978s that are certified for use by the Department of Energy Office of Environmental Management (DOE-EM). Thirty of these have no identified mission needs. There is a desire to convert those 9978s into 9977s for which there are mission needs. Four components of the 9978s will need to be removed and replaced, and four new components will be needed to assemble the 9977s. This process of converting excess packagings using reclaimed components and a minimum of newly fabricated parts will save approximately \$500k compared to buying new packagings. This paper discusses the comprehensive plan for the conversion.

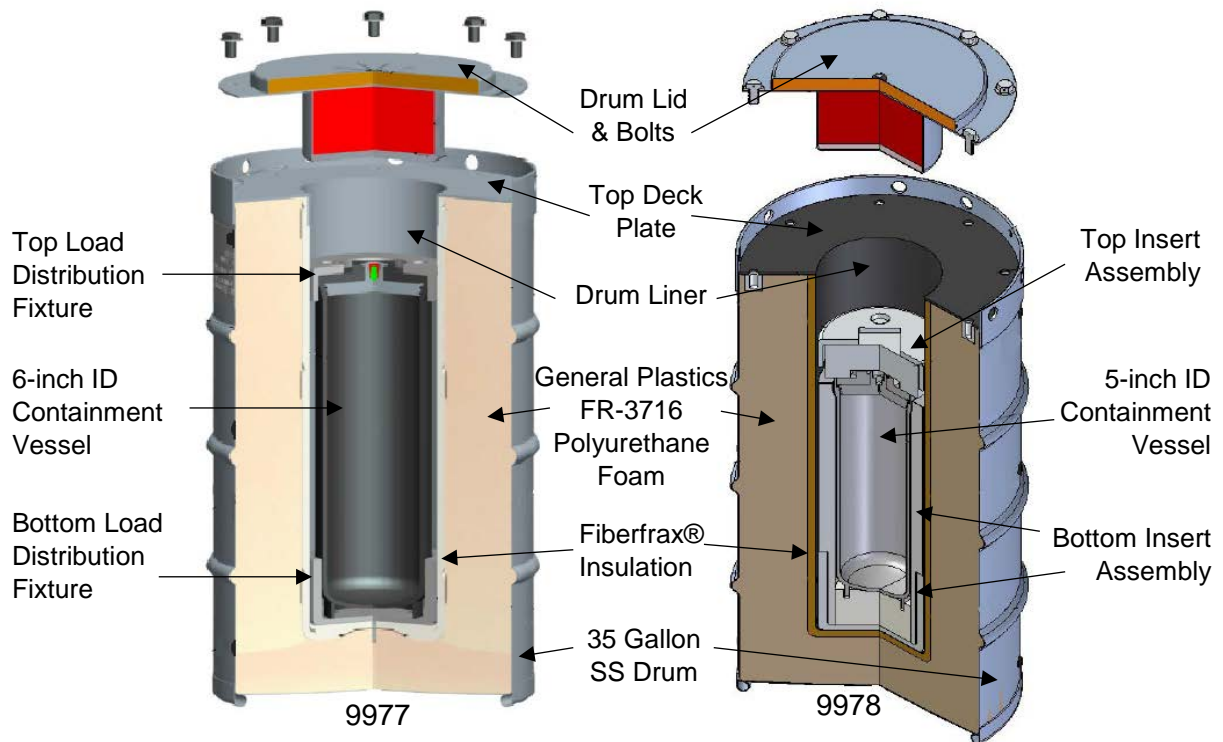
Background

The 9977 Drum Body is a closed unit consisting of a shell, top deck plate, reinforcing rim (vertical flange), and a liner assembly. Two layers of insulation material fill the volume between the drum liner and shell. First, two blankets of Fiberfrax® insulation are wrapped around and attached to the sides and bottom of the liner. The remaining volume between the Fiberfrax® and the drum wall is filled with General Plastics FR-3716 polyurethane foam. The 9977 is designed with a containment vessel with a nominal inside diameter of six inches (6CV). The Top and Bottom Load

Distribution Fixtures (LDFs) fit within the drum liner cavity, above and below the 6CV. The 9977 Drum Body is closed with a Lid Assembly which incorporates chambers above and below the Lid Plate filled with shock-absorbing thermal-insulating materials. Eight heavy hex-head bolts with plain, narrow Type B washers secure the lid to the top deck of the Drum Body. Welded to the Drum Body is the Packaging Identification (ID) Plate. The ID plates contain information such as the package type, certification, name, serial number, and maximum gross weight. They also include the competent authority of the package, their address, the proper shipping name, and the radiation Trefoil symbol. The packaging serial number is also engraved in the Lid Assembly Lid Plate.

The 9978 Drum Body and Lid Assembly are identical to the 9977 Drum Body and Lid Assembly. The 9978 is designed with a containment vessel with a nominal inside diameter of five inches (5CV). The Top and Bottom Load Distribution Fixtures (LDFs) fit within the drum liner cavity, above and below the 5CV. Honeycomb spacers fill the volume between the 5CV and LDFs. The combination of the LDFs and honeycomb spacers form the Top and Bottom Insert Assemblies. Figure 1 shows cutaway illustrations of the 9977 and 9978.

FIGURE 1: 3-DIMENSIONAL CUTAWAY ILLUSTRATION OF THE 9977 AND 9978



An initial forty 9978s were procured by the National Nuclear Security Administration (NNSA). However, three 9978s were used as test stand-ins for the 9977s to qualify the 9977s for use in the Savannah River Site (SRS) K-Area Complex (KAC). The three 9978s were consumed in the testing. The KAC provided funding to produce three replacement 9978s. Three additional 9978s

were purchased by Lawrence Livermore National Laboratory (LLNL). These forty-three 9978s are currently still in the active fleet. Since they've been manufactured, only nine of the forty 9978s in the NNSA fleet have been used to ship material. There are currently shipments planned using these same packagings. Annual maintenance has been done by Savannah River National Laboratory (SRNL) on ten packagings for this shipment, with one serving as a spare. The three 9978s owned by LLNL are in use at their site and are maintained by them. The current 9978 inventory and their locations can be found in Table 1.

TABLE 1: 9978 INVENTORY

Serial Number (9978-xxxxxx)	Produced	Available	Location	Status
100001 & 100003 – 100010	9	9	Los Alamos National Laboratory	Used
100002	1	1	Argonne National Laboratory	New/Unused
100011 – 100028 & 100032 – 100043	30	30	Savannah River Site	New/Unused
100029 – 100031	3	0	Disposed	Consumed in Testing
100044 – 100046	3	3	Lawrence Livermore National Laboratory	In Use
Total	46	43		

The plan is to convert thirty of the 9978s into 9977s. These thirty would come from the new/unused inventory at SRS to ease the cost of disposal of the old components. The remaining thirteen 9978s will remain certified by DOE-EM with ten being transferred to the DOE-EM fleet and the three owned by LLNL remaining under their control.

CONVERSION PLAN

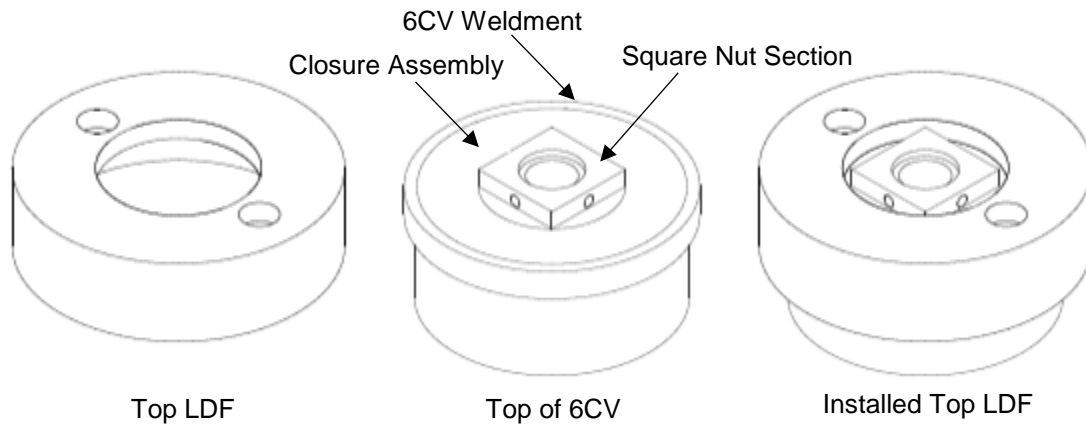
The 9978s were manufactured on the same purchase order as 9977 and H1700 Packagings. In order to ease the manufacturing process and logistics, and to simplify meeting the delivery needs for specific packagings, the Drum Body and Drum Lid subassemblies were standardized on the H1700 Packaging design. In this way, the Drum Bodies and Lids could be manufactured as a group and assigned to specific packagings as needed. As designed and manufactured, there are four components that are identical for the 9977 and 9978 Packagings. These are the Drum Body, Drum Lid, Closure Bolts, and washers. There are four components of the 9978 that will need to be removed and replaced in the conversion process. These are the 5CV, the Top and Bottom Insert Assemblies, and the drum ID plate. There are four components that are needed to assemble the new 9977s. These are the Top and Bottom LDFs, the 6CV, and the 9977 ID plate.

Load Distribution Fixtures and ID Plates

The Top and Bottom LDFs are made from 6051-T6 aluminum round bar and fit within the drum liner cavity. The LDFs center the 6CV in the liner, stiffen the package in the radial direction, and

distribute loads away from the 6CV. As shown in Figure 2, the 9977 Top LDF has a circular central hole for greater clearance with the square nut section on the 6CV Closure Assembly. Originally the LDFs and ID plates were to be procured. Due to cost concerns, however, the decision was ultimately made to fabricate these parts at SRS instead. The serial numbers for the new 9977 ID plates will be 190261 through 190290.

FIGURE 2: TOP LDF INSTALLATION ON THE 6CV



6-inch Containment Vessels

The 6CVs used in the 9977 are nearly identical to those used in the Model 9975 (9975). The 9975 design incorporates double containment, provided by nested Primary and Secondary containment vessels (PCVs and SCVs). The design of the PCV is the same as the design as the 5CV used in the 9978. Similarly, the design of the SCV is the same as the design as the 6CV used in the 9977. Previous 9978s and 9977s have been fabricated using reclaimed 5CVs and 6CVs from 9975s, respectively. This approach will be used in the conversion of 9978s to 9977s. New 6CVs could be manufactured, however, this cost can be avoided through reclaiming thirty SCVs from 9975s that have been removed from service. The steps to convert an SCV to a 6CV are discussed below.

The outer diameter of the SCV Weldment (vessel body) has to be measured. If the SCV Weldment outer diameter exceeds the 6CV Weldment design dimensions indicated in the SARP, then the SCV Weldment will have to be machined to meet the 6CV Weldment design. Additionally, the new 6CV will have to be retested and inspected per the 9977 SARP. A chamfer will be machined into the leak test port socket in the Cone-Seal plug. The original 9975 serial numbers will be marked through on the 6CV Weldment, Cone-Seal Plug, and Cone-Seal Nut and the new 9977 serial numbers will be applied next to them. This will maintain the ties to the original 9975 Fabrication Quality Assurance (QA) documentation. These documents will be collected into the QA Records for the new 9977 Packagings.

9977 Drum Assembly

The new 9977s will comprise the Drum Body, Drum Lid, Closure Bolts, and washers from the 9978; the SCV from the 9975; and the new LDFs and ID plates fabricated at SRS. The 9978 specific components will be removed and disposed of and the new 9977 ID plate will be attached to the Drum Body. The current approved 9977 SARP requires that the ID plate be welded on the drum. In that case, the existing 9978 ID plate would be removed by grinding the welds, and the new 9977 ID plate would be welded to the Drum Body in the same location. However, the welding heat input to the drum and insulating polyurethane foam inside the drum is a concern as it potentially overheats and vaporizes the foam. An alternate method of ID plate attachment to the Drum Body in the form of riveting was proposed to and approved by NNSA Office of Packaging and Transportation (OPT), NA-531. The original 9978 serial number will be marked through on the Drum Lid and the new 9977 serial number (that matches the ID plate) will be applied next to it. New 9977 documentation and/or QA packages will be assembled combining the reclaimed 9978 Drum and Lid documentation, reclaimed 9975 SCV documentation, and the new fabricated component documentation.

CONCLUSION

This plan is to convert thirty of the new/unused 9978s at SRS into 9977s. The remaining thirteen 9978s will remain certified by DOE-EM with ten being transferred to the DOE-EM fleet management and the three owned by LLNL remaining under their control. Using reclaimed 9978 and 9975 components will help ease the cost of fabricating new 9977s and disposing of the old components. The new 9977s will be certified by the NNSA. The 9977 Packagings will not be fully assembled immediately. The LDFs, 6CVs, and Drum assemblies will be stored separately. When the need arises for a 9977, the LDFs and 6CV will be installed into the Drum assembly that has a matching serial number. The final step in preparing these new 9977s for packaging and transportation will be to perform annual maintenance.

REFERENCES

- [1] S-SARP-G-00001, Rev. 2. *Safety Analysis Report for Packaging Model 9977*. Savannah River Nuclear Solutions, Aiken, SC. August 2007.
- [2] S-SARP-G-00002, Rev. 1. *Safety Analysis Report for Packaging Model 9978*. Savannah River Nuclear Solutions, Aiken, SC. March 2009.
- [3] Memo from G. Abramczyk to M. Weber. *Plan for the Conversion of Model 9978 Packaging to Model 9977 Packagings*. SRNL-L4500-2018-00088. September 2018.