GENERAL ELECTRIC SHIELDED CONTAINER - MODEL 400

1.0 PACKAGE DESCRIPTION - PACKAGING

(a) General

All containers of this model, for purposes of constructing additional containers of this model, will have dimensions of plus or minus 5% of the container dimensions specified in this application, and all lifting and/or tiedown devices for additional containers of this model if different from the lifting and/or tiedown devices described in this application will satisfy the requirements of 10CFR71.31(c)(d). This container is detailed in G.E. Drawings 277E411, Revision 2, 106D3980, Revision 2, 106D3983, Revision 1, 856B880, Revision 7 and 178B9960, Revision 0.

Shape:

An upright circular cylinder shielded cask and an upright circular cylinder protective jacket with attached square base.

Size:

The shielded cask is 20 inches in diameter by 24½ inches high. The protective jacket is 29-11/16 inches high by 32 inches across the box section. The base is 44 inches square.

Construction:

The cask is a lead-filled carbon and stainless steel weldment. The protective jacket is a double walled structure of 1/4-inch carbon steel plate and surrounds the cask during transport. The square base is 1/2-inch carbon steel with four I-beams attached.

Weight:

The cask weighs 2,950 pounds. The protective jacket and base weigh 850 pounds.

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(b) Cask Body

Outer Shell:	1/4-inch thick steel plate, 24-1/8 inches high by 20 inches in diameter with a 1/4-inch bottom plate and a 1-inch top flange.
Cavity:	1/4-inch stainless steel wall and bottom plate, 2-3/8 inches inner diameter by 3-inches deep.
Shielding Thickness:	8-5/6 inches of lead on sides, 10-7/8 inches of lead beneath cavity.
Penetration:	None.
Filters:	None.
Lifting Devices:	Two diametrically opposed ears welded to sides of cask, covered by protective jacket during transport.
Primary Coolant:	Air.

(c) Cask Lid

Shape:	A right cylinder attached to flat plates.
Size:	The top plate is 14-inches in diameter by 1/4-inch thick. The bottom plate is 6-inches in diameter by 1/4-inch thick. The right cylinder is 6-inches in diameter by 10-inches high.
Construction:	Lead-filled steel clad cylinders welded to circular steel plates.
Closure:	Four, 1-inch, 8-UNC-2A steel bolts equally spaced 90^{o} apart on a 12-inch diameter bolt circle.

Closure Seal: Molded silicone rubber seal bonded to an aluminum back-up plate.

Penetrations: None.

Shield Expansion Void: None.

Lifting Device: 3/4, 10-UNC-2A threaded 3/4-inch eyebolt attached to lid. Covered by protective jacket during transport.

(d) Protective Jacket Body

Shape: Basically a right circular cylinder with open bottom and with a protruding box section diametrically across top and vertically down sides.

Size: 29-11/16 inches high by 32-inches wide across the box section. The outer cylinder diameter is 25-1/4 inches. Inner diameter is 22-1/4 inches. A 5-1/2 inch wide by 1/4-inch thick steel flange is welded to the outer wall of the open bottom.

Construction: Carbon steel throughout. Double walled construction. The walls are 1/4-inch thick. One and one-eighth inch air gap between cask shell and inner jacket wall and a one-inch air gap between inner and outer jacket walls throughout. Four, 12-inch high by 1/4-inch thick gussets are welded to the outer cylindrical wall and flange, including the two box sections, the gussets are spaced 60^{o} apart.

Attachment: Two, 2-inch bolts connect the protective jacket body, through the flange, to the pallet.

Lifting Devices: Two rectangular 5/8-inch thick steel loops located on top of the box section at the corners. The

steel is 7-inches long by 3-inches high by 3-inches wide.

Tiedown Devices: Two diametrically opposed 1-1/2 inch thick steel ears welded to sides of box section, each ear has a 1-1/2 inch hole to accept clevis or cable.

Penetrations: Slots along periphery of the protective jacket at the bottom, slots in box section under lifting loops, allows natural air circulation for cooling.

(e) Protective Jacket Base

Shape: Hollow cylindrical weldment with square bottom plate. Four I-beams are welded to square bottom of plate.

Size: Bottom plate is 44-inches square and 1/2-inch thick. The cylindrical collar is 22-inches in outer diameter by 3-inches high. The I-beams are 3-inches high by 44-inches long.

Construction: The cylindrical collar houses two sets of 1-1/4 inch by 1-1/4 inch by 1/8-inch steel energy absorbing angles separated by a 1/4-inch thick carbon steel mid-plate. The cask rests on this assembly. The collar is welded to the 1/2-inch thick carbon steel base plate. Four I-beams are welded in parallel to the base plate.

Attachment: Two diametrically opposed tie blocks to accept jacket attachment bolts.

2.0 PACKAGE DESCRIPTION - CONTENTS

(a) General Radioactive material as the metal or metal oxide, but specifically not loose powders; or other non-decomposable (at 650°F) solid materials.

(b) Form

Clad, encapsulated or contained in a metal encasement of such material as to withstand the combined effects of the internal heat load and the 1475°F fire with the closure pre-tested for leak tightness, or in special form.

(c) Fissile Content

Not to exceed 15 grams fissile.

(d) Radioactivity

That quantity of any radioactive material which does not generate spontaneously more than 400 thermal watts by radioactive decay and which meets the requirements of 49CFR173.393.

(e) Heat

Total maximum internally generated heat load not to exceed 400 thermal watts.

An analytical determination, described in Exhibit B of the Application for the GE Model 700 container, of the container temperature profile and heat load resulted in the following:

Cask Surface	-	175°F
Inner Shield	-	112°F
Outer Shield	-	90°F
Ambient	-	80°F
Heat Load	-	400 watts

General Electric will analyze by test or other assessment each container heat loading prior to shipment to verify that the requirements of 10CFR71.35 will be satisfied. Reference is made to the GE - Model 100 Application, Exhibit B, for a method of internal heat load analysis and heat dissipation.

3.0 PACKAGE EVALUATION

(a) General

There are no components of the packaging or its contents which are subject to chemical or galvanic reaction; no coolant is used during transport. The protective jacket is bolted closed during transport. A lock wire and seal of a type that must be broken if the package is opened is affixed to the cask closure. If that portion of the protective jacket which is used in the tiedown system or that portion which constitutes the principal lifting device failed in such a manner to allow the protective jacket to separate from the tiedown and/or lifting devices, the basic protective features of the protective jacket and the enclosed cask would be retained. The package (contents, cask and protective jacket) regarded as a simple beam supported at its ends along its major axis, is capable of withstanding a static load, normal to and distributed along its entire length equal to five times its fully loaded weight, without generating stress in any material of the packaging in excess of its yield strength. The packaging is adequate to retain all contents when subjected to an external pressure of 25 pounds per square inch gauge. Reference is made to the GE - Model 100 Application, Exhibit C, for a method of determining static loads.

The calculative methods employed in the design of the protective jacket are based on strain rate studies and calculations and on a literature search* of the effects on materials under impact conditions. The intent was to design a protective jacket that would not only satisfy the requirements of the U. S. Nuclear Regulatory Commission and the Department

*TID-7651, SE-RR-65-98

of Transportation prescribing the procedures and standards of packaging and shipping and the requirements governing such packaging and shipping but would protect the shielded cask from significant deformation in the event of an accident. In the event that the package was involved in an accident, a new protective jacket could be readily supplied and the shipment continued with minimal time delay.

The effectiveness of the strain rate calculations and engineering intuitiveness in the design and construction of protective jackets was demonstrated with the General Electric Shielded Container - Model 100 (Ref.: Section 3.0 of the Model 100 Application). The protective jacket design for the General Electric Shielded Container - Model 400 will be scaled from the design of the Model 100 in accordance with the cask weight and dimensions, maintaining static load safety factors greater than or equal to unity, and in accordance with the intent to protect the shielded cask from any deformation in the event of an accident.

(b) Normal Transport Conditions

Thermal: Packaging components, i.e., steel shells and lead, uranium and/or tungsten shielding, are unaffected by temperature extremes of -40°F and 130°F. Package contents, at least singly-encapsulated or contained in inner containers, but not limited to special form, will not be affected by these temperature extremes.

Pressure: The package will withstand an external pressure of 0.5 times standard atmospheric pressure.

Vibration: Inspection of the Model 400 casks used since 1961 reveals no evidence of damage of significance to transport safety.

Water Spray and Free Drop: Since the container is constructed of metal, there is no damage to containment resulting from dropping the container through the standard drop heights after being subjected to water spray.

Penetration: There is no effect on containment of overall spacing from dropping a thirteen pound by 1-1/4 inch diameter bar from four feet onto the most vulnerable exposed surface of the packaging.

Compression: The loaded container is capable of withstanding a compressive load equal to five times its weight with no change in spacing.

Summary and Conclusions: The tests of assessments set forth above provide assurance that the product contents are contained in the Shielded Container - Model 400 during transport and there is no reduction in effectiveness of the package.

(c) Hypothetical Accident Conditions

General: The effectiveness of the strain rate calculations and engineering intuitiveness in the design and construction of protective jackets was demonstrated with the GE Shielded Container - Model 100 (Ref.: Section 3.0 of the Model 100 Application). Extrapolations of the Model 100 data were used in the design and construction of the GE Model 400 protective jacket.

Drop Test:

The design and construction of the GE Model 400 protective jacket was based on an extrapolation of the proven data generated during the design and construction of the GE Model 100 and on the results of cask drop experiments by C. B. Clifford[1][2] and H. G. Clarke, Jr.[3] The laws of similitude were used in an analytical evaluation[3][4] to determine the protective jacket wall thickness that would withstand the test conditions of 49CFR173.398(c) and 10CFR71.36 without breaching the integrity of the Model 400 cask. The evaluation, described in GE - Model 1000 Application, Exhibit A, indicated a protective jacket wall thickness of 1/4 inch. The intent of the design for the GE Model 400 is, during accident conditions, to sustain damage to the packaging not greater than the damage sustained by the GE Model 100 during its accident condition tests (Ref.: Section 3.0 of the Model 100 Application). It is expected that damage not exceeding that suffered by the GE Model 100 will result if the GE Model 400 is subjected to the 30 foot drop test.

Puncture Test:

The intent of the design for the GE Model 400 is to sustain less or equal damage to the packaging during accident conditions than the deformation suffered by the GE Model 100. It is expected that

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(1) C. B. Clifford, The Design, Fabrication and Testing of a Quarter Scale of the Demonstrating Uranium Fuel Element Shipping Cask, KY-546 (June 10, 1968).

(2) C. B. Clifford, Demonstration Fuel Element Shipping Cask From Laminated Uranium Metal-Testing Program, Proceedings of the Second International Symposium on Packaging and Transportation of Radioactive Materials, Oct. 14-18, 1968, pp. 521-556.

(3) H. G. Clarke, Jr., Some Studies of Structural Response of Casks to Impact, Proceedings of the Second International Symposium of Packaging and Transportation of Radioactive Materials, Oct. 14-18, 1968, pp. 373-398.

(4) J. K. Vennard, Elementary Fluid Mechanics, Wiley and Sons, New York, 1962, pp. 256-259.

deformation not greater than that sustained by the GE Model 100 will be received by the GE Model 400 in the event that the package is subjected to the puncture test.

Thermal Test:

A fire transient using the THTD Code was not run on this container. However, reference is made to the shielded container Models 100, 700, and 1500 which demonstrate the effectiveness of the double walled steel jacket as a fire as well as crash shield.

General Electric will analyze by test or other assessment each container heat load to verify that the loaded container will withstand the 30 minute 1475^{o}F fire without significant lead melting in the cask.

Water Immersion:

Since optimum moderation of product materials is assumed in evaluations of criticality safety under accident conditions the water immersion test was not necessary.

Summary and Conclusions:

The accident tests of assessments described above demonstrated that the package is adequate to retain the product contents and that there is no change in spacing. Therefore, it is concluded that the General Electric Shielded Container - Model 400 is adequate as packaging for the contents specified in Section 3.0 of this application.

4.0 PROCEDURAL CONTROLS

Vallecitos Site Safety Standards have been established and implemented to assure that shipments leaving the Vallecitos Nuclear Center (VNC) comply with the certificates issued for the various shipping container models utilized by the

VNC in the normal conduc of its business.

Each cask is inspected and radiographed prior to first use to ascertain that there are no cracks, pinholes, uncontrolled voids or other defects which could significantly reduce the effectiveness of the packaging.

After appropriate U. S. Nuclear Regulatory Commission approval, each package will be identified with a welded on steel plate in accordance with the labeling requirements of 10CFR71 and any other information as required by the Department of Transportation.

5.0 FISSILE CLASS - EXEMPT

The fissile contents of this package are limited to not more than 15 grams and, therefore, in accordance with the provisions of 10CFR71.5(a) and 49CFR173.396(a)(1), the licensee is exempt from the requirements of the above regulations concerning these fissile loadings.

6.0 MODES OF TRANSPORTATION

All modes with the exception of passenger aircraft are requested.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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