NRC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9253	14	71-9253	USA/9253/B(U)F-96	1 OF	9

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

U.S. Department of Energy
Washington, DC 20585

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Safety Analysis Report for the TN-FSV Package, dated March 31, 1993, as supplemented; Addendum A for the Oak Ridge Container in the TN-FSV Packaging, dated June 15, 2001, as supplemented; Addendum B for the PWR Fuel Rod Shielded Basket dated December 28, 2007, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.(a) Packaging

(1) Model No.: TN-FSV

(2) Description

A steel and lead shielded shipping cask for irradiated nuclear fuel. The cask has three shipping configurations: Configuration 1 for shipping irradiated Fort St. Vrain high temperature gas cooled reactor (HTGR) fuel elements, Configuration 2 for shipping irradiated fuel parts and intact irradiated Peach Bottom Unit 1 fuel elements within a secondary containment vessel, and Configuration 3 for shipping irradiated Pressurized Water Reactor (PWR) fuel rods within a shielded basket. The cask is a right circular cylinder, with a balsa and redwood impact limiter at each end. The package has approximate dimensions and weights as follows:

Cavity diameter	18 inches
Cavity length	199 inches
Cask body outer diameter	31 inches
Lead shield thickness	3.44 inches
Package overall outer diameter, including impact limiters	78 inches
Package overall length, including impact limiters	247 inches
Packaging weight (Configuration 1)	42,000 pounds
Gross package weight, including contents (Configurations 1 and 2)	47,000 pounds

5.(a) (2) Description (Continued)

The cask body is made of two concentric shells of Type 304 stainless steel, welded to a bottom plate and a top closure flange. The inner shell has an ID of 18 inches and is 1.12 inches thick. The outer shell has an OD of approximately 30 inches and is 1.5 inches thick. The annular space between the inner and outer shells is filled with lead. The bottom plate is 5.5-inch thick Type 304 stainless steel. The closure lid is 2.5-inch thick Type 304 stainless steel, and is fully recessed into the cask top flange. The lid is fastened to the cask body by 12, 1-inch diameter closure bolts. The lid is sealed with double O-ring seals with a leak test port. A vent port and drain port are sealed with single O-rings and cover plates. Configuration 1 uses silicone O-ring seals and Configurations 2 and 3 use butyl O-ring seals. The cask body is covered with a stainless steel thermal shield composed of 0.25-inch thick stainless steel plate over a wire wrap. The impact limiters are constructed of balsa and redwood encased in stainless steel shells.

The cask has two lifting sockets bolted to the cask top flange. Two rear trunnions are provided for cask tie-down.

For Configuration 1:

Irradiated hexagonal HTGR fuel elements are shipped in Configuration 1. The fuel elements are stacked in a carbon steel fuel storage container, which has an OD of approximately 17.6 inches and an overall length of 195 inches. The fuel storage container has a 0.5-inch thick shell, a 2.0-inch thick bottom plate, and a 1.5-inch thick lid. The lid accommodates a removable depleted uranium plug.

For Configuration 2:

Irradiated fuel parts and intact Peach Bottom Unit 1 fuel elements are shipped in Configuration 2. Canisters, containing either fuel parts or a single intact Peach Bottom fuel element, are loaded into a separate, secondary containment vessel, the Oak Ridge Container. The Oak Ridge Container is composed of a right circular cylindrical vessel and a basket assembly. The stainless steel vessel has a 10-gage (0.135-inch) wall thickness, an overall length of approximately 198 inches, and an outside diameter of approximately 20 inches at the lid end. The lid is approximately 7 inches thick and is closed by 12, 1/2-inch diameter bolts and two butyl O-ring seals. There is a single penetration through the lid which is closed by a bolted port cover and two butyl O-ring seals. The basket is composed of a series of discs, tie rods, and support tubes, with five fuel compartment tubes arranged in a star-like configuration. The basket incorporates fixed borated aluminum neutron poison plates. Flux trap spacers are positioned axially between stacked fuel parts canisters, and the canisters and spacers are positioned within a stainless steel sleeve that forms the fuel compartment. Canisters containing fuel parts (called Oak Ridge Canisters) and canisters containing intact Peach Bottom fuel elements may be shipped together.

5.(a) (2) Description (Continued)

For Configuration 3

Irradiated PWR fuel rods are shipped in Configuration 3. The fuel rods are loaded into a PWR fuel rod shielded basket. The basket has an overall length of 166 inches and an overall diameter of 17.5 inches, and fits closely within the TN-FSV cask cavity. The basket consists of a bottom end spacer, a cylindrical body with an inner diameter of 4 inches and an outer diameter of 10-1/2 inches with lateral support discs, and an 11-inch thick top lid. The basket is constructed of stainless steel. Up to 7 PWR fuel rods are loaded into individual stainless steel tubes within the basket.

(3) Drawings

The TN-FSV packaging is constructed and assembled in accordance with the following drawings.

Transnuclear, Inc., Drawing Nos.:

1090-SAR-1, Rev. 3
1090-SAR-2, Rev. 3
1090-SAR-6, Rev. 3
1090-SAR-7, Rev. 3
1090-SAR-8, Rev. 3
1090-SAR-9, Rev. 3
1090-SAR-10, Rev. 2

AREVA Federal Services LLC, Drawing Nos.:

1090-SAR-3, Rev. 4
1090-SAR-4, Rev. 5
1090-SAR-5, Rev. 5

The Oak Ridge Container and internals are constructed and assembled in accordance with the following Transnuclear, Inc. Drawing Nos.:

3044-70-1, Rev. 5
3044-70-2, Rev. 3
3044-70-3, Rev. 2
3044-70-4, Rev. 2
3044-70-5, Rev. 2
3044-70-6, Rev. 2
3044-70-7, Rev. 2
3044-70-8, Rev. 1
3044-70-9, Rev. 0

The Oak Ridge Canister is constructed and assembled in accordance with the following Lockheed Martin Energy Systems, Inc. Drawing No.:

X3E020566A175, Rev. 0

5.(a) (3) Drawings (Continued)

The PWR Fuel Rod Shielded Basket is constructed and assembled in accordance with the following AREVA Federal Services LLC, Drawing Nos.:

P03FM108-SAR, Sheets 1-3, Rev. 2

5.(b) Contents

(1) Type and form of material

(i) For Configuration 1:

Irradiated HTGR fuel elements within a fuel storage container. Each fuel element consists of a graphite block containing fuel rods. The fuel is composed of thorium/uranium carbide and thorium carbide fuel particles within the fuel rods. The graphite block is hexagonal in cross section and is approximately 14.2 inches across the flats and 31.2 inches long. Each fuel element contains a maximum of 1.4 kg of uranium enriched to a maximum of 93.5 weight percent U-235 and approximately 11.3 kg of thorium. The maximum burnup is approximately 70,000 MWd/MTIHM, and the minimum cool time is 1600 days.

(ii) For Configuration 2:

Irradiated, intact Peach Bottom Unit 1, Core 2, fuel elements within aluminum canisters with steel liners. Each fuel element consists of stacked graphite annular rings, or compacts, with an inner diameter of approximately 1.75 inches and an outer diameter of approximately 2.75 inches. The fuel is composed of coated thorium/uranium carbide particles within the graphite. The active fuel length is approximately 90 inches. The fuel element may include associated hardware such as top plug, reflector apparatus, grappling hook, etc. Each fuel element contains a maximum of 0.25 kg of uranium enriched to a maximum of 93.15 weight percent U-235 and approximately 1.5 kg of thorium prior to irradiation. The maximum burnup is approximately 73,000 MWd/MTIHM and the minimum cool time is 27 years.

5.(b) (1) (iii) For Configuration 2:

Irradiated fuel parts within Oak Ridge Canisters, as described in Item No. 5(a)(3), above. The minimum fuel cool time is 15 years. The maximum fissile mass prior to irradiation per Oak Ridge Canister is limited as shown below:

Canister Group	Maximum mass U-235 per canister (grams)	Maximum mass Pu-239 + Pu-241 per canister (grams)
1	475	0
2	865	191
3	200	415
4	275	160
5	910	0

(iv) For Configuration 3:

Undamaged irradiated PWR fuel rods. The fuel rods are composed of uranium oxide pellets within zirconium-alloy cladding. The maximum uranium enrichment is 5.0 weight percent U-235. The maximum fuel rod length is 156.6 inches. For rods categorized as high uranium loading, the maximum uranium mass is 2.36 kgU/rod. For rods categorized as medium uranium loading, the maximum uranium mass is 1.78 kgU/rod. Known or suspected damaged fuel rods, and fuel rods with cladding defects greater than pin holes and hairline cracks are not authorized. Irradiated guide tubes may be substituted for fuel rods.

(2) Maximum quantity of material per package

Total weight of contents and packaging material within the TN-FSV cavity not to exceed 5,000 pounds. For Configuration 1 this includes fuel elements, fuel storage container, and depleted uranium shield plug. For Configuration 2 this includes fuel materials, Oak Ridge Container, basket, Oak Ridge Canisters, Peach Bottom fuel canisters, flux trap spacers, and other packaging materials. For Configuration 3 this includes fuel rods and PWR fuel rod shielded basket.

(i) For the contents described in Item 5(b)(1)(i):

Six fuel elements, with decay heat not to exceed 60 watts per fuel element.

5.(b) (2) Maximum quantity of material per package (Continued)

(ii) For the contents described in Item 5(b)(1)(ii) and 5(b)(1)(iii):

Total weight of fuel materials, canisters, and flux trap spacers within the Oak Ridge Container not to exceed 1,789 pounds. Decay heat not to exceed 120 watts per package. The maximum decay heat per Oak Ridge Canister is 35 watts, except that the maximum decay heat per Oak Ridge Canister in the position next to the lid is 7 watts. The maximum decay heat in any cross sectional region corresponding to the axial length of an Oak Ridge Canister is 55 watts, except that the maximum decay heat in the cross sectional region next to the lid is 35 watts.

(ii) For the contents described in Item 5(b)(1)(ii) and 5(b)(1)(iii): (continued)

Canisters containing intact Peach Bottom fuel elements and Oak Ridge Canisters containing irradiated fuel parts must be loaded into the Oak Ridge Container fuel compartments as follows:

Loading Pattern	One Fuel Compartment	Other Four Fuel Compartments
1	Four Group 2 Canisters	Four Group 1 Canisters
2	Four Group 5 Canisters	Four Group 1 Canisters
3	One Peach Bottom Element and One Group 4 Canister	One Peach Bottom Element and One Group 4 Canister
4	Two Group 3 Canisters and Two Group 4 Canisters	One Peach Bottom Element and One Group 4 Canister

Flux trap spacers, as shown in Transnuclear, Inc. Drawing No. 3044-70-3, must be positioned axially between any two Oak Ridge Canisters.

5.(b) (2) (iii) For the contents described in Item 5(b)(1)(iv):

Total decay heat not to exceed 360 watts per package. The maximum number of rods per package is determined based on the maximum burnup and minimum decay time of any single (most limiting) rod in the package. The maximum number of rods per package is as follows:

Rod Type	Maximum Burnup (GWD/MTU)	Minimum Decay Time (days)	Maximum Number of Rods Per Package
High Uranium Loading (Max. 2.36 kgU/rod)	60	265	7
		210	6
		180	5
	72	450	7
		365	6
	80	1500	7
		900	6
		450	5
		365	4
Medium Uranium Loading (Max. 1.78 kgU/rod)	60	180	7
	72	365	7
	80	500	7
		365	6
Zirconium-alloy guide tubes	NA	180	7

5.(c) Criticality Safety Index (CSI) 100

6. The package must be leak tested as follows:

(a) <u>For Configuration 1</u>:

(1) In the 12-month period prior to shipment and after seal replacement, each containment seal must be tested to show a leak rate no greater than 1×10^{-3} ref-cm^3/sec. The leak test must have a sensitivity of at least 5×10^{-4} ref-cm^3/sec.

(2) Prior to each shipment, the package seals (main seal and vent seal) must be leak tested in accordance with Section 7.1.2 of the Safety Analysis Report. The acceptance criterion is a leak rate no greater than 1×10^{-3} ref-cm^3/sec. The test must have a sensitivity of at least 1×10^{-3} ref-cm^3/sec. The drain seal must also be tested if the drain port cover has been removed since the seal was last leak tested.

6. (b) For Configuration 2:

(1) In the 12-month period prior to shipment and after seal replacement, each containment seal of the outer cask and the Oak Ridge Container must be tested to show a leak rate no greater than 1×10^{-7} ref-cm^3/sec. The leak test must have a sensitivity of at least 5×10^{-8} ref-cm^3/sec.

(2) Prior to each shipment, the Oak Ridge Container containment seals (main seal and vent seal) and the outer cask containment seals (main seal and vent seal) must be leak tested in accordance with Section 7.1.2 of Addendum A. The seals must show no leakage greater than 1×10^{-7} ref-cm^3/sec or no leakage when tested to a sensitivity of at least 1×10^{-3} ref-cm^3/sec. The drain seal of the outer cask must also be tested if the drain port cover has been removed since the seal was last leak tested.

(c) For Configuration 3:

(1) In the 12-month period prior to shipment and after seal replacement, each containment seal of the outer cask must be tested to show a leak rate no greater than 1×10^{-7} ref-cm^3/sec. The leak test must have a sensitivity of at least 5×10^{-8} ref-cm^3/sec.

(2) Prior to each shipment, the outer cask containment seals (main seal and vent seal) must be leak tested in accordance with Section B7.1.2 of Addendum B. The seals must show no leakage greater than 1×10^{-7} ref-cm^3/sec or no leakage when tested to a sensitivity of at least 1×10^{-3} ref-cm^3/sec. The drain seal of the outer cask must also be tested if the drain port cover has been removed since the seal was last leak tested.

7. In addition to the requirements of Subpart G of 10 CFR Part 71:

(a) The package must be prepared for shipment and operated in accordance with Chapter 7 of the Safety Analysis Report for Configuration 1; Chapter 7 of Addendum A for Configuration 2; and Chapter B7 of Addendum B for Configuration 3.

(b) Each packaging must meet the acceptance tests and must be maintained in accordance with Chapter 8 of the Safety Analysis Report for Configuration 1; Chapter 8 of Addendum A for Configuration 2; and Chapter B8 of Addendum B for Configuration 3.

(c) Prior to each shipment for Configurations 1, 2, and 3, the cask main closure seal and vent seal must be inspected. The drain seal must be inspected if the drain port cover has been removed during preparation for shipment. In addition, prior to each shipment for Configuration 2, the Oak Ridge Container main closure seal and vent seal must be inspected. For Configurations 1, 2, and 3, all seals must be replaced within the 12-month period prior to shipment, or earlier if inspection shows any defect.

8. Transport of fissile material by air is not authorized.

9. Fabrication of additional impact limiters (balsa and redwood encased in stainless steel shells) is not authorized.

10. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

11. Packagings may be marked with Package Identification Number USA/9253/B(U)F-85 until June 30, 2010, and must be marked with Package Identification Number USA/9253/B(U)F-96 after June 30, 2010.

12. Expiration date: July 31, 2024.

REFERENCES

Public Service Company of Colorado application dated March 31, 1993; as supplemented February 24, June 2, and June 14, 1994; and September 11 and December 7, 1995.

U.S. Department of Energy supplements dated: March 24, 1997; March 24, 1999; June 15, September 18, October 2, 2001; April 22, 2004; December 28, 2007; April 23, and June 11, 2009; July 13, 2009; March 11, 2014, and June 4, 2019.

Transnuclear, Inc., supplements dated September 19, 2001; and March 1, May 17, June 14 and 21, 2002; June 3, and July 21, 2003.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

John McKirgan, Chief
Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: 6/14/19