

Department of Energy  
Washington, DC 20585

SEP 18 1991

Mr. Charles E. MacDonald  
Chief, Transportation Branch  
Division of Safeguards and Transportation, NMSS  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Mr. MacDonald:

In reference to your letter of August 15, 1991, enclosed is the additional information you requested on the operating procedures and maintenance program for the 4.5-Ton Californium Cask (certificate no. 6642). If you have any questions, please contact Steve Primeau at 353-4210.

Sincerely,

A handwritten signature in black ink, appearing to read "R. W. Barber", written over a horizontal line.

Robert W. Barber  
Director  
Office of Risk Analysis and Technology

Enclosure

cc w/o encl.:  
M. Bennett, OR

**OAK RIDGE NATIONAL LABORATORY**  
 MANAGED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.  
 FOR THE U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008  
 OAK RIDGE, TENNESSEE 37831

September 11, 1991

Mr. James A. Reafsnyder, Deputy Assistant Manager  
 Energy Research and Development  
 DOE Field Office, Oak Ridge  
 Post Office Box 2008  
 Oak Ridge, Tennessee 37831-6269

Dear Mr. Reafsnyder:


Extension of USNRC Certificate of Compliance USA/6642/B( ), Rev. 4

- References:
1. Letter from O. B. Morgan to J. A. Reafsnyder, "Extension of USNRC Certificate of Compliance USA/6642/B( ), Rev. 4 and IAEA Certificate of Competent Authority USA/6642/B(U), Rev. 1, June 19, 1991
  2. Letter from C. E. MacDonald to J. E. Fitzgerald, Jr., August 15, 1991
  3. Safety Analysis Report - Packages: SRL 4.5-Ton Californium Shipping Cask, DPSU 74-124-6, December 1974, Rev. 1, March 1976

A request for renewal of the U.S. Nuclear Regulatory Commission (NRC) Certificate of Compliance USA/6642/B( ), Rev. 4 covering the SRL 4.5-Ton Californium Shipping Cask (Snowball) was submitted previously (Reference 1). The NRC has requested additional information on operating and inspection procedures (Reference 2). Attached are two documents that have been prepared to meet that request. Attachment 1, "Operating Procedures," is a set of requirements that cover the handling, loading, and unloading of the container and the preparations for shipment, both loaded and empty. This document is intended to supplement Section IV of the SARP (Reference 3) appearing on pp. 16 and 17, and Addendum I of the SARP appearing on pp. 44-46. Attachment 2, "Maintenance and Inspection," covers the requirements for the tests, inspections, and maintenance needed to assure the continued performance of the packaging. This document replaces Form DPSTP-R-131-QA-6 which appears on pp. 12-15 of the SARP.

If there are any questions, please contact R. M. Walker (4-5522) or J. E. Bigelow (4-6926).

Sincerely,



O. B. Morgan  
 Associate Director  
 Operations

OBM:JEB:jp

Attachments (2)

cc/att: M. E. Bennett, DOE-OR ✓  
 J. E. Bigelow  
 L. W. Boyd, DOE-OR  
 W. Fulkerson  
 R. K. Genung  
 M. W. Kohring  
 K. E. McCormack  
 D. B. Rosine, DOE-OR

T. H. Row  
 C. S. Travaglini  
 A. W. Trivelpiece  
 R. M. Walker  
 B. W. Welles  
 R. M. Wham  
 File - RC

OPERATING PROCEDURES

Safe use of the SRL 4.5-Ton Californium Shipping Cask (sometimes referred to as the Snowball) is assured by implementation of detailed operating procedures. It is required at Oak Ridge National Laboratory (ORNL) and recommended for all other users that specific formal procedures incorporating the requirements of these generic procedures (as well as any local requirements) be prepared and utilized for performing these operations. Package users may implement more stringent requirements than those specified in this document to conform to local rules.

The Radiochemical Engineering Development Center (REDC) of ORNL, as custodian of the Snowball, provides all other package users with generic procedures and written instructions for whatever operations they need to perform with the package (e.g., loading, unloading, or preparing an empty package for shipment). The generic procedures communicate all formal package handling requirements with which all users must comply. Additional written instructions, when needed, are used to communicate information pertinent to the user's specific application.

These generic procedures summarize all requirements imposed on all package users, and describe additional requirements which the REDC, as package custodian, imposes on itself. Adherence to the procedural requirements in these procedures helps assure that the packing, shipping, and receiving activities at each facility are conducted in a manner that will not compromise the performance of the package.

General Requirements. Several general requirements apply to all aspects of container handling. One is that a remnant of induced activity must be taken into account when the package is being loaded, unloaded, serviced, or maintained. This activity will be greatest immediately after unloading and will dissipate with time. However, some of the activated isotopes, most notably  $^{55}\text{Fe}$  ( $t_{1/2} = 2.7$  years), are relatively long lived and will continue to be present in the cask regardless of its operating schedule. Therefore, when preparing the cask for loading even after it has sat empty for some time, the internal parts are to be handled as if they were contaminated even after cleaning and confirmation that no transferable contamination is present.

Radiolysis of the water and ethylene glycol in the water-extended polyester (WEP) matrix may occur due to neutron bombardment causing the formation of hydrogen gas ( $\text{H}_2$ ). Therefore, prior to each shipment and during each annual inspection, it is required that the WEP shielding space be vented through the 1/4-in. angle valve (pc. 17, Dwg. ST5-15813)<sup>1</sup> to insure that a pressure buildup and/or hazardous  $\text{H}_2$  concentration is not accumulated in service.

When securing the cask to the trailer, the base should be bolted to the trailer bed with four bolts, and all four tiedown lugs should be secured to the trailer bed with wire cables that form a maximum angle of 60° with the trailer bed.

## Procedures for Loading the Package

### General Loading Requirements

The Snowball was designed specifically to ship  $^{252}\text{Cf}$  in Special Form capsules. This isotope will generally be the principal source of neutrons in the package, but it is always accompanied by 3 to 5 other californium isotopes and their radioactive daughter products. The Snowball can be loaded using a variety of source holders and spacers which allow either single source or multiple source shipments of qualified Special Form capsules. All loading and unloading operations are performed in a dry environment.

To aid in loading and unloading at the user's site, the Special Form capsules may be fitted with various kinds of adapters, or additional appendages may be attached to the capsules. These items must be designed and fabricated in accordance with the needs of individual orders and must not impinge on the integrity of either the Special Form capsules or the SRL 4.5-Ton Shipping Cask.

Before the REDC loads a californium source into the Snowball, each Special Form capsule is leak tested and smear tested. Leak testing is performed under the guidelines of ANSI N14.5<sup>2</sup> to "leak-tight" specifications using a helium leak detector (maximum leakage of  $1.4 \times 10^{-8}$  cc/s). A radiation measurement is taken to verify neutron emission levels. Upon receipt of a californium source being returned in the Snowball, the REDC performs the same checks of the Special Form container.

For single and multiple Special Form capsule shipments, the total quantity of  $^{252}\text{Cf}$  in any one shipping container must not exceed 46 Ci (85 mg). While there are no other formal limitations on the contents, the REDC will observe the following limits and recommends that others do also:

- (a) Maximum radioactive contents:  $30 \times A_1$ ;
- (b) Maximum total fissile nuclides: 0.2 g;
- (c) Maximum internal heat generation rate: 5 W.

The mass of the contents is not limited because any object that could be placed in the container cavity would have too little mass to have a discernable effect on the grossweight or the center of gravity of the container.

Prior to loading the Snowball, the following administrative controls are observed. For a shipment leaving the REDC, the contents of the Special Form capsule(s) to be shipped are checked against the quantity limits specified in the previous paragraph. Each component to be inserted into the cavity, including the Special Form capsules, is identified and measured, and the measurements are recorded as part of the QA record. A checker independently confirms the component identities and verifies that the Special Form capsules are qualified as Special Form, then signs the checklist. This signature verifies that the Special Form capsules have passed the qualification tests prescribed in 10 CFR 71<sup>3</sup>.

A package user is not required to perform the checks described in the previous paragraph if the Special Form capsules are being returned in the same shipping configuration in which they were received, or if the REDC performs these checks and supplies the user with a verified acceptable shipping configuration. However, the user must have local procedures in place to verify that the correct Special Form capsules are being shipped and that the correct shipping configuration is being used.

### Specific Loading Requirements

At the REDC, the container is first fully disassembled, and all components are checked for contamination levels. These levels are documented by the attending health physicist. Old shipping labels are removed from the container. The outer surface of the shipping container is visually inspected for any signs of damage, and the paint on the outer shell is touched up if necessary. The shield plug is checked for induced radiation, and it and the container cavity are visually inspected for any signs of damage or unusual wear.

Inserts or spacers are installed in the container cavity to position the capsules and to facilitate their loading and unloading. These inserts or spacers are not required for heat transfer, neutron shielding, or criticality control and there are no requirements on their design, other than they must not cause damage to the capsules or the shipping container during normal or hypothetical accident conditions. They may be fabricated of 6061-aluminum, 304L stainless steel, lead, or polyethylene.

At the REDC, loading takes place in a dry loading facility (e.g. a hot cell). Before the Snowball is placed in a loading facility, determinations are made that the loading facility is sufficiently clean to prevent contamination of the shipping container. After the Snowball is placed in the loading facility, it is loaded with the Special Form capsules to be shipped. When a Special Form capsule is to be shipped from the REDC, it has already been smear tested, leak tested, checked for neutron emission levels, and visually inspected for any signs of damage.

The Special Form capsules may be fitted with various kinds of adapters, or additional appendages may be attached to the capsules to aid in loading and unloading at the user's site. Because each shipment is unique, specialized instructions for package loading and unloading sometimes need to be developed. These instructions, when needed, are designed specifically to fit the user's needs, and are communicated to the user in a letter sent to the user either preceding or accompanying the shipment.

After the Special Form capsules and various package inserts are loaded, the container shield plug is placed in the shipping container. The loading facility is then reopened, and the shipping container is removed from the facility. The shield plug is secured with 5/8-in. hex nuts torqued to a maximum of 350 in.-lb. The WEP shielding is vented through the 1/4-in. angle valve, and the outer cover plate of the shipping container is then installed with 3/8-in. hex head bolts (with lock washers) torqued to a maximum of

230 in.-lb. Finally, a registered tamper seal is installed on the cover plate between two drilled hex head bolts in accordance with 10 CFR 71.43(b).

Leak testing of the assembled shipping container is not required, since the primary containment boundary is the Special Form capsule which has been leak tested prior to loading.

#### Requirements for Transport

Following loading, the container is moved to the trailer on which it will be transported. Any californium container shipment for which the transport index exceeds 10 (i.e., the radiation level 1 m from the package surface exceeds 10 mrem/h) must be shipped as "exclusive use". Exclusive use is defined in 10 CFR 71.4 as "the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of a consignor or consignee".

Overseas shipments are made by ship or air freight. Special provisions are required if an overseas shipment must be made as an exclusive use shipment.

A radiation survey of the entire package surface is performed before the Snowball is loaded onto the trailer. The highest radiation reading obtained during this survey is recorded; a reading 1 m from the package surface measured from the spot where the highest radiation reading has been obtained is recorded and used to calculate the transport index for the shipment. Since the principal isotope being shipped is a strong neutron emitter, the survey must include instruments designed to measure fast, intermediate, and thermal neutrons as well as gamma radiation.

For an exclusive use shipment of the Snowball, the following radiation levels must not be exceeded<sup>3</sup>: 200 mrem/h anywhere on the bottom surface of the trailer, at any point on the vertical planes projected from the outer edges of the trailer, and on the upper surface of the shipping container; 10 mrem/h at any point 2 m from the vertical planes projected from the outer edges of the trailer; and 2 mrem/h at the rear of the truck cab. Prior to shipment, radiation levels are measured and recorded, and compliance with the regulatory limits at all these locations is verified. (Measurements are not made at every location if it is obvious from some readings that others must fall below the regulatory limits.) A shipment will not be made if radiation measurements exceed the allowable radiation levels.

Final preparations for transport include the following: proper labeling of the shipping container and attachment of placards to the shipping vehicle, and securing of the shipping container to the trailer with a facility approved tiedown plan. The container base should be bolted to the trailer bed, and all four tiedown lugs should be secured to the trailer bed with wire cables that form a maximum angle of 60° with the trailer bed.

### Procedures for Unloading the Package

Upon receipt of the shipping container, the user checks the general condition of the package and verifies the presence of the tamper seals. In the event that a tamper seal is missing or broken, appropriate facility-specific procedures are followed. The procedures must include notification of the shipper.

The REDC does not impose requirements on package users that they check radiation readings on incoming shipments. However, it is recommended as good practice that each facility implement such a procedure upon package receipt. The REDC checks radiation levels on all incoming shipments.

The Snowball may be moved into an unloading facility only after determination that the facility is sufficiently clean to prevent contamination of the shipping container during the unloading operation. The facility is opened to receive the shipping container following the necessary facility operating procedures. The top cover should be removed and the WEP shielding vented through the 1/4-in. angle valve before placing the package in the facility. Also, depending on local procedures, the hex nuts may be removed before placing the package in the facility. The package is emptied by removing the shield plug, then withdrawing the package contents through the top of the container. As mentioned previously, the Special Form capsules may be fitted with various kinds of adapters, or additional appendages may be attached to the capsules to aid in loading and unloading at the user's site. Specialized instruction for unloading the package are provided where needed to fit these special cases.

If the package is being unloaded at the REDC, the Snowball is surveyed after removal of the Special Form capsules to verify that the container is empty and to determine the radiation levels from induced activity in the internal parts of the container. This practice is recommended but not required of other package users.

### Preparation of an Empty Package for Transport

The SRL 4.5-Ton Californium Shipping Cask may be transported to a facility in an empty condition so that a source may be returned to the REDC, or it may be returned empty from a user. The procedure for preparing an empty package for transport is essentially the same as preparing a loaded package for transport. At the REDC, the container is first fully disassembled, and all components are checked for contamination levels. These levels are documented by the attending health physicist. Prior to shipment, documentation is completed, stating the condition of the container, including the findings of the health physicist.

## REFERENCES

1. V. Whatley, Jr., et al., Safety Analysis Report - Packages SRL 4.5-Ton Californium Shipping Cask, DPSPU 74-124-6, Rev. 1, March 1976.
2. American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment, ANSI N14.5-1987.
3. Code of Federal Regulations, Title 10, Part 71, January 1, 1988.



## MAINTENANCE AND INSPECTION

Inspections of the SRL 4.5-Ton Californium Shipping Cask (Snowball) are required prior to each shipment, annually, and biennially. Maintenance is required only when routine inspections indicate damage. The most critical single component of the shipping package, the Special Form capsule, is inspected with every shipment. Inspections which occur with each shipment are discussed in the operating procedures for this package. Annual and biennial inspections are performed on the Snowball to insure that it continues to meet design standards. During prolonged periods of storage, the cask is exempt from these inspections; however, the inspections must be performed before the cask is returned to service. The annual and biennial inspections are discussed in the following.

The annual inspection of the Snowball includes visual inspections of the welds on the lifting and tiedown lugs, the lifting and tiedown lugs themselves, the fusible plugs, the general surface condition of the cask, the O-ring seal on the bottom face of the shield plug, and the bolts and nuts used for closure of the cask. The water-extended polyester (WEP) shielding is also vented through the 1/4-in. angle valve during the annual inspection. The biennial inspection of the package includes all of the parts of the annual inspection along with dye penetrant testing of the welds on the lifting and tiedown lugs and a radiation survey to evaluate the shielding integrity.

### Structural and Pressure Tests

Structural inspections include visual inspections of the lifting and tiedown lugs, the general surface condition of the cask, and the closure mechanism of the cask on an annual basis. Visual inspection of the lifting and tiedown lugs is performed to insure that there is no misalignment, wear or other deformation which would affect their strength. Visual inspection of the surface of the cask insures that it is free of corrosion, gouges, cracks, or other deformations, and that the painted surfaces are free of major cracks, chips, or blisters. Visual inspection of the closure mechanisms of the shield plug and cover plate insures that the bolts, studs and nuts are not bent or otherwise deformed, that the threads are uniform and free of burrs, and that provisions for installing seal wires are present.

The welds attaching the lifting and tiedown lugs to the cask surface are checked biennially using dye penetrant. The paint around these welds is removed prior to performing the checks and reapplied following the checks.

No pressure tests are performed on the Snowball; however, the shielding space is vented (annually and prior to each use) through the 1/4-in. angle valve to insure that there is no pressure buildup within the cask due to radiolysis of the water and ethylene glycol in the WEP. The Special Form capsules provide the containment boundary for the californium sources being shipped in the Snowball. The shipping container merely provides confinement of these Special Form capsules, and, therefore, is not pressure tested.

## Leak Tests

Leak tests are not performed on the Snowball since containment is provided by the Special Form capsule. Leak tests are performed on each Special Form capsule in accordance with ANSI N14.5<sup>1</sup> before it is shipped from the Radiochemical Engineering Development Center (REDC) of Oak Ridge National Laboratory (ORNL) in the Snowball and again when the capsule is returned. The leak tests are conducted using a helium leak detector which has a sensitivity greater than  $1 \times 10^{-8}$  cm<sup>3</sup>/s.

## Subsystems Maintenance

The nine fusible plugs are inspected as part of the annual inspection. The fusible plugs are located on the cask outer shell and are designed to prevent the buildup of pressure in the water-extended polyester (WEP) shielding material during the fire portion of the hypothetical accident conditions test. Each fusible plug consists of a 1-in. pipe plug filled with an alloy which melts at low temperatures. Since the fusible plugs are a passive device, a visual inspection simply assesses their presence and general condition. Fusible plugs are replaced if the inspection detects a problem, and a review of the cause of failure is initiated.

## Valves, Rupture Discs, and Gaskets on Containment Vessel

No valves, rupture discs, or gaskets are on the containment vessel of this package (Special Form capsules); however, the Snowball has an O-ring seal on the bottom face of the shield plug flange. This seal is visually inspected annually to insure that it has no evidence of deterioration or damage, and that it fits snugly in the O-ring groove in the flange. No sharp edges or burrs should be on the groove. Damaged seals are replaced.

## Tests for Shielding Integrity

Shielding in the Snowball is provided by the water-extended polyester (WEP). A radiation survey of the cask is performed biennially to determine if the shielding integrity of the WEP has deteriorated. A <sup>252</sup>Cf source of approximately 10 mg is placed in the cask cavity, and radiation measurements are made and compared with previous measurements. This test may be made as part of the preparations for a shipment with the actual source to be shipped rather than the test source.

## Thermal

No thermal tests are required as part of the maintenance program for the Snowball. Thermal protection is provided by the WEP; therefore, no coolant, heat transfer fins, or other thermal protection devices are utilized. The

fusible plugs are the only container components which have a temperature-related function. The annual inspection of the fusible plugs has been discussed previously.

Miscellaneous

No additional maintenance tests are required or performed on the SRL 4.5-Ton Californium Shipping Cask to assure its integrity. Visual inspections play a very important role in the overall safety and operation of this container. Only two packages of this type are now in existence. The REDC, as package custodian, performs visual examinations of the package every time it moves, loads, or unloads the package, to determine whether any deterioration of the package may have occurred.

REFERENCE

1. American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment, ANSI N14.5-1987.