PDR 71-5939

GENERAL ELECTRIC

NUCLEAR ENERGY

ENGINEERING

DIVISION

GENERAL ELECTRIC COMPANY, P.O. BOX 460, PLEASANTON, CALIFORNIA 94566

February 21, 1980

Mr. Charles E. MacDonald, Chief
Transportation Branch
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Ref: Certificate of Compliance No. 5939

Dear Mr. MacDonald:

General Electric has for several years shipped large quantities of radioactive materials in the G.E. Model 1500 shipping container. General Electric hereby requests that Certificate of Compliance No. 5929 for that container be renewed.

In support of this request a consolidated application for certification is enclosed with this letter. Some minor changes, either editorial or reflecting the current cask drawings, have been made and are designated by vertical lines.

A completely updated set of drawings was submitted to the Commission on February 6, 1980. The submittal erroneously listed Drawing No. 163B8389, Rev. 0. The correct number is 163B8389, Rev. 2.

The leak test data requested in your letter of December 21, 1979, is enclosed as Exhibit D of this application.

A check for the $150.00 renewal fee is enclosed.

As this application is being submitted at least thirty days prior to the expiration date of the certificate, it is our understanding that the extension provisions of 10CFR2.109 are applicable.

Sincerely,

G. E. Cunningham
G. E. Cunningham
Sr. Licensing Engineer

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GENERAL ELECTRIC SHIELDED CONTAINER - MODEL 1500

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 706E792, Rev. 5, 706E441, Rev. 12, 135C5598, Rev. 2, 129D4690, Rev. 0, 163B8389, Rev. 2, 106D3870, Rev. 11, and 106D3858, Rev. 6, attached.

Shape:

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

Size:

The shielded cask is 30-1/4 inches in diameter by 48-1/4 inches high. The protective jacket is 60-7/8 inches high by 49-3/4 inches across the box section. The base is 59-1/2 inches square.

Construction:

The cask is a lead-filled carbon and stainless steel weldment. The protective jacket is a double walled structure of 3/8 inch carbon steel plate and surrounds the cask during transport. The square base is 1/2 inch carbon steel with four I-beams attached.

1.0 Package Description - Packaging (continued)

(a) General (continued)

Weight: The cask weighs 12,600 pounds. The protective jacket and base weigh 2,400 pounds

(b) Cask Body

Outer Shell: 3/8 inch thick steel plate, 47-3/4 inches high by 30-1/4 inches in diameter with a 1/2 inch bottom plate and a one inch top flange.

Cavity: 1/4 inch stainless steel wall and bottom plate, 7 inches in diameter by 25 inches deep.

Shielding Thickness: 11 inches of lead on the sides, 11-1/2 inches of lead beneath cavity and 11 inches of lead above cavity.

Penetration: One 1/2 inch outer diameter by 0.065 inch wall stainless steel tube gravity drain line from the center of the cavity bottom to the side of the outer shell near the cask bottom. Closed with a fusable lead cored 1/2-NPT hex head brass pipe plug or a solid stainless steel plug or an equivalent plug.

General Electric may, at its discretion, permanently close and seal the drain line for this container with no interference to other structural properties of the cask.

1.0 Package Description - Packaging (continued)

(b) Cask Body (continued)

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: Two right cylinders of decreasing diameter attached to flat plates.

Size: Top plate is 17-1/2 inch diameter by 1/4 inch thick. Bottom plate is 9-3/8 inch diameter by 1/4 inch thick. The top right cylinder is 6-5/8 inches high and is tapered such that the diameter at the top is 12-1/4 inches and the diameter at the bottom is 12 inches. The bottom right cylinder is 4-3/8 inches high and is tapered such that the top diameter is 9-5/8 inches and the bottom diameter is 9-3/8 inches.

Construction: Lead filled steel clad cylinders welded to circular steel plates.

Closure: Six one-inch - 8-UNC-2A steel bolts equally spaced 60° apart on a 14-7/8 inch diameter bolt circle.

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

1.0 Package Descripcion - Packaging (continued)

(c) Cask Lid (continued)

Penetrations:	None.
Shield Expansion Void:	None.
Lifting Device:	Single steel loop, 3/4 inch diameter steel rod located in center of lid top. Covered by protective jacket during transport.

(d) Liners — None anticipated. If used, they will be made of lead, tungsten or uranium encased in stainless steel.

(e) 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:	60-7/8 inches high by 49-3/4 inches wide across the box section. Outer cylindrical diameter is 36-1/2 inches. Inner diameter is 33 inches. A 5-1/2 inch wide by 3/8 inch thick steel flange is welded to the outer wall of the open bottom.
Construction:	Carbon steel throughout. Double walled construction. The walls are 3/8 inch thick. One inch air gap between cask shell and inner jacket wall and between inner and outer jacket walls, throughout. Eight 12 inch high by 3/8 inch thick gussets are welded to the outer cylindrical wall and flange. Including the two box sections, the gussets are spaced 36° apart.

1.0 Package Description - Packaging (continued)

(e) Protective Jacket Body (continued)

Attachment:	Six - 2-inch bolts connect the protective jacket body, through the flange to the pallet.
Lifting Devices:	Two rectangular 7/8 inch thick steel loops located on top of the box section at the corners. The steel is 8-3/4 inches long by 3 inches high by 5-1/2 inches wide. A stiffening plate, 4 inches wide, 9 inches high by 1/4 inch thick is attached to each side plate.
Tiedown Devices:	Two diametrically opposed 7 inches by 3-1/2 inches by 2-1/2 inch 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.

(f) 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 59-1/2 inches square and 1/2 inch thick. The cylindrical collar is 31-3/4 inches in diameter by 3 inches high. The I-beams are 3 inches high by 59-1/2 inches long.

1.0 Package Description - Packaging (continued)

(f) Protective Jacket Base (continued)

Construction: The cylindrical collar houses two sets of 1-1/4 inch by 1-1/4 inch by 1/4 inch steel energy absorbing angles separated by a 3/8 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 block 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: 500 grams of U-235 or 300 grams Pu or a prorated ratio of the two such that:

$$\frac{\text{grams U-235}}{500} + \frac{\text{grams Pu}}{300} \leq 1$$

The cask would be shipped as Fissile Class III. The criticality analysis is contained in Exhibit C of this application.

2.0 Package Description - Contents (continued)

(d) Radioactivity

That quantity of any radioactive material which does not generate spontaneously more than 3,120 thermal watts by radioactive decay and which meets the requirements of 49CFR173.393.

(e) Heat

Total maximum internally generated heat load not to exceed 3,120 thermal watts. Equilibrium thermocouple temperature recordings for this package loaded to 3,028 watts thermal were as follows:

Cavity wall	307°F
Maximum lead temperature	307°F
Inner surface of protective jacket	139°F
Outer surface of protective jacket	99°F
Ambient	80°F

The temperature change resulting from the difference between the requested watt loading and the test condition is small. 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

3.0 Package Evaluation (continued)

(a) General (continued)

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, 5.1, 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. Atomic Energy Commission and the Department 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.

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

3.0 Package Evaluation (continued)

(a) General (continued)

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 1500 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.

A tie-down analysis is included as Exhibit A to this application.

(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 specification 2R containers, but not limited to special form, will not be affected by these temperature extremes.

3.0 Package Evaluation (continued)

(b) Normal Transport Conditions (continued)

Pressure:	The package will withstand an external pressure of 0.5 times standard atmospheric pressure.
Vibration:	Inspection of the Model 1500 casks used since 1966 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 or 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 or assessments set forth above provide asusrance that the product contents are contained in the Shielded Container - Model 1500 during transport and there is no reduction in effectiveness of the package.

3.0 Package Evaluation (continued)

(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 1500 protective jacket. The increased weight and dimensions of the Model 1500 container over the Model 100 container necessitated a protective jacket wall of 3/8 inch steel compared to a 1/4 inch wall for the Model 100.

Drop Test: The design and construction of the GE Model 1500 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

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(1) C. B. Clifford, The Design, Fabrication and Testing of a Quarter Scale of the Demonstration 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, October 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, October 14-18, 1968, pp. 373-398.

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

3.0 Package Evaluation (continued)

(c) Hypothetical Accident Conditions (continued)

Drop Test: (continued) that would withstand the test conditions of 49CFR173.398(c) and 10CFR71.36 without breaching the integrity of the Model 1500 cask. The intent of the design for the GE Model 1500 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 1500 is subjected to the 30 foot drop test. A bolt analysis is attached as Exhibit B.

Puncture Test: The intent of the design for the GE Model 1500 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 deformation not greater than that sustained by the GE Model 100 will be received by the GE Model 1500 in the event that the package is subjected to the puncture test.

Thermal Test: Since it is expected that the GE Model 1500 cask will sustain negligible damage and only minor damage will occur to the protective jacket in the drop and puncture tests, it is reasonable to consider the resultant package, for purposes of thermal resistance, as essentially undamaged. Accordingly, the package was assessed using the General Electric Transient Heat Transfer Computer Program, Version D (THTD), which allows the analysis

3.0 Package Evaluation (continued)

(c) Hypothetical Accident Conditions (continued)

Thermal Test: (continued) of the general transient problems involving conduction, convection, and radiation. The program allows the thermal properties of the materials to be entered as a function of temperature and the boundary conditions to be entered as a function of time.

The significant assumptions, approximations, and boundary conditions used for the analysis are listed below:

1. Fire temperature — $1472^{\circ}F$
2. Effective Fire Emissivity — 0.9
3. Fire shield surface Emissivity — 0.8 and constant with temperature
4. Emissivity of other Surfaces — 0.8 and constant with temperature
5. There is intimate contact between the lead shielding and the stainless steel shell of the cask.
6. There is negligible heat transfer by conduction through the pipes used as spacers between the cask and the first shield and between the two shields of the protective jacket.
7. There is negligible heat transfer by convection between the two shields of the protective jacket and between the cask and first shield of the protective jacket.

3.0 Package Evaluation (continued)

(c) Hypothetical Accident Conditions (continued)

Thermal Test: (cont.)

8. There is an internal heat load of 3,120 watts with a temperature profile as outlined in Section 2.0 of this application.

The computer program calculations were run for a 30 minute fire. The calculations indicate a maximum temperature rise of less than 390°F for the lead after 30 minutes and no lead melting could be expected. Although a coast-up analysis was not performed on this container, the resulting maximum lead temperature, after equilibrating for forty minutes, is expected not to exceed 470°F. Exhibit A to the Model 100 Application further describes the computer code THTD.

Water Immersion:

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

Summary and Conclusions:

The accident tests or 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 1500 is adequate as packaging for the contents specified in 2.0 of this section.

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 conduct 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 Dept. of Transportation.

5.0 Fissile Class Class III

6.0 Modes of Transportation

All modes except passenger aircraft are requested.

EXHIBIT A

TIE DOWN ANALYSIS