

SAFETY ANALYSIS REPORT
FOR
MODEL CN6-80 SHIELDED CASK
TO
10 CFR 71 TYPE "A" PACKAGING REQUIREMENTS

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0.2 Package Description

0.2.1 Packaging

0.2.1.1 General Description

The Model CN6-80 packaging is a reusable shipping package designed to protect radioactive material from normal conditions of transport.

0.2.1.2 Materials of Construction, Dimensions & Fabricating Methods

General Arrangement drawings of the Model CN6-80 packaging are included in Appendix 1.10.1. They show the overall dimensions as well as the material.

The cask body consists of a one inch (1-1/8" for casks fabricated after October 31, 1980) external steel shell and a 3/8 inch internal steel shell separated by a 4 inch lead shield between two shells. The top and bottom ends of the cylindrical cask are constructed of a pair of stacked 4 inch steel plates. The top serves as a removable cask lid and is secured to the cylindrical cask body by eight 1 1/4" studs. A 29" secondary cask lid is located in the center of the primary lid and is secured to the primary lid by eight 1" studs. All internal cask surfaces are lined with light gauge stainless steel to facilitate decontamination. Lifting lugs and tiedowns are a structural part of the package. 3

0.2.1.3 Containment Vessel

The CN6-80 cask serves as the containment vessel and its mechanical

1.0 STRUCTURAL EVALUATION

This Section identifies and describes the principal structural engineering design of the packaging, components, and systems important to safety in compliance with the performance requirements of 10 CFR 71.

1.1 Structural Design

1.1.1 Discussion

The principal structural member of the Model CN6-80 package is the primary containment vessel or transport shield, as described in Section 0.2.1. The above components are identified on the drawing as noted in Appendix 1.10.1. A detailed discussion of the structural design and performance of these components will be provided below.

1.1.2 Design Criteria

The shield top and bottom are constructed of two-four inch thick steel plates laminated together to provide a full 8 inches of solid steel. Cylindrical side walls have an external skin of 1 inch steel plate (1-1/8" for casks fabricated after October 31, 1980) and an internal skin of 3/8 inch thick plate. These two plates encase 4 1/2 inches of lead resulting in a total side wall thickness of 5 5/8 (5 3/4) inches.

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The weight of the cask and liner (or payload) will not exceed 51,500 pounds. The cask weight is approximately 44,000 pounds. The center of gravity for the assembled package is located at the approximate geometric center of gravity.

1.3 Mechanical Properties of Materials

The Model CN6-80 packaging uses an outer and inner shell fabricated of various thicknesses of low carbon hot rolled steel conforming to ASTM A-36. For casks fabricated after October 31, 1980, low carbon steel shall conform to ASTM A-516, Grade 70. Both yield and ultimate stresses of A-516, Grade 70, are slightly higher than those of A-36 (5% greater yield; 20% greater ultimate). For conservatism, the lower A-36 values are used for analysis throughout this report. Specific properties are as follows:

Per		MIL-HDBK-V
F_{tu}	=	55,000 psi
F_{ty}	=	36,000 psi
F_{su}	=	35,000 psi
F_{brg}	=	90,000 psi

Lead shielding will possess those properties referenced in ORNL-NS1C-68, Table 2.6, Page 84.

Lid studs are all of SAE Grade 5 quality possessing the following properties, per ASTM A325 and A449:

	<u>1"</u>	<u>1½"</u>
Proof Load:	78,000 psi	74,000 psi
Tensile Strength:	115,000 psi	105,000 psi

The secondary lid closure studs are examined in a comparable fashion. Conservatively, the total payload mass of 7500 lbs. is assumed to be reacted by the secondary lid studs. Thus, the total secondary lid stud load is estimated as:

$$\begin{aligned} R &= (W_L + W_P) a_g \cos \\ &= (2000 + 7500) (19.1) \cos 43.5^\circ = 131619 \text{ lbs.} \end{aligned}$$

Since there are eight secondary lid studs (1-8UNC, SAE Gr. 5), each stud load is 16,452 lbs. The tensile strength of the stud is:

$$P = F_t A = (115,000) (.563) = 64745 \text{ lbs.}$$

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Thus the margin of safety of the secondary lid is:

$$\text{M.S.} = 64745/16452 - 1 = +2.94$$

Therefore, it can be safely concluded that the package can survive a normal corner drop.

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