5.

(a) Packaging

(1) Model No,: RAJ-II

(2) Description

The RAJ-II package is a rectangular box consisting of an inner container and outer container both made of stainless steel. The inner container is a double-wall stainless steel sheet structure with alumina silicate thermal insulator filling the gap between the two walls to reduce 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 contents. The contents may be Boiling Water Reactor (BWR) fuel assemblies, BWR fuel bundles or individual fuel rods. The fuel assembly is a fuel bundle with the channel installed.

The outer container is a stainless steel rectangular frame covered with a stainless steel sheet. Wood and honeycomb resin-impregnated kraft paper are placed in the outer container to limit the effect of an impact event. The inner container is fastened inside the outer container using clamps to a vibration proof device that dampens vibration during routine transport conditions. Confinement of the fissile contents is provided by the fuel bundle structure, fuel assembly, inner container, or fuel rod container.

The fuel rod clad and ceramic form of the fuel pellets provide primary containment of the radioactive material. A fuel rod is made by stacking pellets into a Zircalloy cladding tube which is evacuated, back-filled with helium to atmosphere pressure, and sealed by welding Zircalloy end plugs in each end of the tube. The fuel rod is designed as a pressure vessel. The ASME Boiler and Pressure Vessel Code, Section III, is used as a guide in the mechanical design and stress analysis of the fuel rod. The rod is designed to withstand the applied loads, both external and internal. The fuel pellet is sized to provide sufficient volume within the fuel tube to accommodate differential expansion between fuel and cladding. Welds of the fuel rods are verified for integrity by such means as X-ray inspection, ultrasonic testing, or process control. A representative nominal internal pressure of fuel rods at room temperature conditions is 1.1 MPa (160 psia). There is no pressure relief device that would allow radioactive contents to escape.

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)
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 following Global Nuclear Fuel (GNF) Drawings:

Outer Container
105E3737, Rev. 6
105E3738, Sheets 1 and 2, Rev. 8
105E3738, Sheet 3, Rev. 7
105E3739, Rev. 4
105E3740, Rev. 4
105E3741, Rev. 1
105E3742, Rev. 3
105E3743, Rev. 5
105E3744, Rev. 6

Inner Container
105E3745, Rev. 8
1 05E3746, Rev. 1
105E3747, Rev. 4
105E3748, Rev. 2
105E3749, Rev. 6

Fuel Rod Containers
105E3773, Rev. 1
0028898, Rev. 1
AA10901, Rev. 4

(b) Contents

(1) Type and form of material

BWR fuel assembly, fuel bundle, or fuel rods. The combination of a fuel bundle and a fuel channel is a fuel assembly. Fuel rods are transported in a fuel rod container or as fuel rod cluster fastened together using ring clamps. Fuel rods include designs for both boiling water reactors (BWR) and pressurized water reactors (PWR).

[The radioisotope concentrations are limited by the amounts that may be contained either in two fuel bundles or the maximum number of loose rods that can fit in two rod containers. ---Not true since the concentrations are limited by the specification for ECG or ER U, it is the quantities that are limited by the maximum contents.]

The maximum quantity of radioisotopes in the contents of the package is limited to such quantity that is contained in two fuel assemblies or the maximum number of fuel rods that may be transported in two fuel rod containers. The fissile material is low enriched uranium less than 5 wt% uranium-235. The maximum quantity of fissile material is contained in 24.2 kg of uranium. The fuel pellets are fabricated from Enriched Commercial Grade uranium or Enriched Reprocessed uranium as defined in ASTM C 996 (Ref. X) and summarized in Table 1-1.

Table Error! No text of specified style in document.**- Contents Specification**

	Enriched Commercial Grade		Enriched Reprocessed
U-232	0.0001 µg/gU		0.050 µg/gU
U-234	11.0 X 10^3 µg/g^{235}U		2000 µg/gU
U-236	250 µg/gU		2500 µg/gU
Tc-99	0.01 µg/gU		5 µg/gU
Alpha Activity Np / Pu	< 0.4 Bq/gU		3300 Bq/kgU
Total Gamma Activity	< 5000 MeV Bq/kg		4.4 X 10^5 MeV Bq/kg

Enriched commercial grade uranium contents is unirradiated uranium with an A2 value that is unlimited on the basis of the isotopic mixtures given in ASTM C996. Enriched commercial grade uranium is a Type A quantity of radioactive material irrespective of the quantity of radioactive material. The isotopic mixture for the actual reprocessed uranium contents is consistent with ASTM C 996 with exception that U-236, alpha activity from neptunium and plutonium and gamma radiation from fission products exceeds the limits for enriched reprocessed uranium. The quantity of radioisotopes in the reprocessed uranium contents is a Type B quantity on the basis of maximum quantity of uranium per package and isotopic mixture specified in Table 1.

(i) BWR fuel bundle with a maximum enrichment of 5.0 weight percent. Fuel pellet density shall not exceed UO2 theoretical density (10.96 g/cc). Cladding material for all fuel rods is zirconium 2 alloy. Central water rods or water channels and partial length rod positions are designated by an alpha numeric coordinate system. The major diagonal runs from (A, 1) to (I,9) for 9X9 fuel assemblies and (A-1) to (J,10) for 10X10 fuel assemblies. Central water rods or water channels extend the full length of the fuel assembly. Partial length fuel rods extend approximately 1/3 or 2/3 the full length from the bottom of the fuel assembly. Cluster separators are optional and may be polyethylene or other plastics. Other parameters specific to the fuel bundle design are as shown in Table 2.

Table 2 – BWR Fuel Bundle Parameters

Fuel Design	Fuel Pellet	Fuel Rod	Cladding		Pitch	Water Rod	Partial Length Fuel Rod	
							Short	Long
	OD (cm)	Height (cm)	ID (cm)	OD (cm)	(cm)	Positions	Height, Positions	Height, Positions
GE11 9x9	0.956	370.84	0.975	1.118	1.438	E-4 F-4 D-5 E-5 F-5 D-6 E-6	--	243.84 cm B-2 E-2 H-2 B-5 H-5 B-8 E-8 H-8
GE12B 10x10	0.876	405.5	0.894	1.026	1.295	F-4 G-4 F-5 G-5 D-6 E-6 D-7 E-7	--	259.61 cm B-2 D-2 G-2 I-2 B-4 I-4 E-5 F-6 B-7 I-7 B-9 D-9 G-9 I-9
GE13 9x9	0.956	370.84	0.975	1.118	1.438	E-4 F-4 D-5 E-5 F-5 D-6 E-6	--	274.32 cm B-2 E-2 H-2 B-5 H-5 B-8 E-8 H-8
GE14C 10x10	0.876	381	0.894	1.026	1.295	F-4 G-4 F-5 G-5 D-6 E-6 D-7 E-7	--	243.84 cm B-2 D-2 G-2 I-2 B-4 I-4 E-5 F-6 B-7 I-7 B-9 D-9 G-9 I-9
GE14G 10x10	0.876	370.84	0.894	1.026	1.295	F-4 G-4 F-5 G-5 D-6 E-6 D-7 E-7	--	B-2 D-2 G-2 I-2 B-4 I-4 E-5 F-6 B-7 I-7 B-9 D-9 G-9 I-9
GNF2 10x10	0.888	381	0.906	1.026	1.295	F-4 G-4 F-5 G-5 D-6 E-6 D-7 E-7	137.2 cm E-4 D-5 E-5 F-6 G-6 F-7	259.1 cm E-1 F-1 A-5 J-5 A-6 J-6 E-10 F-10
SVEA-96 10x10	0.848	390	0.863	0.984	1.28	E-5 F-5 E-6 F-6	130 cm E-4 F-4 D-5 G-5 D-6 G-6 E-7 F-7	240 cm A-1 J-1 A-10 J-10

(ii) A minimum of eight rods in a fuel bundle or fuel assembly Burnable neutron absorber (BA) rods with a nominal gadolinia content of at least 2 wt%. The following conditions shall be met for the positions of BA rods:

1) BA rods shall be in positions that are symmetric across the major geometric diagonal.

2) No BA rod shall be located in the outermost edge or corner location of the fuel rod lattice.

3) Partial length fuel rods shall not be BA rods.

4) At least one BA rod shall be located in three of the four fuel lattice quadrants.

5) No BA rods are required in fuel lattices that do not have fissile material (natural uranium defined as uranium containing a mass percentage of uranium-235 that does not exceed 0.72%) or is fissile excepted (uranium enriched in uranium-235 to a maximum of 1 percent by weight).

(iii) Fuel channel installed

(iv) Uranium oxide or uranium carbide fuel rods with a maximum enrichment of 5.0 weight percent. Fuel pellet density shall not exceed UO2 theoretical density that is10.96 g/cc. Cladding material for all fuel rods is zirconium 2 alloy., not to exceed 25 individual fuel rods strapped together in a cluster or any number of fuel rods when confined to an approved fuel rod container (5 inch diameter stainless steel pipe, rod protective case, or rod transport box). There are no limits for the fuel rod parameters (fuel rod OD, clad ID, or clad OD).

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

Total weight of payload contents (fuel bundles, fuel channels, fuel rods and rod shipping containers) not to exceed 684 kg (1508 pounds).

(i) For the contents described in 5(b)(1)(i) : two fuel bundles

(ii) For the contents described in 5(b)(1)(iv): 25 fuel rods or one fuel rod container per compartment (2 compartments per package)

5.(c) Criticality Safety Index for contents as follows:

Fuel Assembly described in 5(b)(1)(i) ,5(b)(1)(ii) and 5(b)(1)(iii) as limited in 5(b)2(i)	0.6
Fuel Assembly described in 5(b)(1)(i) and 5(b)(1)(iii) as limited in 5(b)2(i)	2.1
Fuel Bundle described in 5(b)(1)(i), 5(b)(1)(ii) as limited in 5(b)2(i)	0.7
Fuel Bundle described in 5(b)(1)(i) as limited in 5(b)2(i)	2.8

Fuel rods described in in 5(b)(1)(iv) as limited in 5(b)2(ii)	0.7

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 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~~.

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. 7 of this certificate, amended to reference Drawing Nos.: 105E3738, Sheets 1 and 2, Rev. 8; 105E3743, Rev. 5; and 105E3744, Rev. 6; as listed in Condition 5(a)(3), may be used until August 31, 2010.

12. Expiration date: November 30, 2014.