NRC FORM 618
(8-85)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1.a CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
5450	31	USA/5450/AF	1	7

2. PREAMBLE

a. This certificate is issued to certify that the 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)

Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Westinghouse Electric Corporation application dated December 20, 1985, as supplemented.

c. DOCKET NUMBER 71-5450

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 Nos.: RCC, RCC-1, RCC-3, and RCC-4

(2) Description

Steel fuel element cradle assembly consisting of a strongback and adjustable fuel element clamping assembly, shock mounted to a 14-gauge steel outer container by shear mounts. Neutron absorber plates are required for the contents as specified. Gross weight for the RCC is 6,300 lbs., RCC-1 and RCC-3 is 7,200 lbs., and RCC-4 is 8,400 lbs.

(3) Drawings

The packagings are constructed in accordance with the following Westinghouse Electric Corporation Drawing Nos.:

For the RCC packaging:	RCCL002, Sheets 1 through 3, Rev. 2.
For the RCC-1 packaging:	RCCL102, Sheets 1 through 3, Rev. 2.
For the RCC-3 packaging:	RCCL302, Sheets 1 through 3, Rev. 2.
For the RCC-4 packaging:	RCCL402, Sheet 1, Rev. 3; Sheets 2 through 3, Rev. 2.

(4) Fuel rod container reinforced 13-gauge steel box constructed in accordance with Westinghouse Electric Corporation Drawing No. C5650D55, Rev. 7.

(5) Dimensions and placement of neutron absorber plates in accordance with unnumbered drawing attached to Westinghouse Letter # LA 89-19 dated 2/14/89.

5. (b) Contents

(1) Type and form of material

(i) Uranium dioxide as Zircaloy or stainless steel clad unirradiated fuel elements. Two neutron absorber plates consisting of 0.19" thick, full length stainless steel containing 1.3% minimum boron or 0.19" thick OFHC copper are required between fuel elements of the following specifications:

Type	14x14 Zr Clad	15x15 Zr Clad	14x14 SST Clad	15x15 SST Clad	17x17 Zr Clad	16x16 Zr Clad	14x14 Zr Clad
Pellet diameter (nom), in	0.344-0.367	0.367	0.384	0.384	0.308-0.322	0.322	0.3805
Rod diameter (nom), in	0.400-0.422	0.422	0.422	0.422	0.360-0.374	0.374	0.44
Maximum fuel length, in	144	144	120	120	168	144	144
Maximum rods/element	180	204	180	204	264	235	176
Maximum cross section, (nom), in sq	7.8	8.4	7.8	8.4	8.4	7.8	7.98
Maximum U-235/element, kg	17.7	18.3	18.5	18.7	16.95 (144"L) 19.8 (168"L)	16.6	19.0
Maximum U-235 enrichment, w/o	4.0	3.65	4.0	3.65	3.65	4.0	3.85

(ii) Uranium dioxide as Zircaloy clad unirradiated fuel elements contained within the Model No. RCC-4 packaging. Two neutron absorber plates consisting of 0.19" thick carbon steel are required between fuel elements of the following specifications:

Type	17x17 Zr Clad
Pellet diameter, in	0.308 - 0.322
Rod diameter, in	0.360 - 0.374
Maximum fuel length, in	168
Maximum rods/element	264
Maximum cross section (nom) in sq	8.4
Maximum U-235/element, kg	19.3
Maximum U-235 enrichment, w/o	3.55

5. (b) (1) Type and form of material (continued)

(iii) Uranium dioxide as Zircaloy clad unirradiated fuel elements. Two neutron absorber plates consisting of carbon steel, 0.035 inches in thickness, with a cermet Gd_2O_3 coating affixed to each side providing a total of 0.054 $g\text{-}Gd_2O_3/cm^2$ for both sides of the plate, are required between fuel elements of the following specifications:

Type	14x14 Zr Clad	15x15 Zr Clad	14x14 SST Clad	15x15 SST Clad	17x17 Zr Clad	17x17 Zr Clad	16x16 Zr Clad	16x16 Zr Clad
Pellet diameter (nom), in	0.344-0.367	0.367	0.384	0.384	0.322	0.308	0.322	0.325
Rod diameter (nom), in	0.400-0.422	0.422	0.422	0.422	0.374	0.360	0.374	0.382
Maximum fuel length, in	144	144	120	120	168	168	144	150
Maximum rods/element	180	204	180	204	264	264	235	236
Maximum cross section, (nom), in sq	7.8	8.4	7.8	8.4	8.4	8.4	7.8	7.98
Maximum U-235/element, kg	22.1	21.5	23.1	22.0	21.75 (144"L) 25.5 (168"L)	19.9 (144"L) 23.3 (168"L)	20.7	21.1
Maximum U-235 enrichment, w/o	5.0	4.3	5.0	4.3	4.7	4.3	5.0	5.0

Type	15x15 Zr Clad (B&W Type)	14x14 Zr Clad w/ Annular Pellets**
Pellet diameter (nom), in	0.367	0.3444
Rod diameter (nom), in	0.422	0.4000
Maximum fuel length, in	141.8	144
Rods/element	208	179
Maximum cross section, (nom), in sq	8.5	7.8
Maximum U-235/element, kg	17.8	18.1
Maximum U-235 enrichment, w/o	3.95	5.0

** For 14x14, zircaloy-cladded fuel assembly with annular pellets, the middle 132 inches of the active fuel length consists of solid pellets, and the top and bottom 6 inches of the active fuel length consists of annular pellets with a nominal hole diameter of 0.172 inches. The fuel assemblies shall be held in place by at least 7 clamping fram arms.

5. (b) (1) Continued

(iv) Uranium dioxide as Zircaloy clad unirradiated fuel elements containing a minimum of 48 IFBA rods and 25 Instrument/Guide tubes per specification and loading pattern described in Westinghouse drawing SKA-89044, Sheet 1, Rev. 2. Two neutron absorber plates consisting of carbon steel, 0.035 inches in thickness, with 4 mils of Gd_2O_3 (0.02 gm-Gd_2O_3/cm^2) affixed to each side of the plate are required between fuel elements of the following specifications:

Type	17 x 17 Zr Clad
Pellet diameter (nom), in	0.308
Rod diameter (nom), in	0.360
Maximum fuel length, in	168
Maximum rods/element	264
Maximum cross section (nom), in sq	8.4
Maximum U-235/element, kg	22.5 (144"L)
Minimum ZrB_2 rods/assembly	48
Minimum ZrB_2 IFBA length, in	108
Maximum U-235 enrichment, w/o	4.85

(v) Uranium dioxide as Zircaloy clad unirradiated fuel elements. Two neutron absorber plates consisting of carbon steel 0.035 inches in thickness, with 4 mils of Gd_2O_3 (0.02gm-Gd_2O_3/cm^2) affixed to each side of the plate are required between fuel elements of the following specification:

Type	17 x 17 Zr Clad
Pellet diameter (nom), in	0.308
Rod diameter (nom), in	0.360
Maximum fuel length, in	168
Maximum rods/element	264
Maximum cross section (nom), in sq	8.4
Maximum U-235/element, kg	22.5 (144"L)
Maximum U-235 enrichment, w/o	4.85

5. (b) (1) Continued

(vi) Uranium dioxide as Zircaloy or stainless steel clad unirradiated fuel rods of the following specifications:

Type	SST Clad	Zr Clad	Zr Clad	Zr Clad	Zr Clad	Zr clad
Pellet diameter (nom), in	0.384	0.344-0.367	0.308-0.322	0.322	0.3805	0.325
Rod diameter, in	0.422	0.400-0.422	0.360-0.374	0.374	0.44	0.382
Fuel length (max), in	120	144	168	144	144	150
U-235 enrichment (max), w/o						
Note (1)	4.0	4.0	3.65	4.0	3.85	---
Note (2)	4.2	4.2	4.3	4.3	---	4.2
Note (3)	---	---	3.55	---	---	---

Notes:

(1) Two neutron absorber plates consisting of 0.19-inch thick, full length stainless steel containing 1.3% (minimum) Boron or 0.19-inch thick OFHC copper are required between the rod boxes.

(2) Two neutron absorber plates consisting of carbon steel, 0.035 inch in thickness, with 4 mils of Gd_2O_3 (minimum 0.02 gm Gd_2O_3/cm^2) affixed to each side of the plate are required between the rod boxes.

(3) Two neutron absorber plates consisting of 0.19-inch thick carbon steel are required between the rod boxes.

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

(i) For the contents described in 5(b)(1)(i), 5(b)(1)(ii), 5(b)(1)(iii), and 5(b)(1)(iv):

Two fuel elements

(ii) For the contents described in 5(b)(1)(v):

One fuel element

(iii) For the contents described in 5(b)(1)(vi):

Two inner containers containing not more than 80 kilograms U-235

5. (c) Fissile Class I

6. Fuel rods must be closely packed in the fuel rod container on no more than an equivalent metal-to-metal square lattice. Partially loaded fuel rod containers must be fitted with a minimum of three, equally spaced blocks, of which the noncombustible portion of the blocks and the method by which they are secured must assure that the rods are maintained on no more than an equivalent metal-to-metal square lattice within the fuel rod container.

7. Each fuel assembly must be unsheathed or must be enclosed in an unsealed, polyethylene sheath which will not extend beyond the ends of the fuel assembly. The ends of the sheath must not be folded or taped in any manner that would prevent the flow of liquids into or out of the sheathed fuel assembly.

   Alternatively, the fuel assembly may be enclosed in an elongated plastic bag or sheath along its full length. At the bottom end of the fuel assembly, the bag will be cut off or folded back to assure that the entire cross section of the lower end of the assembly is unobstructed. When folding is used, the portion of the sheath that is folded back will be cinched with tape near its end to hold it in place, and the length will be such that when the assembly is loaded in the packaging, the folded sheath will be clamped in place in at least two grid locations. The top end of the bag may be gathered together and taped closed. However, the top end then will be slit on all four sides. The slits will run perpendicular to the axis of the assembly and will extend the inner distance between the top nozzle pads and spring clamps (approximately 60% of the length of each side). The slits will be made in a plane near that formed by the top of the pads and clamps.

8. Use of packaging fabricated after February 28, 1986, is not authorized.

9. The gross weight must not exceed 6,300 pounds for the RCC packaging, 7,200 pounds for the RCC-1 and RCC-3 packagings, and 8,400 pounds for the RCC-4 packaging.

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

    (a) The package must be maintained in accordance with the maintenance procedures submitted with Westinghouse supplements dated June 20, September 16, and September 19, 1991.

    (b) The package must be prepared for shipment and operated in accordance with the operating procedures submitted with Westinghouse supplements dated June 20, September 16, and September 19, 1991.

11. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12.

12. Expiration date: September 30, 1996.

REFERENCES

Westinghouse Electric Corporation application dated December 20, 1985.

Supplements dated: April 28, July 1, 21, 1986; January 4, February 14, April 18, October 5, and November 30, 1989; March 5, April 17, June 20, September 16, September 19, and September 24, 1991; February 11, and March 21, 1994.

Department of Energy supplement dated: March 1, 1984.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Cass R. Chappell

Cass R. Chappell, Section Leader
Cask Certification Section
Storage and Transport Systems Branch
Division of Industrial and
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Date: MAR 25 1994

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

APPROVAL RECORD

Model Nos. RCC, RCC-1, RCC-3, and RCC-4 Packages
Certificate of Compliance No. 5450
Revision 31

By application dated February 11, 1994, as supplemented March 21, 1994, Westinghouse Electric Corporation requested an amendment to Certificate of Compliance No. 5450 for the RCC series packages. Westinghouse requested that the authorized contents of the package be revised to include 14x14 OFA fuel assemblies with annular pellets at the ends of the rods. Specifications for the fuel assemblies are as follows:

> Unirradiated 14x14 OFA UO_2 fuel assembly with a maximum square cross-section of 7.8 inches, and consisting of 179 fuel rods maximum. The fuel rods are cladded in Zircaloy and have a nominal diameter of 0.4000 inches. The active fuel length is 144 inches. The middle 132 inches of the active fuel length consists of solid pellets with a nominal diameter of 0.3444 inches. The top and bottom 6 inches of the active fuel length consist of annular pellets with a nominal inner diameter of 0.172 inches and a nominal outer diameter of 0.3444 inches. The maximum U-235 enrichment is 5.0 wt%, and the maximum U-235 loading per assembly is 18.1 kg.
>
> Two (2) neutron absorber plates consisting of carbon steel, 0.035 inches in thickness, with a cermet of Gd_2O_3 affixed to each side providing a total of 0.054 g-Gd_2O_3/cm^2 for both sides of the plate, are required between fuel assemblies. The fuel assemblies shall be held in place on the strongback with at least seven (7) clamping frame arms.

The 14x14 OFA fuel assembly meets the specifications for the Zircaloy-cladded, 14x14 fuel assembly previously authorized under Condition 5(b)(1)(iii) of Certificate of Compliance No. 5450, Revision 30, except that the top and bottom six inches of the active fuel length consist of annular fuel pellets. Also, the poison loading is an increase from the value previously specified in Item 5(b)(1)(iii) of the certificate of compliance. Two fuel assemblies will be shipped per package.

Westinghouse performed criticality calculations using the KENO-Va code to evaluate the reactivity of RCC packages loaded with 14x14 OFA fuel assemblies. The calculations were performed for an infinite array of damaged packages. Analyses of previously approved assemblies indicate that the hypothetical accident condition array represents the limiting reactivities. Westinghouse considered five cases in their calculations. A description and the result of each case are summarized in Table 1 below.

TABLE 1 - WESTINGHOUSE KENO RESULTS FOR 14X14 OFA FUEL ASSEMBLY								
Case	Model Description	Pellet Config.	Moderator Density		K_{eff}	σ	Adj. K_{eff}[1]	ΔK
			Inside Rods	Outside Rods				
1	3D model - no pkg. comp. except strongback, poison plates, and outer shell	solid and annular	1.00	0.00	0.92487	0.00490	0.94126	0.0052
2	3D model - no pkg. comp. except strongback, poison plates, and outer shell	solid and annular	1.00	1.00	0.93107	0.00425	0.94646	
3	2D model - packaging components included	solid	0.02	0.00	0.79181	0.00401	0.80683	
4	3D model - no pkg. comp. except strongback, poison plates, and outer shell	solid and annular	0.02	1.00	0.94439	0.00375	0.95909	0.0049
5	3D model - no pkg. comp. except strongback, poison plates, and outer shell	solid	0.02	1.00	0.94007	0.00335	0.95411	

1. Adjusted K_{eff} includes bias and 2σ.

On four of the cases (Cases 1, 2, 4, and 5), Westinghouse used a three-dimensional model that did not include any packaging components except the strongback, poison plates, and outer shell. Cases 1 and 2 show that the array of packages is adequately subcritical when flooded with full-density water. These cases also show that leakage of water into the internal regions of the fuel rods increases reactivity only slightly (0.0052ΔK increase). Cases 4 and 5 evaluated the reactivity of the array under optimum moderation. Optimum moderation occurs with low-density water (0.02 g/cm^3) in the external regions of the fuel rods and full-density water in the internal regions of the fuel rods. These cases show that at optimum moderation, the reactivity of assemblies with both solid and annular pellets is not significantly greater than the reactivity of assemblies with only solid pellets (0.0049ΔK increase).

The calculated K_{eff}'s for Cases 4 and 5 exceed the acceptance criterion of 0.95. The model used for these cases, however, is conservative because a significant amount of steel within the packaging is ignored. Therefore, Westinghouse considered another case (Case 3) which shows that with a model that more fully represents the actual packaging design, the K_{eff} for an array of packages remains below 0.95 under optimum moderation. The model used for Case 3 is a two-dimensional model that includes additional packaging components such as the clamp frames. Case 3 yielded a K_{eff} of 0.807 (including bias and 2σ). The calculation was performed for solid pellets only and without moderation in the internal regions of the fuel rods. Based on the small reactivity changes between Cases 1 and 2, and between Cases 4 and 5, and considering the low K_{eff} calculated for Case 3, Westinghouse concluded that the K_{eff} for an array of packages containing 14x14 OFA fuel assemblies would remain below 0.95 under optimum moderating conditions.

The staff performed an independent confirmatory analysis. This analysis used a 3-D model with annular pellets and included structural components of the packaging. The model also assumed flooding with optimum water density. The staff's analysis shows that under the most reactive conditions, the K_{eff} for an array of packages remains below 0.95.

Based on the applicant's analysis and the staff's confirmatory analysis, the staff concludes that the amendment will not affect the ability of the package to meet the requirements of 10 CFR Part 71.

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Date: MAR 25 1994