

**Safety Evaluation Report for the
Amendment Request for the 9975-85 Packaging Using
Either Pressure Drop or Pressure Rise Method for
Pre-Shipment Leakage Rate Test**

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SUMMARY

By memorandum COR-OM-11/15/2010-301010, dated November 17, 2010, the National Nuclear Security Administration, Livermore Site Office, submitted a deviation request¹ from the requirements of Chapter 8 of the 9975-85 Safety Analysis Report for Packaging (SARP). The deviation request was to allow the use of either the pressure drop method or the pressure rise method for the pre-shipment leakage rate test, on both the O-ring seal and the Leak Test Port Plug of the 9975-85 package design. The subject memorandum included an attached justification for the deviation request.

For evaluating containment integrity prior to shipment, the 9975-85 package design is currently certified to use the pressure drop method for evaluating the seal integrity of both the outer O-ring containment seal and the leak test port plug prior to shipment. The pressure drop test method, as well as the proposed pressure rise test method are both established by ANSI N14.5-1997,² which also specifies the method of performing each test and a range for the nominal sensitivity for each of the tests.

Based on the statements and representations in the letter amendment request,¹ the Rev. 0 SARP dated December 2003,³ and the Department of Energy (DOE) Packaging Certification Program (PCP) staff's confirmatory evaluation as summarized in this Safety Evaluation Report (SER), the DOE PCP finds the request for deviation acceptable to allow the use of either the pressure drop method or the pressure rise method for the pre-shipment leakage rate test for both the O-ring seal and the Leak Test Port Plug. The deviation request is consistent with the provisions stipulated in ANSI N14.5-1997,² and satisfies the requirements of DOE Order 460.1C and the conditions set forth in the current Certificate of Compliance (CoC).⁴ DOE PCP has concluded that an additional condition of approval will be added to Rev. 26 of CoC USA/9975/B(M)F-85(DOE) pursuant to the approval of this deviation request as follows:

"(10) Verification of the pre-shipment containment integrity of the containment system, on both the O-ring seal and the Leak Test Port Plug, shall be accomplished using either the pressure rise method or the pressure drop method of testing as specified in ANSI N14.5-1997."

This SER addresses the request for deviation from the requirements of the SARP¹ to allow the use of either the pressure drop or the pressure rise method² for pre-shipment leakage rate test. Previous certification review of this packaging that serves as the basis for the CoC (USA/9975/B(M)F-85 (DOE), Revision 25)⁴ of the 9975-85 packaging are deemed adequate for all aspects of the packaging design, except the evaluation of the two alternative methods for pre-shipment leakage rate tests. Therefore, this SER addresses only the pre-shipment leakage rate testing alternatives.

1. GENERAL INFORMATION AND DRAWINGS

Detailed packaging descriptions, drawings and contents can be found in the SARP.³ The components of the packaging include a drum outer container, insulation, bearing plates, a containment system consisting of a primary containment vessel (PCV) and a secondary containment vessel (SCV), lead shielding, and aluminum honeycomb spacers and impact limiting material.

The PCV, which fits inside the SCV, consists of a Type 304L stainless steel pressure vessel, and has a standard Schedule 40, Type 304L stainless steel pipe cap at the blind end. A Type 304L stainless steel stayed head is welded to the pipe top end. The head is machined to include a 5-1/2-12UN-2B internal thread and a female cone-seal surface.

The PCV closure assembly consists of a male-female cone joint with surfaces that have been machined to identical angles so that they mate with essentially zero clearance. Two grooves for fluoroelastomer O-rings are machined into the face of the Type 304L stainless steel male cone seal plug. A leak test port is provided between the two O-ring grooves, and is closed by the leak-test port plug and tested after closing. The containment boundary for the vessel is formed by the containment vessel body, the cone-seal plug, the outer O-ring, and the leak-test port plug.

The SCV consists of a Type 304L stainless steel pressure vessel, and has a standard Type 304L stainless steel pipe cap at the blind end. A Type 304L stainless steel stayed head is welded to the pipe top end. The SCV closure is virtually identical to that used on the PCV, except that SCV has a diameter of 6 in. versus a diameter of 5 in. for the PCV.

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no general-information/drawing-related issues that need to be addressed relative to this request.

2. STRUCTURAL

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no structural-related issues that need to be addressed relative to this request.

3. THERMAL

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no thermal-related issues that need to be addressed relative to this request.

4. CONTAINMENT

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no containment-related issues, other than the pre-shipment leakage rate testing alternatives for containment verification (addressed in Section 8 of this SER), that need to be addressed relative to this request.

5. SHIELDING

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no shielding-related issues that need to be addressed relative to this request.

6. CRITICALITY

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no criticality-related issues that need to be addressed relative to this request.

7. OPERATIONS

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no operationally-related issues that need to be addressed relative to this request.

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Section 8.2.2.1 of the SARP³ specifies the post load (i.e., pre-shipment) leakage rate testing to be performed to verify containment integrity. Specifically:

Section 8.2.2.1 of the SARP³ specifies the post load (i.e. pre-shipment) leakage rate testing that is to be performed to verify containment integrity. Specifically:

- For the O-ring seal, Section 8.2.2.1.1 of the SARP states that *"A leak-rate test of the outer O-ring seal is required after the containment vessel is loaded to verify that the cone-seal assembly has been properly installed. The leakage test shall be capable of indicating leakage to less than 1×10^{-3} ref·cm³/sec, with a sensitivity of 5×10^{-4} ref·cm³/sec, using the pressure drop leak test method (A.5.1) in accordance with Section 7.6 of ANSI N14.5."*
- For the leak-test port plug, Section 8.2.2.1.1 of the SARP states that that *"A leak-rate test of the leak-test port plug is required after the O-ring seal has been tested to verify that the port plug has been properly installed. The leakage test shall be capable of indicating leakage to less than 1×10^{-3} ref·cm³/sec, with a sensitivity of 5×10^{-4} ref·cm³/sec, using the pressure drop leak test method (A.5.1) in accordance with Section 7.6 of ANSI N14.5."*

With respect to these two leakage rate test methods:

- The ANSI 14.5 pressure drop test method (identified in the standard as A.5.1) has a nominal test sensitivity range of $10^{-1} - 10^{-5}$ ref·cm³/s ($10^{-2} - 10^{-6}$ Pa·m³/s); and
- The ANSI 14.5 pressure rise test method (identified in the standard as A.5.2) has the same nominal test sensitivity range of $10^{-1} - 10^{-5}$ ref·cm³/s ($10^{-2} - 10^{-6}$ Pa·m³/s).

Thus, these two test methods provide a nominal sensitivity range that fully brackets the required sensitivity for the pre-shipment leakage rate testing of 1×10^{-3} ref·cm³/sec, as specified in Section 8.2.2.1 of the SARP.³

As mentioned in the justification for the letter amendment request, the 9977 and 9978 SARPs prescribe the pressure rise test as the approved test method, whereas the 9975-85 uses the

pressure drop method. For the 9975-96, either method is acceptable for the leak test port plug. Except for marking differences, the PCV and SCV in 9975 are identical to the PCV in 9978 and 9977, respectively, and the PCV and SCV in 9975-85 and 9975-96 are identical to each other. The table below shows the pre-shipment leakage rate test methods that are currently approved in the CoCs for the 9975-85, 9975-96, 9977 and 9978 packaging designs.

	Current SARP Chapter 8 Test Method	
	O-ring Seal	Leak Test Port Plug
9975-85	Pressure drop	Pressure drop
9975-96	Pressure drop	Pressure drop or rise
9977	Pressure rise	Pressure rise
9978	Pressure rise	Pressure rise

Based on the review of the information presented in the request for deviation,¹ the SARP,³ and the ANSI 14.5-1997 Standard,² the staff finds that either the pressure drop method or the pressure rise method is acceptable for use in pre-shipment leakage rate testing of the 9975-85 packaging design.

DOE PCP has concluded that an additional condition of approval needs to be added to the Rev. 26 of the DOE CoC USA/9975/B(M)F-85(DOE) pursuant to the approval of this deviation request as follows:

“(10) Verification of the pre-shipment containment integrity of the containment system, on both the O-ring seal and the Leak Test Port Plug, shall be accomplished using either the pressure rise method or the pressure drop method of testing as specified in ANSI N14.5-1997.”

9. QUALITY ASSURANCE

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no quality assurance-related issues that need to be addressed relative to this request.

References

1. Letter Amendment Request for the 9975-85, 9975-96, 9977, and 9978, COR-OM-11/15/2010-301010, submitted to Dr. Jim Shuler, Environmental Management, by the National Nuclear Security Administration (NNSA) , Livermore Site Office (November 17, 2010).
2. Leakage Tests on Packages for Shipment, American National Standard for Radioactive Materials, American National Standards Institute, ANSI N14.5-1997 (1997).
3. Safety Analysis Report for Packaging Model 9975 B(M)F-85, WSRC-SA-2002-00008, Revision 0, December 2003.
4. U.S. Department of Energy Certificate of Compliance, USA/9975/B(M)F-85 (DOE), Revision 25, Certificate Number 9975, issued April 7, 2011, expiration date of March 31, 2012.