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8 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

This section details the requirements of the acceptance and maintenance test program for the Safkeg-HS 3977A package. The requirements of the sections below ensure compliance with Subpart G of 10 CFR Part 71 [8.1].

It is the responsibility of the authorized maintenance organization to produce approved procedures which comply with the requirements of this SARP and 10 CFR 71 Subpart G with regard to all aspects of maintenance. The maintenance organization shall also have a Quality Assurance Program that meets the requirements of 10 CFR 71 Subpart H and shall maintain records that meet the requirements of 10 CFR 71.91.

The authorized maintenance organization is required to notify the SARP owner of any instance in which the packaging fails to meet the criteria of Section 8.2 during maintenance activities.

All the drawings referred to in this section shall be at the revision status as specified in the Certificate of Compliance.

8.1 Acceptance Tests [71.85]

This section describes the requirements for the acceptance tests to be performed prior to the initial use of the packaging. The tests shall be performed in accordance with written procedures produced by the manufacturing organization and in compliance with the requirements and descriptions in this section.

Initial inspection and acceptance tests are carried out during the fabrication of the packaging components by the manufacturer. These tests include dimensional, visual, liquid penetrant and radiographic inspections, structural pressure tests, and leakage tests. The tests and acceptance criteria are specified in the general arrangement drawings in the Certificate of Compliance.

8.1.1 Visual Inspections and Measurements

All components including the inserts shall be subject to visual checks to ensure that they have been fabricated and assembled in accordance with the general arrangement drawings in the Certificate of Compliance. The dimensions, tolerances and surface finishes shown on the drawings shall be verified by measurement of each packaging component.

Non-conforming components shall be rejected using the approved manufacturer's organization's non-conformance system. Disposition of rejected components should be reworked, used as is, or scrapped and replaced. The SARP owner should be notified of all disposition actions.

8.1.2 Weld Examinations

All keg welds shall be examined according to drawings 0C-5942, 0C-7502 and 0C-7942. The containment vessel welds shall be examined in accordance with the licensing drawings 1C-5945, 1C-5946 and 1C-7944 for the standard CV lid, drawings 1C-7506 and 1C-7507 for the split CV lid for insert Design No. 4081 and drawings 1C-7946 and 1C-7947 for the split CV lid for insert Design No. 4109. Non-conforming components shall be rejected using the approved manufacturer's organization's non-conformance system. Disposition of rejected components should be reworked, used as is, or scrapped and replaced. The SARP owner should be notified of all disposition actions.

8.1.3 Structural and Pressure Tests [71.85 (b)]

A Pressure test of the containment vessel shall be performed in accordance with the ASME B&PV Code, Subsection NB-6000 [8.2]. These tests shall be conducted at 12.5 bar gauge (181 psig) which is 1.25 times the maximum design pressure of 10 bar gauge (145 psig). The pressure shall be held for a minimum of 10 minutes. The pass criteria for the test shall be no gross leakage (i.e. no visible leakage detected without use of instruments) and no permanent deformation of the lid of the containment vessel under test. This test pressure exceeds the requirements of 10 CFR 71.85(b) [8.1] which requires a test pressure of 1.5 x MNOP (7 barg) which is 10.5 bar gauge (152 psig).

Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.

8.1.4 Leakage Tests

Leakage testing of the containment boundary defined in Section 4 shall be carried out in accordance with ANSI N14.5 [8.3]. The containment vessel flange/cavity wall shall be leak tested after fabrication using the gas filled envelope test A.5.3 in ANSI N14.5 [8.3] as described in section 8.1.5.3. The containment vessel lid top shall be helium leak tested prior to and after machining for the standard CV lid and after machining for the split CV lid versions, using the gas filled envelope test A.5.3 in ANSI N14.5 as described in section 8.1.5.2. Leak rate testing of the containment vessel closure shall be performed using the evacuated envelope gas detector method A.5.4 with helium as the tracer gas and a helium leak detector. The test sensitivity shall be 5×10^{-8} ref.cm³/s and the acceptance rate shall be 1×10^{-7} ref.cm³/s. The helium leak test procedures shall be written and approved by a level III examiner [8.4]

Leakage testing of the inserts shall be carried out in accordance with ANSI N14.5 [8.3]. Leak rate testing shall be performed using the vacuum bubble method. The test sensitivity shall be 10^{-3} ref.cm³/s and the acceptance rate shall be no visible stream of bubbles.

For the CV having a sealed split lid, the body/plug sealing system shall be leak tested in accordance with the criteria specified in ANSI N14.5 [8.3], using a gas pressure rise or gas pressure drop method with a sensitivity of 10^{-3} ref.cm³/s and a pass rate of 5×10^{-4} ref.cm³.s⁻¹.

Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings specified in the Certificate of Compliance.

8.1.5 Component and Material Tests

8.1.5.1 Package weight

The package shall be weighed on a set of calibrated scales with a resolution of 10g. The weight of the package shall not exceed 163 kg (359.4 lbs). Any non-conforming packages shall be reworked or rejected.

8.1.5.2 Containment Vessel Lid Top

The standard containment vessel lid top shall be helium leak tested prior to machining in accordance with the gas filled envelope test A.5.3 in ANSI N14.5 [8.3], to ensure it is leak tight prior to further manufacture. The helium leak test procedure shall be written and approved by a level III examiner [8.4].

The leak test sensitivity shall be a minimum of 5×10^{-8} ref.cm³/s air and the acceptance leak rate shall be 1×10^{-7} ref-cm³/s. Any non-conforming components not meeting this criterion shall be reworked or rejected.

On completion of the machining operation, the containment vessel lid top for both the standard and split lid versions shall be helium leak tested in accordance with the gas filled envelope test A.5.3 in ANSI N14.5 [8.3], to ensure it is leak tight prior to further manufacture. The helium leak test procedure shall be written and approved by a level III examiner [8.4]

The leak test sensitivity shall be a minimum of 5×10^{-8} ref.cm³/s air and the acceptance leak rate shall be 1×10^{-7} ref-cm³/s. Any non-conforming components not meeting this criterion shall be reworked or rejected.

8.1.5.3 Containment Vessel Flange/Cavity Wall

The containment vessel flange/cavity wall shall be helium leak tested in accordance with the gas filled envelope test A.5.3 in ANSI N14.5 [8.3], to ensure it is leak tight prior to

further manufacture. The helium leak test procedure shall be written and approved by a level III examiner [8.4]

The leak test sensitivity shall be a minimum of 5×10^{-8} ref.cm³/s air and the acceptance leak rate shall be 1×10^{-7} ref-cm³/s. Any non-conforming components not meeting this criterion shall be reworked or rejected.

8.1.5.4 Cork

Each batch of the inner, outer and top cork shall have its specific weight measured according to drawings 0C-5943 and 0C-7503 and meet the criterion of 250 to 290 kg/m³. Any cork not meeting this criterion shall be rejected.

8.1.5.5 DU Shielding

The chemical composition and fracture toughness of each batch of depleted uranium shall be analyzed to assure that the alloy meets the specifications. The chemical composition and fracture toughness shall meet the requirements given in drawings 1C-5945 and 1C-5946 for the standard CV lid, drawings 1C-7506 and 1C-7507 for the split CV lid and drawings 1C-7946 and 1C-7947 for the sealed split CV lid. The density of the depleted uranium contents shall be determined using measurement of the weight and volume. The density shall meet the requirements given in drawings 1C-5945 and 1C-5946 for the standard CV lid, drawings 1C-7506 and 1C-7507 for the split CV lid and drawings 1C-7946 and 1C-7947 for the sealed split CV lid. The finished DU components shall be visually inspected to verify that the surfaces are free of cracks and voids. Any items not meeting the acceptance criterion will be rejected.

8.1.5.6 Stock Material Used to Manufacture the Containment Boundary

The stock material, Stainless Steel 304L, used to manufacture items that make up the containment boundary as defined in Section 4.1, shall be examined with liquid penetrant and ultrasonic tests according to drawings 1C-5945 and 1C-5946 for the standard CV lid, drawings 1C-7506 and 1C-7507 for the split CV lid and drawings 1C-7946 and 1C-7947 for the sealed split CV lid.

8.1.5.7 Silicone Sponge Rubber Disc

Each batch of the silicone rubber shall have its density measured according to drawing 2C-6920 and meet the criterion of 16±6 lbs per cubic foot. Any silicone rubber not meeting this criterion shall be rejected.

8.1.6 Shielding Tests

Shielding is provided by the inserts and Depleted Uranium (DU) in the containment vessel body and lid. A tungsten liner is also used in conjunction with insert 4081 to provide additional shielding. Dimensional checks shall be carried out on the inserts and tungsten liner

in accordance with Section 8.1.1. This is considered an adequate shielding check due to the simple design of the inserts and the tungsten liner.

For the containment vessel either ultrasonic testing of the DU at the component stage or a gamma scan of the containment vessel shall be carried out.

The gamma scan shall be performed over the surface of the containment vessel lid and body on completion of manufacture. The measured dose rates are compared to the dose rates calculated for the surface of the containment vessel lid and body with the minimum dimensions and the minimum density of the DU and stainless steel, as well as the chemical composition, all as specified in the Certificate of Compliance drawings. The calculations and the measurements (the scan) shall use the same source, the same source quantity, and the same geometry and configuration (of the source, shielding and detector). The DU lid and body shielding are acceptable if the measured dose rates do not exceed the calculated dose rates.

8.1.7 Thermal Tests

A prototype package has been fully tested as described in Section 2 and shown to perform satisfactorily under both Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC).

The package design is such that specific tests of manufactured components are not required to prove adequate thermal performance. This package has no special thermal features other than the cork insulation. With the low heat load and the design margins on allowable material temperature, the package requires no special thermal testing as part of the post-manufacture acceptance test.

8.1.8 Miscellaneous Tests

Not applicable.

8.2 Maintenance Program

The maintenance program for the SAFKEG 3977A packaging applies to periodic maintenance, and to packagings that have failed the pre-shipment inspection specified in Section 7.1.1. It ensures the continued performance of the package throughout its lifetime.

The maintenance program includes periodic testing, inspection and replacement schedules. Criteria are also included for the repair of components and parts on an 'as needed' basis. A summary of the maintenance requirements is given in Table 8-1.

This section provides the minimum requirements required in order to maintain the package. From these requirements each organization, authorized to perform maintenance, shall prepare specific instructions and checklists, in accordance with that organization's Quality Assurance Program, that will ensure compliance with the requirements of Section 8.2.

Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.

The maintenance organization is required to notify the SAR owner of any instance in which the packaging fails to meet the criteria of Section 8.2 is found during maintenance.

The periodic maintenance activities, as specified in Section 8.2, shall have been performed not more than 1 year prior to shipment.

8.2.1 Structural and Pressure Tests

Structural and pressure testing do not form part of the periodic maintenance requirements.

8.2.2 Leakage Tests

8.2.2.1 Containment Vessel

Maintenance leakage testing of the containment vessel shall be in accordance with the evacuated envelope (gas detector) test A.5.4 in ANSI N14.5 [8.3]. The helium leak test procedure shall be written and approved by a level III examiner [8.4]. The test shall use a suitable helium leak detector. The test sensitivity shall be 5×10^{-8} ref.cm³/s and the test pass rate shall be 1×10^{-7} ref.cm³/s. The O-rings shall be coated with a light film of silicone O-ring lubricant for lubrication, and replaced if damaged.

The leakage rate testing shall be performed during the periodic maintenance tests, this shall not exceed 12 months prior to package use. The leakage rate test shall also be performed after the following maintenance activities:

- replacement of the containment seal
- repair of the containment sealing surface

- repair or replacement of the containment vessel lid or body

8.2.2.2 Inserts

New seals shall be fitted to the inserts.

The maintenance leakage testing of the inserts shall be in accordance with the vacuum bubble test A.5.6(b) in ANSI N14.5 [8.3]. For insert Design No. 3987, only the insert outer seal shall be leak tested. The test sensitivity shall be 10^{-3} ref.cm³/s and the acceptance rate shall be no visible stream of bubbles.

The leakage rate testing shall be performed during the periodic maintenance tests, this shall not exceed 12 months prior to package use. The leakage rate test shall also be performed after the following maintenance activities:

- replacement of the insert seal
- repair of the insert sealing surface
- repair or replacement of the insert lid or body

8.2.3 Component and Material Tests

The following sections describe the periodic maintenance requirements for package operation. Additional maintenance may be required on packagings that have failed the pre-shipment inspection process. Any additional maintenance requirements shall follow the periodic maintenance and its associated record keeping requirements.

8.2.3.1 Stainless Steel Surfaces

All of the stainless steel surfaces of the keg and containment vessels shall be visually inspected for corrosion. The presence of any surface corrosion on any component shall be cause for further inspection. If the corrosion can be easily wiped off, and no pitting is apparent beneath it, the component is acceptable. If the corrosion cannot be easily wiped off, or if scaling is present, or if pitting is observed, then the surface shall be reworked and the component must undergo a dimensional inspection and dye penetrant and/or radiographic testing to determine the extent of the damage.

In the case of the containment vessel, a hydrostatic test shall be performed. All acceptance criteria for a newly fabricated component (drawing 1C-5944 for a standard CV lid, drawing 1C-7504 for a split CV lid, and drawing 1C-7944 for the sealed split CV lid.) shall apply to the reworked component. If the corrosion has compromised the structural integrity of the component (e.g. the component no longer meets dimensional criteria for a new part as specified on drawing 1C-5944 for the standard CV lid, 1C-7504 for the split CV lid and drawing 1C-7944 for the sealed split CV lid.), then the component shall be rejected. The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.2 Keg

- 1) The model/serial numbers of the keg assembly (keg body and keg lid) shall be checked to ensure that the number marked on the body matches that on the lid: where the model/serial numbers of the keg assembly (body and lid) do not match, these assemblies shall be removed from service.
- 2) The keg name plate shall be checked for legibility of the nameplate information.
- 3) The keg outer shell shall be visually checked for unacceptable defects. Unacceptable defects are dents; cracking of welded joints; penetration of the keg skin; or abrasion or scratches that reduces the thickness of the keg below its licensed dimensions, including tolerances, as shown in the general arrangement drawings as specified in the Certificate of Compliance.
- 4) The keg closure studs shall be checked for tightness of fit in the keg top flange and damage (i.e. stripped or distorted). A die nut (thread class 6g) shall be used to clear any tight threads. The closure studs shall be checked that they are positioned in accordance with drawing 0C-5942. If the stud is loose or the height is incorrect, the stud shall be removed, cleaned, and repositioned using Loctite 270 or Loctite 263. If any keg closure studs are damaged they shall be removed and replaced with studs that meet the requirements of drawing 0C-5942, and positioned using Loctite 270 or Loctite 263 in accordance with drawing 0C-5942.
- 5) The keg lid seal and respective groove shall be checked for visible damage such as splits or cuts in the lid seal and scratches in the lid seal groove. The lid seal shall fit correctly into the seal groove. The lid seal shall be replaced as necessary; there is no requirement for periodic replacement.
- 6) The keg, keg lid, and keg closure nuts shall fit up freely. Any damaged nuts or washers shall be replaced according to drawing 0C-5942.
- 7) The fuse plug and spring washer shall be visually inspected for presence in the keg and damage and wear. A damaged or missing fuse plug or washer shall be replaced according to the specifications in drawing 0C-5942.
- 8) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 9) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.3 Containment Vessel with a Standard Lid or Split Lid Versions

- 1) The model/serial numbers of the body and lid shall be checked to ensure that the number marked on the body matches that on the lid: where the model/serial numbers of the containment vessel assembly (body and lid) do not match, these assemblies shall be removed from service.
- 2) The Containment Vessel components shall be checked for visible damage and in particular that the closure components assemble freely by hand. Any defects affecting the operation or integrity must be corrected or a part replaced.
- 3) The welds on the containment vessel body and lid for the standard CV lid or shielding plug for the split CV lid shall be visually checked for defects and evidence of cracking.
- 4) The threads in the closure of the containment vessel and the closure screws shall be cleaned and the threads shall be coated with molybdenum disulfide dry film spray lubricant.
- 5) The surface finish of the faces against which the O-rings seat shall be visually inspected. These faces shall be circular and there shall be no scratches across the lay. Scratches shall be polished out to return the surface to the specification in the drawings or the component rejected.
- 6) The three O-rings, marked on drawing 1C-5944 for the standard CV lid, drawing 1C-7504 for the split CV lid [for insert Design No. 4081](#) or drawing 1C-7944 for the split CV lid [for insert Design No. 4109](#), shall be replaced. These O-rings must be replaced annually. The O-rings shall be coated with a light film of silicone O-ring lubricant (Parker Super O-Lube). The O-rings shall be within the valid expiration date as specified by the manufacturer. O-rings shall be procured and tested in accordance with drawing 1C-5944 for the standard CV lid, drawing 1C-7504 for the split CV lid [for insert Design No. 4081](#) or drawing 1C-7944 for the split CV lid [for insert Design No. 4081](#).
- 7) Leakage testing of the containment vessel shall be carried out in accordance with Section 8.2.2.1.
- 8) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 9) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.4 Cork Set

- 1) The cork packing pieces (top cork, inner cork and outer cork) shall be visually inspected for chipping and cracking. The pieces shall be checked for fit within the assembled package. They shall fit without interference.
- 2) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 3) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.5 Inserts

- 1) The model/serial numbers of the body and lid shall be checked to ensure that the number marked on the body matches that on the lid: where the model/serial numbers of the insert (body and lid) do not match, these assemblies shall be removed from service.
- 2) The insert components shall be checked for visible damage and in particular that the lid screws freely by hand onto the body. Any defects affecting the operation or integrity must be corrected or a part replaced.
- 3) The lid and body threads shall be cleaned and coated with molybdenum disulfide dry film spray lubricant.
- 4) The presence of the O-ring shall be checked and replaced if missing. The O-ring shall be coated with a light film of silicone O-ring lubricant.
- 5) The insert shall be leak tested as specified in section 8.2.2.2.
- 6) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 7) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.6 Silicone Sponge Rubber Disc

- 1) The silicone sponge rubber disc shall be visually inspected and its density checked. Any damaged discs or those that do not meet the density checks shall be replaced.

- 2) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 3) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.3.7 Tungsten Liner in CT-5

- 1) The tungsten liner shall be visually inspected for damage. The dimensions, shown on the drawing 2C-7510 shall be verified by measurement. Any damaged liners or those that do not meet the measurement checks shall be replaced.
- 2) Non-conforming components shall be rejected and controlled for rework, or scrapped and replaced. Components that are reworked or replaced shall meet the specifications given in the general arrangement drawings as specified in the Certificate of Compliance.
- 3) The inspection results and any necessary replacement or repairs, shall be recorded in the package maintenance records.

8.2.4 Thermal Tests

This package has no special thermal features other than the cork insulation. Therefore, the package requires no special thermal testing as part of the routine maintenance. Visual inspection is sufficient to check that components are in satisfactory condition.

8.2.5 Miscellaneous Tests

This section discusses the requirements for replacing component parts on the package. These parts may be newly manufactured or substituted components from other packages. The keg which bears the serial number of the package will form the host component.

8.2.5.1 Replacement of a Closure Lid

If a closure lid is replaced, a maintenance leak rate test shall be performed in accordance with Section 8.1.4. The replacement shall be noted in the maintenance log along with the results of the leak test.

8.2.5.2 Replacement of the Containment Vessel Body

If the containment vessel body is replaced, it shall first be checked to ensure that the lid, closure screws and O-rings all fit. A maintenance leak test shall then be performed according to Section 8.1.4. The replacement shall be noted in the maintenance log along with the results of the leak test.

8.2.5.3 Replacement of a Containment Vessel

If the containment vessel is substituted the replacement shall be noted in the package maintenance log. The replacement containment vessel shall be manufactured to the requirements shown in the general arrangement drawings as specified in the Certificate of Compliance.

8.2.5.4 Replacement of a Keg Lid

If the keg lid is replaced, the replacement shall be noted in the package maintenance log.

Table 8-1 Package Maintenance Summary				
Item	SARP Section	Pre Shipment Action	Annual Maintenance Action	Tests on repair/replacement
Insert	8.2.3.5	V, Leak Test (for liquid contents only)	V, Leak test	Leak Test
Insert O-ring	8.2.2.2	V	R	Leak Test
Tungsten Liner	8.2.3.7	V	V	
Silicone Sponge Rubber Disc	8.2.3.6	V	V	
Containment Vessel Surfaces	9)	V	V	Leak Test
Containment O-ring (inner)	9)	V, Leak Test	R, Leak Test	Leak Test
Leak test O-ring (outer)	9)	V	R	
Test Port O-ring	9)	V	R	
O-ring sealing surfaces	9)	V	V	
Containment Vessel threaded inserts	9)	O	V	
Containment vessel screws	9)	O, V	V	
Keg surfaces	0	V	V	
Keg lid seal	0	V	V	
Lid seal sealing surfaces	0	V	V	
Keg Studs	0	O, V	V	
Keg bolts and washers	0	O	V	
Fuse plug	0		V	
Fuse plug washer	0		V	
Cork	8.2.3.4	V	V	

Notes: V = Visual Inspection, R = Replace, O = Operational test

8.3 Appendix

8.3.1 References

- [8.1] Title 10, Code of Federal Regulations, Part 71, Office of the Federal Register, Washington D.C.
- [8.2] ASME III Division 1 – Subsection NB, Class One Components, Rules for Construction of Nuclear Facility Components, ASME Boiler and Pressure Vessel Code, 2001 edition, the American Society of Mechanical Engineers, New York, New York.
- [8.3] ANSI N14.5, American Standards for Radioactive Materials – Leakage Tests on Packages for Shipment, American National Standards Institute, 1997.
- [8.4] ANSI/ASNT CP-189-2006, Standard for Qualification and Certification of Nondestructive Testing Personnel, The American Society for Non Destructive Testing Inc.