ENCLOSURE 4

Markup of Revision 10 of the Certificate of Compliance No. 9309

Non-Proprietary Information – Class I (Public)

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
9309	11~~0~~	71-9309	USA/9309/B(U)F-96	1 OF	~~8~~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)*

Global Nuclear Fuel - Americas, LLC
P.O. Box 780
Wilmington, NC 28402

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

NEDO-33869 Revision 9, Global Nuclear Fuel - Americas, LLC, application dated ~~July 11~~September~~,~~ 201~~6~~4.

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.: RAJ-II

(2) Description

The RAJ-II package is a rectangular box that is 742 mm (29.21 in) high by 720 mm (28.35 in) wide by 5,068 mm (199.53 in) long to transport a maximum of two Boiling Water Reactor (BWR) fuel assemblies or individual rods that meet the ASTM C996~~-96~~ standard of enriched commercial grade uranium, enriched reprocessed uranium, uranium oxide generic P~~p~~ressurized W~~w~~ater R~~r~~eactor (PWR) or uranium carbide loose fuel rods in a 5 inch diameter stainless steel pipe.

It is comprised of one inner container and one outer container both made of stainless steel. The inner container is comprised of a double-wall stainless steel sheet structure with alumina silicate thermal insulator filling the gap between the two walls to reduce the flow of the heat into the contents in the event of a fire. Foam polyethylene cushioning material is placed on the inside of the inner container for protection of the fuel assembly. The outer container is comprised of a stainless steel angular framework covered with stainless steel plates. Inner container clamps are installed inside the outer container with a vibro-isolating device between to alleviate vibration occurring during transportation. Wood and honeycomb resin impregnated kraft paper are placed as

5.(a)(2) continued

shock absorbers to reduce shock in the event of a drop of the package. The fuel rod cladding and ~~ceramic nature of the fuel pellets~~welded end plugs provide primary containment of the radioactive material. The radioactive material is bound in ceramic pellets with very limited solubility and minimal propensity to suspend in air.

~~5.(a)(2) continued~~

The approximate dimensions and weights of the package are as follows:

Maximum gross shipping weight	1,614 kg (3,558 lbs)
~~—~~Maximum weight of inner container	308 kg (679 lbs)
~~—~~Maximum weight of outer container	622 kg (1,371 lbs)
~~—~~Maximum weight of packaging	930 kg (2,050 lbs)
Loose rods pipe nominal mass per component	106 kg (234 lbs)
Protective case nominal mass per component	87 kg (192 lbs)
Dimensions of inner container	
Length	4,686 mm (184.49 in)
~~—~~Width	459 mm (18.07 in)
Height	286 mm (11.26 in)
Dimensions of outer container	
Length	5,068 mm (199.53 in)
~~—~~Width	720 mm (28.35 in)
Height	742 mm (29.21 in)

(3) Drawings

This packaging is constructed in accordance with the Global Nuclear Fuel (GNF) Drawing Nos.:

Outer Container Drawings
105E3737, Rev. ~~6~~8
105E3738, ~~Sheets 1 and 2,~~ Rev. ~~8~~10
~~105E3738, Sheet 3, Rev. 7~~
105E3739, Rev. ~~4~~6
105E3740, Rev. ~~4~~6
105E3741, Rev. ~~1~~3
105E3742, Rev. ~~3~~5
105E3743, Rev. ~~5~~7

105E3744, Rev. ~~6~~8

Inner Container Drawings
105E3745, Rev. ~~8~~10
105E3746, Rev. ~~1~~3
105E3747, Rev. ~~4~~6
105E3748, Rev. ~~2~~4
105E3749, Rev. ~~6~~8

Contents Containers
105E3773, Rev. ~~1~~2
0028B98, Rev. ~~1~~2

5. continued

(b) Contents

(1) Type and form of material

Enriched commercial grade uranium or enriched reprocessed uranium, as defined in ASTM C996-~~96~~, uranium oxide or uranium carbide fuel rods enriched to no more than 5.0 weight percent in the U-235 isotope, with limits specified in Table 1 and Table 2 below.

Table 1: Maximum weight of uranium dioxide pellets per fuel assembly

Type 8x8 fuel assembly	**Type 9x9 fuel assembly**	**Type 10x10 fuel assembly**
235 kg	240 kg	275 kg

Table 2: Maximum Authorized Concentrations

Isotope	**Maximum C~~c~~ontent**
U-232	~~2~~5.00 x 10^{-9} $^{-8}$ g/gU
U-234	2.00 x 10^{-3} g/gU
U-235	5.00 x 10^{-2} g/gU
U-236	2.50 x 10^{-2} g/gU
Np-237	1.66 x 10^{-6} g/gU
Pu-238	6.20 x 10^{-11} g/gU
Pu-239	3.04 x 10^{-9} g/gU
Pu-240	3.04 x 10^{-9} g/gU
Gamma Emitters	~~5.18~~4.4 x 10^{5} MeV - Bq/kgU

5.(b)(1) continued

(i) 8 x 8 fuel assemblies comprised of 60 to 64 rods in a square array with a maximum active fuel rod length of 381 cm. The maximum pellet diameter, minimum clad thickness, rod pitch, water rod specifications, and poison rod specification are in accordance with Table 3 below.

(ii) 9 x 9 fuel assemblies comprised of 72 to 81 rods in a square array with a maximum active fuel rod length of 381 cm. The maximum pellet diameter, minimum clad thickness, rod pitch, water rod specifications, and poison rod specification are in accordance with Table 3 below.

(iii) 10 x 10 fuel assemblies comprised of 91 to 100 rods in a square array with a maximum active fuel rod length of 385 cm. The maximum pellet diameter, minimum clad thickness, rod pitch, water rod specifications, and poison rod specification are in accordance with Table 3 below.

(iv) Uranium oxide fuel rods configured loose, in a 5-~~ }~~inch diameter schedule 40 stainless steel pipe/protective case or strapped together. ~~When fuel rods are placed in polyethylene sleeves, each polyethylene sleeve shall not exceed 0.0152 cm in thickness.~~ The maximum pellet diameter, minimum clad thickness, and rod specifications are in accordance with Table 4 below.

(v) Uranium carbide or generic PWR uranium oxide fuel rods configured loose, in a 5-~~ }~~inch diameter schedule 40 stainless steel pipe. ~~When fuel rods are placed in polyethylene sleeves, each polyethylene sleeve shall not exceed 0.0152 cm in thickness.~~ The maximum pellet diameter, minimum clad thickness, and rod specifications are in accordance with Table 4 below.

5.(b)(1) continued

Table 3: Fuel Assembly Parameters

Parameter	**Units**	**Type**	**Type**	**Type**	**Type**
Fuel Assembly Type	Rods	8x8	9x9	FANP 10x10	GNF 10x10
UO_2 Density (% Theoretical)		≤ 98% ~~Theoretical~~	≤ 98% ~~Theoretical~~	≤ 98% ~~Theoretical~~	≤ 98% ~~Theoretical~~
Number of W~~w~~ater R~~r~~ods (See Condition 8)	#	0, 2x2	0, 2-2x2 off-center diagonal, 3x3	0, 2-2x2 off-center diagonal, 3x3	0, 2-2x2 off-center diagonal, 3x3, 1-axially varying centered ~~off-center diagonal, 3x3~~
Number of F~~f~~uel R~~r~~ods	#	60 - 64	72 - 81	91 - 100	91 - 100
Fuel Rod OD	cm	≥ 1.176	≥ 1.093	≥ 1.000	≥ 1.010
Fuel Pellet OD	cm	≤ 1.05	≤ 0.96	≤ 0.895	≤ 0.895
Cladding Type		Zirconium Alloy	Zirconium Alloy	Zirconium Alloy	Zirconium Alloy
Cladding ID	cm	≤ 1.10	≤ 1.02	≤ 0.933	≤ 0.934
Cladding Thickness	cm	≥ 0.038	≥ 0.036	≥ 0.033	≥ 0.038
Active F~~f~~uel L~~l~~ength	cm	≤ 381	≤ 381	≤ 385	≤ 385
~~Nominal~~ Fuel Rod Pitch	cm	≤1.63	≤ 1.45	≤ 1.30	≤ 1.~~30~~363
U-235 Pellet Enrichment	wt%	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
~~Maximum~~ Lattice Average Enrichment	wt%	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
Channel Thickness[a]	cm	0.17 – 0.3048	0.17 – 0.3048	0.17 – 0.3048	~~0.17 – 0.3048~~Any
Partial Length Fuel Rods ~~(1/3 through 2/3 normal length)~~	# ~~Max #~~	None None	≤ 12 ~~12~~	≤ 14 ≤ 14	≤ 16 ≤ ~~14~~16
Minimum Gadolinia Requirements Lattice Average Enrichment[b] ≤ 5.0 wt % U-235 ≤ 4.9 wt % U-235 ≤ 4.7 wt % U-235 ≤ 4.6 wt % U-235 ≤ 4.5 wt % U-235 ≤ 4.3 wt % U-235 ≤ 4.2 wt % U-235 ≤ 4.1 wt % U-235 ≤ 3.9 wt % U-235 ≤ 3.8 wt % U-235 ≤ 3.7 wt % U-235 ≤ 3.6 wt % U-235 ≤ 3.~~5~~4 wt % U-235 ≤ 3.3 wt % U-235 ≤ 3.2 wt % U-235 ≤ 3.1 wt % U-235 ≤ ~~3.0~~2.9 wt % U-235 ~~≤ 2.9 wt % U-235~~	# @ wt% Gd_2O_3	 7 @ 2 wt % 7 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 4 @ 2 wt % 4 @ 2 wt % 4 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % None None ~~None~~	 10 @ 2 wt % 10 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 4 @ 2 wt % 4 @ 2 wt % 4 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % ~~None~~ None	 12 @ 2 wt % 12 @ 2 wt % 12 @ 2 wt % 10 @ 2 wt % 10 @ 2 wt % 9 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % 6 @ 2 wt % 6 @ 2 wt % 4 @ 2 wt % 4 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % 2 @ 2 wt % None	 12 @ 2 wt % ~~12~~11 @ 2 wt % 11 @ 2 wt % 10 @ 2 wt % 9 @ 2 wt % 9 @ 2 wt % 8 @ 2 wt % 8 @ 2 wt % ~~6~~7 @ 2 wt % ~~6~~7 @ 2 wt % 6 @ 2 wt % ~~4~~5 @ 2 wt % 4 @ 2 wt % ~~2~~3 @ 2 wt % 2 @ 2 wt % ~~2~~1 @ 2 wt % None

[a] Any
[b] Any

Polyethylene Equivalent Mass per Assembly[c] ~~(Maximum per Assembly)[e]~~	kg ~~kg~~	≤ 11 ~~11~~	≤ 11 ~~11~~	≤ 10.2 ~~10.2~~	≤ 10.2 ~~10.2~~
Thermal Performance Criteria[d]		r/t_{BWR} (P_f 921/293 - P_a) ≤ 31.1 MPa (4,514 psi)			

a. Transport with or without channels is acceptable
b. Required gadolinia rods must be distributed symmetrically about the major diagonal. Minimum required number of gadolinia rods applies for full-length rod locations, excluding the lattice peripheral locations. Additional gadolinia rods in other locations are allowed as long as the minimum is met. After seven (7) gadolinia rods there must be at least one (1) gadolinia rod in at least two out of the four quadrants of the fuel rod array (refer to 6.3.4.2 of the application).
c. Polyethylene equivalent mass calculation (refer to 6.3.2.2 of the application)
d. r/t is the fuel rod inner radius to thickness ratio, P_f is the absolute fill pressure, and P_a is atmospheric pressure (refer to 3.4.4 of the application)
~~e.~~

5.(b)(1) continued

Table 4: Fuel Rod Parameters

Parameter	Units	Type					
Fuel Assembly Type		8x8 ~~(1)~~ (UO_2)	9x9 ~~(1)~~ (UO_2)	10x10 ~~(1)~~ (UO_2)	CANDU-14 (UC)	CANDU-25 (UC)	Generic PWR (UO_2)
~~UO_2 or UC~~ Fuel Density (% Theoretical)		≥~~<~~98% ~~theoretical~~	≥~~<~~98% ~~theoretical~~	≥~~<~~98% ~~theoretical~~	≥~~<98~~97% ~~theoretical~~	≥~~<~~978% ~~theoretical~~	≥~~<98~~100% ~~theoretical~~
Fuel R~~r~~od OD	cm	≥1.10	≥1.02	≥1.00	≥1.340	≥0.996	≥1.118
Fuel Pellet OD	cm	≤1.05	≤0.96	≤0.90	≤1.254	≤0.950	≤0.98
Cladding Type		Zirc. Alloy	Zirc. Alloy	Zirc. Alloy	Zirc. Alloy or SS	Zirc. Alloy or SS	Zirc. Alloy or SS
Cladding ID	cm	≤1.10	≤1.02	≤1.00	≤1.267	≤0.951	≤1.004
~~Cladding Thickness~~	~~cm~~	~~≥0.038~~	~~≥0.036~~	~~≥0.038~~	~~≥0.033~~	~~≥0.033~~	~~≥0.033~~
Active F~~f~~uel Length	cm	≤381	≤381	≤385	≤47.752	≤40.013	≤450
~~Maximum~~ U-235 Pellet Enrichment	wt.%	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0
~~Maximum~~ Average F~~f~~uel R~~r~~od Enrichment	wt.%	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0	≤5.0
Polyethylene Equivalent Mass[a] per Compartment[b]	kg	Unlimited			Protective Sleeves: <2.3 All other packing materials: ≤27.5 within SS Pipe, Unlimited outside SS Pipe		
Reference Density for Polyethylene Equivalent Mass[a] Calculation[b]	g/cm³	Protective Sleeves: 0.925 All Other Packing Materials: 0.08			Protective Sleeves: 1.005 All Other Packing Materials: 0.70		
Thermal Performance Criteria[f]		r/t (P_f 921/293 - P_a) ≤ 31.1 MPa			r/t (P_f 921/293 - P_a) ≤ 56.3 MPa		
Loose Rod Configuration		**Maximum Number of Rods per Compartment based on the Maximum Active Fuel Length**					

Freely Loose		≤25	≤25	≤25	N/A	N/A	N/A
Packed in 5” SS Pipe or Protective Case~~(3)~~[c]		≤22	≤26	≤30	≤~~74~~ ~~(2)~~695[d,e]	≤~~130~~ ~~(2)~~1458 [d,e]	≤~~105~~ ~~(2)~~105[d]
Strapped Together		≤25	≤25	≤25	N/A	N/A	N/A

a. Polyethylene equivalent mass for packing materials (refer to 6.3.2.2 of the application)
b. Polyethylene packing materials examples: protective sleeves, end caps, and cushioning foam
c. Protective case consists of stainless steel (SS) box with lid
d. Only in 5-inch SS pipes. Including partial rods: applying dense packing of congruent rods in the pipe will result in maximum number of rods that can physically fit within the pipe to be less than the number provided in the table above
e. Allows for dense loading of the relatively short UC rods axially along the length of the component
f. r/t is the fuel rod inner radius to thickness ratio, P_f is the absolute fill pressure, and P_a is atmospheric pressure (refer to 3.4.4 of the application)

~~(1) Previous analysis (Ref. 1) based on most conservative loose rod configuration (i.e., no credit taken for 5” SS pipe)~~
~~(2) Including partial rods (in reality, apply dense packing of congruent rods in the pipe) and only in 5” SS pipes~~
~~(3) Protective case consists of SS box with lid.~~

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

Total weight of payload contents (fuel assemblies, or fuel rods and rod shipping containers) not to exceed 684 kg (1508 pounds). The maximum uranium payload is 484 kg (1069 pounds).

(i) For the contents described in 5(b)(1)(i), 5(b)(1)(ii), and 5(b)(1)(iii): two fuel assemblies.

(ii) For the contents described in 5(b)(1)(iv) and 5(b)(1)(v): allowable number of fuel rods, as specified in Table 4, per compartment (2 compartments per package).

(c) Criticality Safety Index, except for contents described in 5(b)(1)(v) and limited in 5(b)(2)(ii) 1.0

Criticality Safety Index for contents described in 5(b)(1)(v) and limited in 5(b)(2)(ii) ~~2.1~~1.6

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

(a) The package shall be prepared for shipment and operated in accordance with the Package Operations of Chapter 7 of the application.

(b) The packaging must meet the Acceptance Tests and Maintenance Program of Chapter 8 of the application.

(c) Prior to each shipment, the stainless steel components of the packaging must be visually inspected. Packages in which stainless steel components show pitting corrosion, cracking, or pinholes are not authorized for transport.

(d) If wrapping is used on the unirradiated fuel assemblies, the ends must be assured to be open during the shipment in the package.

7. Cluster separators are optional and may be comprised of polyethylene or other plastics. Polyethylene or plastic mass limits shall be determined in accordance with Section 6.3.2.2 (Material Specifications) of the application.

8. Water rods are limited as shown in Table 3 above.

   For 8 x 8 fuel assembly designs, there can be either 0 or 1 water rod, and the water rod location occupies a space equivalent to 2 x 2 fuel rods. This is designated as 0, 2 x 2 in the table.

   For 9 x 9 and 10 x 10 fuel assembly designs, there can be either 0, 1, or 2 water rods in the assembly, and the water rod location occupies a space equivalent to (a) two 2 x 2 fuel rod equivalent spaces on a diagonal at the center of the assembly, or (b) one 3 x 3 fuel rod equivalent space (9 fuel rods space) in the center of the assembly. These configurations are designated as 0, 2 - 2x2 off-center diagonal, 3x3 in the table. For GNF 10x10 fuel assembly designs, the water rod can occupy a space equivalent to a single 2 x 2 fuel rod equivalent at the bottom of the assembly and expanded at the top; this configuration is designated as 1-axially varying centered in the table.

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

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

11. Revision No. ~~9~~ 10 of this certificate may be used until ~~August~~ Month ~~31~~dd, ~~2015~~20xx.

12. Expiration date: ~~November~~ Month ~~30~~dd, ~~2019~~20xx.

REFERENCES

NEDO-33869 Revision 9, Global Nuclear Fuel - Americas, LLC, application dated ~~July 11,~~September ~~2014~~2016.

~~As supplemented: July 17, 2014.~~

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

Timothy Lupold, Acting Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: August 8, 2014