CONTAINMENT SAFETY EVALUATION REPORT

Docket No. 71-9337
Model No. 3979A
Certificate of Compliance No. 9337
Revision No. 0

B-26

4. CONTAINMENT

4.1. Description of the Containment System

The containment boundary of the Safkeg-LS 3979A package is formed from the containment vessel (CV) flange/cavity wall, lid top and containment seal O-ring, as shown in Figure 4-1.

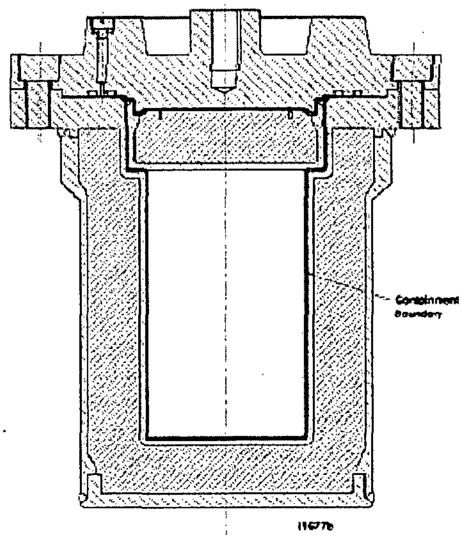

Figure 4-1 of CTR 2008/10, Rev. 2

The lid top is sealed to the flange/cavity wall by the containment seal O-ring which is fitted in a face seal configuration with the O-ring recessed into the flange. The lid top is held in position with 8 alloy steel closure screws which screw into the containment vessel flange/cavity wall and lid and are tightened to a torque of 10 ± 0.5 Nm. On tightening the closure screws a uniform and repeatable compression of the O-rings is provided.

The closure screws are recessed into the lid top to physically protect them from damage. There is also a shear lip in the lid top and flange protecting the screws from shear failure due to transverse impact loads. The closure screws are positive fasteners, that cannot be opened unintentionally, or by any pressure that may arise within the package.

There are no valves or pressure relief devices present in the containment boundary and the package does not rely on any filter or mechanical cooling system to meet the containment requirements. There is a weld present in the containment boundary as shown on Detail A of Drawing No. 1C-6044, Issue C and Detail B of Drawing No. 1C-6045, Issue C. However, the weld is needed to hold the lead shielding in position, and does not fulfill any containment requirement.

The containment system is designed and fabricated in accordance with ASME B&PV Code Section III, Subsection NB. The complete specifications such as closure screw torques, materials of construction, O-ring specifications and design dimensions for the containment system are given in drawings 1C-044, Issue C, 1C-6045, Issue C, and 1C-6046, Issue C, in Section 1.3.2 of CTR 2008/10, Rev. 2.

The flange/cavity wall and lid top are machined from solid stainless steel 304L. The containment O-ring is manufactured from Ethylene Propylene (EPM). All the materials have been selected for compatibility with each other, the inserts, and the payload, in order to avoid chemical, galvanic, or other reactions, as indicated in section 2.2.2.

EPM was been selected as the containment O-ring material as EPM offers a temperature range of -40°C to 150°C and is able to withstand short excursions to 200°C for 2 hours.

Figure 4-2, of CTR 2008/10, Rev. 2 shows the two additional O-ring seals fitted to the CV: a test point seal, and a test seal. These seals are present to facilitate the leak test of the containment seal during the pre-shipment leak test. The test point is a tapped hole that allows connection of a pressure drop leak tester to the interspace volume between the test seal and the containment seal. The test seal is located close to the containment seal to provide a small interspace volume thus increasing the sensitivity of the pressure rise leakage test. The inserts as specified in section 1.2.2.2 are also fitted with an O-ring seal. The test point seal, the test seal, and the insert seal are not relied upon for containment.

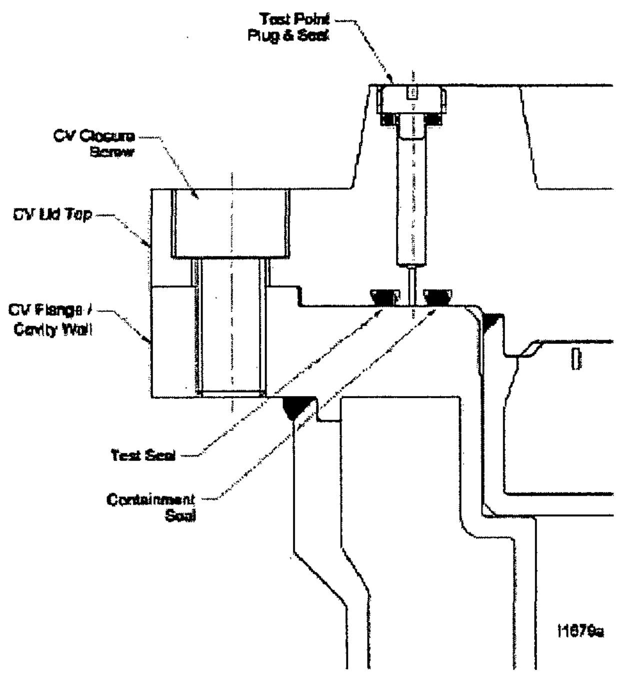

Figure 4-2 of CTR 2008/10, Rev. 2
(This section was written using Section 4 and Section 4.1 of CTR 2008/10, Rev. 2)

4.2. Containment under Normal Conditions of Transport (Type B Packages)

The maximum internal pressure of the containment vessel under NCT is taken as the design pressure of 7 bar gauge.

Section 4.2 of CTR 2008/10, Rev. 2, the applicant states, "The Safkeg-LS 3979A package has been designed specifically to meet the criteria for leaktight during NCT and to be testable to demonstrate that the CV containment boundary is leaktight for the design, testing, fabrication, and maintenance leak tests. Leaktight is defined as demonstration of a leakage rate of $\leq 10^{-7}$

ref.cm^3/s as specified in ANSI N14.5." Under NCT the shielding inserts provide confinement of the radioactive material, but the containment is ensured by the CV seal in the CV.

In section 4.2.5 of CTR 2009/21, Issue C, the applicant states that, "A helium leak test was carried out prior to assembly of the keg on the containment vessel in accordance with ANSI N14.5-1997 as detailed in CP 390. The pass rate set for the test was 2 x 10^{-7} cm^3/s with a sensitivity of 5 x 10^{-8} cm^3/s helium at an upstream pressure of 1 atmosphere absolute and a downstream pressure of 0.01 atm or less."

In section 5.16 of CTR 2009/21, Issue C, the applicant states that, "The helium leak test carried out prior to the NCT and HAC tests is detailed in Reference 15 [TR 09/03/17]. The tested leak rate was 0.05 x 10^{-10} cm^3/sec which meets the acceptance criteria of 2 x10^{-7} cm^3/sec.

The helium leak test carried out after the NCT and HAC tests is detailed in TR 09/03/30 (Ref. 28 of CTR 2009/21, Issue C). The tested leak rate was 1.92 x 10^{-10} cm^3/sec which meets the acceptance criteria of 2 x10^{-7} cm^3/sec.

The results of the leak tests demonstrate that the containment vessel remained leak tight before and after the NCT and HAC tests. This indicates that the tests did not affect the containment vessel and its sealing system."

The staff verified that the helium leak test was performed on the <u>entire containment boundary</u> (CTR 2010/08, Issue A), that the package is leaktight, and the containment boundary is not affected by the NCT tests.

4.3. Containment under Hypothetical Accident Conditions (Type B Packages)

The maximum internal pressure of the containment vessel under HAC is taken as the design pressure of 10 bar gauge.

Section 4.3 of CTR 2008/10, Rev. 2, the applicant states, "The Safkeg-LS 3979A package has been designed specifically to meet the criteria for leaktight during HAC and to be testable to demonstrate that the CV containment boundary is leaktight for the design, testing, fabrication, and maintenance leak tests. Leaktight is defined as demonstration of a leakage rate of ≤ 10^{-7} ref.cm^3/s as specified in ANSI N14.5."

In section 4.2.5 of CTR 2009/21, Issue C, the applicant states that, "A helium leak test was carried out prior to assembly of the keg on the containment vessel in accordance with ANSI N14.5-1997 as detailed in CP 390. The pass rate set for the test was 2 x 10^{-7} cm^3/s with a sensitivity of 5 x 10^{-8} cm^3/s helium at an upstream pressure of 1 atmosphere absolute and a downstream pressure of 0.01 atm or less."

In section 5.16 of CTR 2009/21, Issue C, the applicant states that, "The helium leak test carried out prior to the NCT and HAC tests is detailed in Reference 15 [TR 09/03/17]. The tested leak rate was 0.05 x 10^{-10} cm^3/sec which meets the acceptance criteria of 2 x10^{-7} cm^3/sec.

The helium leak test carried out after the NCT and HAC tests is detailed in TR 09/03/30 (Ref. 28 of CTR 2009/21, Issue C. The tested leak rate was 1.92 x 10^{-10} cm^3/sec which meets the acceptance criteria of 2 x10^{-7} cm^3/sec.

The results of the leak tests demonstrate that the containment vessel remained leak tight before and after the NCT and HAC tests. This indicates that the tests did not affect the containment vessel and its sealing system."

In addition to the pre/post NCT and HAC helium leakage tests, the applicant evaluated there would be not escape of krypton-85 exceeding 10 A_2 in 1 week (10CFR71.51). This evaluation was done in CS 2009/06, Issue A and CS 2009/07, Issue A.

The staff verified that the helium leak test was performed on the entire containment boundary (CTR 2010/08, Issue A), that the package is leaktight, and the containment boundary is not affected by the HAC tests.

4.4. Special Requirements for the Shipments of Plutonium by Air

The applicant has **not** evaluated the Safkeg-LS 3979A to 10 CFR 71.64, 71.74, and 71.88 for plutonium air shipments. The contents listed in Table 1-4-7 and 1-4-8 do include plutonium.

Therefore, the applicant is restricted from shipping plutonium by air.

4.5. Leakage Rate Tests for Type B Packages

Section 7.1.3 of CTR 2008/10, Rev. 2 discusses the **pre-shipment** leak test on the containment boundary. This test will be performed in accordance with ANSI N14.5 by using the gas pressure rise or gas pressure drop methods. According to section 7.1.3 of CTR 2008/10, Rev. 2, and the sensitivity of the test will be done at 10^{-3} ref.cm^3/s, which is in accordance with ANSI 14.5 guidelines.

Section 8.2.2 of CTR 2008/10, Rev. 2 discusses the **periodic** and **post maintenance** leak tests. This test will be performed in accordance with ANSI N14.5 by using the evacuated envelope (gas detector) method. According to section 8.2.2, the test sensitivity will be 5 X 10^{-8} which will detect the 1 X 10^{-7} ref. cm^3/s leak rate, per ANSI 14.5. This leakage test will be done after replacement of the containment seal, repair of the containment sealing surface, and/or repair or replacement of the containment vessel lid or body as well as within 12 months prior to package use. Staff verified that the periodic and post maintenance helium leak test are performed on the entire containment boundary (CTR 2010/08, Issue A).

Staff notes that Section 8.2.3.3 of CTR 2008/10, Rev. 2 states, "O-rings shall be procured in accordance with drawing 1C-6044." Therefore, no repairs may be made to damaged containment vessel seals for return to service.

Section 8.1.4 of CTR 2008/10, Rev. 2 discusses the **fabrication** leak test. This test will be performed in accordance with ANSI N14.5 by using the evacuated envelop method. According to section 8.1.4, the test sensitivity will be 5 X 10^{-8} which will detect the 1 X 10^{-7} ref. cm^3/s leak rate, per ANSI 14.5. This section of the SAR also states that the Inserts (not part of the containment boundary) will be leak tested. Staff verified that the fabrication helium leak test is performed on the entire containment boundary (CTR 2010/08, Issue A).

4.6. Evaluation Findings

Based on review of the statements and representations in the application, the staff concludes that the containment design has been adequately described and evaluated and that the package design meets the containment requirements of 10 CFR Part 71.