

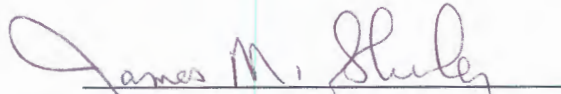
**Safety Evaluation Report for the  
Safety Analysis Report for Packaging Model 9979,  
Revision 2, October 2011**

Docket No. 11-45-9979

Prepared by:

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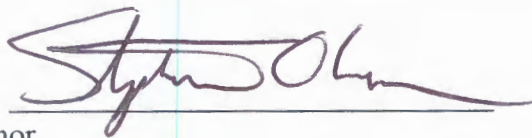
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Date:

11/22/11

## SUMMARY

The Model 9979 Type A Fissile shipping package is designed for transport of Type A quantities of fissile materials over public highways, for which Certificate of Compliance (CoC) USA/9979/AF-96 (DOE), Revision 0, was issued in May 2010. According to the 9979 Safety Analysis Report for Packaging (SARP)<sup>1</sup>, the 30-gallon confinement drum of the 9979 packaging is required to incorporate a pressure release component to vent between 18-20 psig to limit the internal pressure buildup during HAC. In August 2011, a Quality Assurance (QA) audit conducted by the Department of Energy (DOE) Packaging Certification Program (PCP) found that the procured pressure relieving plugs were shown to not be capable of providing the performance specified in the 9979 SARP<sup>1</sup>, and the vendor of the pressure relieving plugs could not certify to the 18-20 psig requirements on packagings with serial numbers 0100 through 0599. Consequently, the Revision 0 of the CoC was withdrawn, and packagings fabricated under Revision 0 are not authorized for use.

In response, the CoC holder, Savannah River National Laboratory (SRNL), made modifications to the 9979 packaging design to 1) reduce the venting pressure range of the plug to 12-15 psig and reseal at no less than 3 psig, and 2) eliminate the three ¼-in. diameter venting holes under the 55-gallon drum top curl. Revision 2 of the 9979 SARP<sup>2</sup> was issued in October 2011 to document the modifications of the 9979 packaging design.

Based on the statements and representations in Revision 2 of the 9979 SARP, and the DOE PCP staff's confirmatory evaluation as summarized in this Safety Evaluation Report (SER), the DOE PCP finds changes to the SARP changes acceptable to provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 and DOE Order 460.1C have been met.

The DOE PCP has also concluded the following conditions of approval need to be added to the CoC pursuant to the approval of this revision of the SARP:

- The 9979 packagings with serial numbers 0600 and higher are authorized for use.
- The 2.0 ml polystyrene waterproof tape shall be replaced on any 9979 packaging that is to be re-used.
- The shipper shall verify prior to shipment that the 2.0 ml polystyrene waterproof tape is in place over all venting and fill holes in the 55-gallon drum.
- The 9979 packagings with serial numbers from 0100- 0599 that are to be repaired shall conform to the following conditions:
  - The pressure relieving plug shall be replaced in accordance with Revision 2 of SARP.
  - The three ¼” holes in the 55-gallon drum below the drum curl shall be permanently plugged with stainless steel solid rivets, fasteners or weld repairs.
  - The repairs shall be approved by SRNL Design Agency, SRNL Design Authority and SRNL QA and included in the documentation package(s).
  - The shipper shall verify prior to shipment that the 2.0 ml polystyrene waterproof tape is in place over all venting and fill holes in the 55-gallon drum.



- The 9979 packagings with serial numbers from 0100-0599 that are to be used as-is shall conform to the following conditions:
  - These packages are limited to a one-time shipment with disposal at the end of the shipment and shall not be re-used.
  - The shipper shall accomplish all shipments and disposal before September 30, 2012.
  - The shipper shall verify prior to shipment that the 2.0 ml polystyrene waterproof tape is in place over all venting the three (3) ¼ inch venting holes below the top curl and fill holes in the 55-gallon drum.
  - These packages shall not be shipped on any route above 9,500 feet elevation.
- The Design Agency shall maintain a database of all packagings with serial numbers 0100-0599 (inclusive) including such information as to whether they have been repaired or will be used-as-is, status, and history of loading, transportation and disposal.

## 1. GENERAL INFORMATION AND DRAWINGS

A detailed packaging description, drawings and contents can be found in the 9979 SARP<sup>2</sup>. The 9979 package consists of a 30-gallon confinement drum nested inside an internally insulated 55-gallon over-pack drum. The 30-gallon confinement drum secures the package payload, thereby providing the capability (a) to prevent loss or dispersal of its radioactive contents when the package is exposed to the Normal Conditions of Transport (NCT), and (b) to ensure that the fissile material contents would remain subcritical when the package is exposed to both the NCT and the Hypothetical Accident Conditions (HAC), as required by 10 CFR 71.

Two weight limits are applicable to the 9979 package. The gross weight of a fully loaded 9979 package shall not exceed 415 lb. The package contents, including radioactive material, dunnage, packing, and thermal insulating bag, if used, is limited to 200 lb.

The 55-gallon over-pack drum, which is nominally 23 in. in diameter and 34½ in. in height, is fabricated of 16-gauge sheet carbon steel and is painted externally with a water-based paint. It includes an internal welded liner fabricated of 18-gauge carbon steel on the cylinder and of 16-gauge carbon steel on the bottom. The lid of the 55-gallon drum, fabricated of 16-gauge carbon steel, also has a 16-gauge carbon steel top liner. The lid for the 50-gallon overpack drum, which incorporates a blind plug in the bung hole, is secured to the drum body with a reinforced split-ring device and is sealed with an ethylene-propylene-diene monomer (EPDM) gasket.

The space between the drum wall and the liner, as well as the space between the lid and its top liner, are filled with polyurethane foam. The foam material serves as a thermal barrier for the 30-gallon confinement drum and its contents during exposure of the package to a severe fire environment, such as the HAC fire described in 10 CFR 71.73. The foam and steel liner also provide structural support by positioning the 30-gallon confinement drum, both radially and axially, within the 55-gallon overpack liner. The 55-gallon overpack drum is also fitted with vent plugs that are sealed against NCT environments; however, it will allow venting of gases produced by the foam in the event of exposure to a severe fire environment. There is no venting hole to vent the pressure in between the annulus of the 55-gallon and 30-gallon drums.

The 30-gallon confinement drum, which has a nominal 18.6 in. diameter and a 29 in. height, is also fabricated with 16-gauge sheet carbon steel and is painted externally with a water-based paint. The lid for the 30-gallon confinement drum, which incorporates a pressure-relieving plug

in the bung hole, is secured to the drum body with a reinforced split-ring device and is sealed with a silicone gasket. The pressure relieving plug is designed to open between 12-15 psig to limit buildup of internal pressure during HAC, which will reseal at a pressure no less than 3 psig. The 30-gallon drum is positioned, both radially and axially, within the 55-gallon drum by the close fit of the liner. An insulating cover is placed over the lid of the 30-gallon confinement drum before closure of the 55-gallon overpack drum.

The drawings that pertain to the 9979 packaging are listed in Table 1.1 of this Technical Review Report.

**Table 1.1. List of Drawings Pertaining to the 9979 Packaging**

<b>Drawing No.</b>	<b>Revision</b>	<b>Title</b>
R-R5-G-00006	1	9979 Type AF Package Tree
R-R1-G-00026	1	9979 Type AF 30-Gallon Container Split-Ring Assembly (U)
R-R1-G-00027	1	9979 Type AF 55-Gallon Drum Lid Split-Ring Assembly (U)
R-R1-G-00028	3	9979 Type AF 30-Gallon Drum Assembly (U)
R-R1-G-00029	2	9979 Type AF 55-Gallon Drum Assembly (U)
R-R1-G-00030	2	9979 Type AF Packaging Assembly (U)
R-R2-G-00057	3	9979 Type AF 55-Gallon Drum Sub-Assembly and Weldment (U)
R-R2-G-00058	1	9979 Type AF 30-Gallon Drum (U)
R-R2-G-00059	3	9979 Type AF 55-Gallon Drum Lid Sub-Assembly and Weldment (U)
R-R2-G-00060	1	9979 Type AF 30-Gallon Drum Lid with Dual Bung Closures (U)
R-R4-G-00062	1	9979 Type AF 30-Gallon Drum Lid Gasket (U)
R-R4-G-00064	1	9979 Type AF Insulation Bag
R-R4-G-00065	1	9979 Type AF Insulation Cover Assembly for 30-Gallon Drum (U)

On the basis of the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluations, the PCP finds the general information (and drawings) presented in Chapter 1 of the SARP acceptable. Evaluations of the design and performance of the package for safety and regulatory compliance in structural, thermal, containment, shielding, criticality safety, operating procedures, acceptance tests and maintenance, and QA are given in the remaining sections of this SER.



## 2. STRUCTURAL

The DOE PCP staff reviewed the changes in Chapter 2 of the SARP Revision 2 to evaluate the structural design and performance of the packaging following the modifications. The review and evaluation were focused on the effects of the design modifications on the structural performance, and the package performance at reduced external pressure under NCT and at excessive internal pressures under HAC.

The change of the rating of the pressure relieving plug in the 30-gallon drum lid, and the elimination of the ¼-in. diameter venting holes of the 55-gallon drum, have negligible effects on package weight, material compatibility and structural performance of the package when subjected to HAC drop tests. The pressure relieving plug is rated to vent between 12-15 psig, and reseal at a pressure differential no less than 3 psig. Since the 9979 package is designed only for domestic ground transport and not air transport of fissile materials, the minimum external pressure enroute the highest elevation within United States (Loveland Pass, 11,990 feet) is 9.35 psia. Based on a conservative assumption that the pressure in the annulus between the 55- and 30-gallon drums is equal to the minimum external pressure, the maximum differential pressure acting on the pressure relieving plug under NCT is 11.81 psig (MNOP 21.16 psia – 9.35 psia). Therefore, the pressure relieving plug will not open in the worst-case scenario under NCT. This is conservative because the ¼-in. diameter venting holes under its top curl of the 55 gallon drum have been eliminated and the 55-gallon drum overpack does not leak under NCT, leading to a higher-than-ambient pressure of ~17 psia (assuming no moisture) within the annulus. Therefore, the differential pressure acting on the plug will be less than 11.81 psig, which further assures that the pressure relieving plug will not open under NCT. The ¼ -in. diameter venting holes were originally designed to vent the annulus during HAC thermal events. However, thermal analysis in the SARP shows a temperature of 1434°F after about 5 minutes of HAC fire for the gasket of the 55-gallon drum, which is much higher than its decomposition temperature of approximately 500 °F.\* Therefore the gasket will degrade and prevent the 55-gallon drum from sustaining any significant internal pressure exceeding the design limit of 36 psig. The maximum pressure in the annulus during HAC fire is 30.77 psig (40.12 psia – 9.35 psia), lower than the design limit of 36 psig. Eliminating the venting holes will not affect the structural performance of the 55-gallon drum during HAC.

On the basis of the statements and representations in Chapter 2 of the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds the structural design and performance of the 9979 packaging presented in Chapter 2 of the SARP acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

## 3. THERMAL

The DOE PCP staff reviewed the changes in Chapter 3 of the Revision 2 SARP to evaluate the effects of the change of pressure rating of the pressure relieving plug of the 30-gallon drum from 18~20 psig to 12-15 psig. The MNOP of the 30-gallon drum is 21.16 psia under NCT, with the minimum reduced external pressure of 9.35 psia (for ground transportation below the elevation of 11,990 ft), the pressure difference is 11.81 psig. This value is less than the venting pressure of 12 psig of the pressure relieving plug. As such, the vent plug does not vent under NCT.

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\* GCP Industrial Products. *Material Safety Data Sheet EPDM Rubber Sheet*, Version 2, May 2, 2007.

However, since the margin between the pressure difference and the relieving pressure is small, the venting plug may be opened under certain conditions (e.g., moisture content >1%, temperatures >100°F.). Therefore, precautions should be taken to avoid any possible contamination of the 55-gallon overpack when the overpack will be reused, and the 30-gallon drum is moved out from the 55-gallon overpack. In the Revision 2 SARP, the required procedure has been included in Section 7.2.2, *Removal of Contents*, Item 4, "Survey the bottom surface of the overpack closure lid for contamination".

Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds the thermal design and performance of the 9979 packaging presented in Chapter 3 of the SARP acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

#### **4. CONTAINMENT**

The DOE PCP staff reviewed Chapter 4 of the Revision 2 SARP. The effects of the proposed changes on confinement capability of the 30 gallon drum of the 9979 packaging were analyzed. One change was made to Chapter 4 in SARP Revision 2 (Section 4.1, p 4-1). It consisted of the statements that "the closure lid of the 30 gallon drum includes ¾-inch and 2-inch 'bung-hole' flanges. The ¾-inch flange is closed with a steel (non-venting) plug and the 2-inch flange is closed with a pressure-relieving plug that limits drum pressures between 12-15 psia".

Based on the statements and representations in Chapter 4 of the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP concludes that the revisions presented in Chapter 4 of the SARP are acceptable and provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

#### **5. SHIELDING**

The DOE PCP staff reviewed Chapter 5 of the Revision 2 SARP. Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds that there are no shielding-related issues relative to this revision. The modifications of the design of the 9979 packaging and the changes to the 9979 SARP do not change or affect the content, the content configuration, or the shielding function of the package. Therefore, the evaluation of the shielding performance of the 9979 package remains valid.

#### **6. CRITICALITY**

The DOE PCP staff reviewed Chapter 6 of the Revision 2 SARP. Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds that there are no criticality safety-related issues relative to this revision. The modifications of the design of the 9979 packaging and the changes to the 9979 SARP do not change or affect the content, the content configuration, and the criticality control function of a single package or package arrays. Therefore, the evaluation of the criticality safety performance of the 9979 package remains valid.



## **7. PACKAGE OPERATIONS**

The DOE PCP staff reviewed Chapter 7 of the Revision 2 SARP. Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds the operating procedure revisions presented in Chapter 7 of the SARP acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

## **8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM**

The DOE PCP staff reviewed Chapter 8 of the Revision 2 SARP. Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the PCP finds the acceptance test and maintenance program presented in Chapter 8 of the SARP acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

## **9. QUALITY ASSURANCE**

The DOE PCP staff reviewed Chapter 9 of the Revision 2 SARP. Based on the statements and representations in the Revision 2 SARP and the DOE PCP staff's confirmatory evaluation, the DOE PCP finds the quality assurance presented in Chapter 9 of the SARP acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

## **REFERENCES**

1. Savannah River National Laboratory, *Safety Analysis Report for Packaging Model 9979 Type AF-96*, S-SARP-G-00006, Revision 1, May 2010.
2. Savannah River National Laboratory, *Safety Analysis Report for Packaging Model 9979 Type AF-96*, S-SARP-G-00006, Revision 2, XX 2011