

U.S. Nuclear Regulatory Commission
Transportation Certification Branch
SAFETY EVALUATION REPORT
FOR THE TUNGSTEN-SHIELDED CASK
USA/5597/B()

SUMMARY

The U.S. Department of Energy has requested approval by letter dated July 31, 1978, for the Tungsten-Shielded cask to be used for shipment of special radioactive material.

Based on the statements and representations contained in the application, as amended, the staff has concluded that the packaging and its contents, as described, meet the requirements of 10 CFR Part 71 for a Type B() package.

REFERENCES

U.S. Department of Energy application dated July 31, 1978, as amended February 13, 1980, and December 20, 1984.

DRAWINGS

The packaging is constructed in accordance with Oak Ridge National Laboratory Drawings No. M-11575-EM-001-E-Rev. 3, X3D11575-002-Rev. 0, and X3D-11575-003-Rev. 4.

DESCRIPTION

The packaging consists of a right circular cylinder with a hemispherical bottom. It has a maximum outside diameter of 16 inches at the base. The cask itself has an outside diameter of 8 inches. The overall height is 15-1/4 inches. Inner cavity dimensions are 3.120 inches in diameter by 6-1/2 inches high. Shielding is composed of a 2-inch thick isostatically pressed and sintered tungsten alloy containing 95% tungsten, 3.5% nickel, and 1.5% iron, with a 1/4-inch type 304L stainless steel cladding outside and a 1/8-inch type 304L stainless steel cladding inside. The gasketed lid consists of a 150-pound flange to which the top shield plug is attached and is held in place by eight 5/8-inch studs and bolts. A capped 1-inch pipe is welded to the underside of the cask lid to position the contents. The gross weight of the basic cask is 381 pounds.

A tungsten insert personnel shield and shipping pallet are used for shipping radioactive materials having higher internal heat loads and external radiation levels. The gross weight of the cask, insert, heat shield, and skid is 565 pounds.

CONTENTS

Solid radioactive material which meets the requirements for special form radioactive material defined in 10 CFR Part 71. The internal decay heat of the contents shall not exceed 50 watts. For contents having internal decay heat that is less than 25 watts, the tungsten insert, the personnel shield, and the shipping pallet may be eliminated.

STRUCTURAL ANALYSIS

The applicant demonstrated compliance with structural test requirements of 10 CFR Part 71 using analysis, supplemented with testing.

Compliance with general (10 CFR §71.43), lifting and tie-down standards (10 CFR §71.45) is demonstrated by analysis.

The structural behavior of the cask for normal and hypothetical accident condition tests is evaluated by analysis with one exception. The one exception is the 30-foot drop test in the most damaging orientation. The 30-foot drop test is performed using an actual "as built" cask.

The most damaging drop was determined to be 45° angle top corner drop which resulted in slight flattening of the metal on the top flange at the point of impact. No other damage was observed. There was no evidence of loss of confinement of the cask cavity which is intended to hold special form material.

The applicant has demonstrated that there will be no significant reduction in shielding configuration for normal or hypothetical accident conditions. Because the contents are special form material containment criteria are not applied to the cask, but confinement of the material must be demonstrated. The demonstrations provided satisfy that requirement, and the staff concludes that the structural requirements of 10 CFR Part 71 have been adequately addressed.

THERMAL ANALYSIS

Thermal analysis for the Tungsten Shielded Cask was performed using the HEATING3 computer code with 25W internal heat. The analyses for normal and accident conditions showed temperatures to stay within acceptable limits for adequate cask performance.

The effect of the higher 50W heat load was evaluated by testing for normal conditions of transport. The effect of increasing the internal heat load was considered for accident conditions and judged to be negligible. For normal conditions, a test was performed on a cask with skid and personnel shield, indoors with a 71°F ambient temperature and 47.4W internal heat load. The results were then corrected to 100°F and 50W with temperatures of 110°F on top and sides and 115°F on the bottom. For accident conditions, the slight increase in the cask initial temperature will have little effect on peak fire transient temperatures.

The staff has reviewed the applicant's thermal evaluation and concludes that it satisfies the thermal requirements of 10 CFR Part 71.

CONTAINMENT

Containment is provided by meeting the requirement for special form radioactive material.

SHIELDING

Because the tungsten shield is shown to be undamaged as a result of normal conditions of transport and hypothetical accident conditions, it is concluded that dose measurements required prior to shipment of a loaded package will assure compliance with the dose limits of 10 CFR §71.47 and §71.51(a)(2).


Dose measurements have been made on the cask with the tungsten insert using an iridium-192 source. The measurements demonstrate the adequacy of the cask shield and provided useful data for additional shielding estimates.

The shielding when the tungsten insert is used is configured in such a way that spacers which are not shown in the construction drawing must be used to assure adequate shielding of the special form sources for normal conditions of transport. The staff's evaluation indicates that the source must stay in a fully shielded configuration under normal conditions, and an approval condition requiring spacers must be imposed.

For accident conditions, the applicant shows that the shielding is not significantly reduced; the applicant further contends that the source remains within a fully shielded configuration within the tungsten insert. The staff has considered the effect of a point source, originally in the fully shielded configuration, coming out of the tungsten insert. This situation is a reduction from 3 inches of tungsten to 2 inches of tungsten. Such a condition would satisfy the post accident dose limits of 10 CFR §71.51.

CONCLUSION

Based on our review, the statements and representations contained in the application and the conditions listed above, we find that the Model No. Tungsten-Shielded Cask meets the requirements of 10 CFR Part 71.


Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety, NRC

Date: MAR 13 1986