

**CERTIFICATE OF COMPLIANCE  
FOR RADIOACTIVE MATERIAL PACKAGES**

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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

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|--|---|
| a. ISSUED TO ( <i>Name and Address</i> )   | b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION            |
| AREVA Federal Services LLC<br>1102 Broadway Plaza, Suite 300<br>Tacoma, WA 98402 | AREVA Federal Services LLC<br>application dated March 25, 2009. |

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.: BEA Research Reactor (BRR) Package
- (2) Description

A package used to transport fuel elements that have been irradiated in various test and research reactors. The package is a lead-shielded cask body, payload basket, an upper shield plug, a closure lid, upper and lower impact limiters, and utilizes ASTM Type 304 stainless steel as its primary structural material. The cask is a right circular cylinder 77.1 inches long and 38 inches in diameter, not including the impact limiter attachments and the thermal shield. Thick lead shielding is located between two circular shells, in the lower end structure, and in the shield plug. The payload cavity has a diameter of 16 inches and a length of 54 inches.

Impact limiters are attached to each end, having essentially identical design. Each limiter is 78 inches in diameter and 34.6 inches long overall, with a conical section 15 inches long towards the outer end. The impact limiter design consists of Type 304 stainless steel shells and approximately 9 lb/ft<sup>3</sup> polyurethane foam. There are four baskets used with the package, one for each type of fuel transported. The baskets are made from welded construction using Type 304 stainless steel in plate, bar, pipe, and tubular forms. Each basket has a diameter of 15.63 inches and a length of 53.45 inches, and features a number of cavities that fit the size and shape of the fuel.

The package is designed to be transported as one package per conveyance, with its longitudinal axis vertical, by highway truck or by rail in exclusive use. When loaded and prepared for transport, the package is 119.5 inches long, 78 inches in diameter (over the impact limiters), and weighs 32,000 lb.

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5.(a) Packaging (continued)

(3) Drawings

The packaging is constructed in accordance with AREVA Federal Services LLC drawings:

- 1910-01-01-SAR, BRR Package Assembly SAR Drawing, Sheets 1-4, Rev. 2
- 1910-01-02-SAR, BRR Package Impact Limiter SAR Drawing, Sheets 1-2, Rev. 0
- 1910-01-03-SAR, BRR Package Fuel Baskets SAR Drawing, Sheets 1-3, Rev. 2

(b) Contents

(1) Type and form of material

- (i) Irradiated MURR fuel element to a maximum burnup of 180 MWD or a U-235 depletion of 30.9%. The minimum cooling time is 180 days after reactor shutdown. Each fresh MURR element contains  $775.0 \pm 7.8$  g U-235, enriched up to 93 wt.%. The MURR element overall length, including irradiation growth, is 32.75 inches. The bounding weight of one assembly is 15 lb. The maximum decay heat per fuel element is 158 W. MURR fuel element dimensions are in Table 1.1.

**Table 1.1**

<b>MURR - Key Fuel Dimensions</b>	
Item	Dimension (inches)
Maximum active fuel length	24.8
Overall length	32.75
Minimum cladding thickness	0.011 - 0.015
Nominal fuel matrix thickness	0.02
Maximum number of fuel plates	24
Fuel matrix	U-Al (x)
Cladding material	Aluminum
Maximum U-235 per element (g)	782.8
Maximum enrichment (wt.%)	93.0

- (ii) Irradiated MITR-II fuel element to a maximum burnup of 225 MWD or a U-235 depletion of 59.3%. The minimum cooling time is 930 days after reactor shutdown. Each fresh MITR-II element contains  $510.0 +3.0/-10.0$  g U-235, enriched up to 93 wt.%. The MITR-II element overall length, including irradiation growth, is 26.52 inches. The bounding weight of one assembly is 10 lb. The maximum decay heat per assembly is 30 W. MITR-II fuel element dimensions are in Table 1.2.

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

**Table 1.2**

<b>MITR-II - Key Fuel Dimensions</b>	
Item	Dimension (inches)
Maximum active fuel length	22.76
Overall length	26.52
Minimum cladding thickness	0.017
Nominal fuel matrix thickness	0.03
Maximum fuel matrix width	2.171
Maximum number of fuel plates	15
Fuel matrix	U-Al (x)
Cladding material	Aluminum
Maximum U-235 per element (g)	513

- (iii) Irradiated ATR fuel element to a maximum burnup of 480 MWD or a U-235 depletion of 58.6%. The minimum cooling time is 1,670 days (4.6 years) after reactor shutdown. There are two general classes of ATR fuel element, XA and YA. The XA fuel element has a fresh fuel loading of  $1,075 \pm 10$  g U-235. The YA fuel element has a fresh fuel loading of  $1,022.4 \pm 10$  g U-235. A second YA fuel element design (YA-M) has the side plate width reduced by 15 mils. The ATR element overall length, after removal of the end box structures, 51.0 inches max. The bounding weight of one assembly is 25 lb. The maximum decay heat per assembly is 30 W. ATR fuel element dimensions are in Table 1.3.

**Table 1.3**

<b>ATR - Key Fuel Dimensions</b>	
Item	Dimension (inches)
Maximum active fuel length	48.77
Overall length	51
Minimum cladding thickness	0.03/0.015/0.04
Maximum fuel matrix thickness	0.02
Maximum number of fuel plates	19
Fuel matrix	U-Al (x)
Cladding material	Aluminum
Maximum U-235 per element (g)	1,085

- (iv) Irradiated TRIGA fuel elements. TRIGA fuel element dimensions are in Table 1.4. The BRR package is limited to five specific TRIGA fuel types:

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

1. 8 wt% U - U/Zr with uranium aluminum clad element (General Atomics catalog number 101).
2. 8.5 wt% U - U/Zr with uranium stainless steel clad element (General Atomics catalog number 103).
3. 8.5 wt% U - U/Zr with uranium stainless steel clad element, high enriched uranium (General Atomics catalog number 109). This fuel element is sometimes referred to in the literature as a Fuel Life Improvement Program (FLIP) element.
4. 20 wt% U - U/Zr with uranium stainless steel clad element (General Atomics catalog number 117). This fuel element is sometimes referred to in the literature as a FLIP-LEU-I element.
5. 8.5 wt% U - U/Zr with uranium stainless steel clad element, instrumented (General Atomics catalog number 203).

**Table 1.4**

Parameter	GA Cat. # 101	GA Cat. # 103	GA Cat. # 109	GA Cat. # 117	GA Cat. # 203
Active Fuel Length (in)	14	15	15	15	15
Fuel Pellet OD (in)	1.41	1.44	1.44	1.44	1.44
Overall Element Length (in)	28.37	28.9	28.9	29.68	45.25
Cladding OD (in)	1.48	1.48	1.48	1.48	1.48
Cladding Thickness (in)	0.03	0.02	0.02	0.02	0.02
Graphite Reflector Length Top/Bottom (in)	4.0 / 4.0	2.6 / 3.7	2.6 / 3.7	2.6 / 3.7	3.1 / 3.4
Zr Fuel Matrix Mass (g)	2,070	2,088	2,060	2,060	2,088
U-235 (g)	36	39	137	101	39

The maximum length of a TRIGA fuel element, including irradiation growth, is 45.50 inches. For all fuel elements, spacers are utilized within the TRIGA baskets. The bounding weight of any TRIGA fuel element is 10 lb. The maximum decay heat per element is 20 W. TRIGA fuel parameters are in Table 1.5.

**Table 1.5**

Fuel Type	Maximum U-235 depletion (%)	Maximum Burnup (MWD/MTU)	Minimum Decay Time
GA Cat. # 101	22.42	36,953	28 days
GA Cat. # 103/203	20.72	34,111	28 days
GA Cat. # 109	59.74	339,368	1 year
GA Cat. # 117	43.81	75,415	1 year

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- 5.(b)(2) Maximum quantity of material per package
- (i) For the contents described in 5(b)(1)(i):  
8 irradiated MURR fuel elements. Only one fuel element is allowed per basket location.
  - (ii) For the contents described in 5(b)(1)(ii):  
11 irradiated MITR-II fuel elements. Only one fuel element is allowed per basket location.
  - (iii) For the contents described in 5(b)(1)(iii):  
8 irradiated ATR fuel elements. Only one fuel element is allowed per basket location.
  - (iv) For the contents described in 5(b)(1)(iv):  
19 irradiated TRIGA fuel elements. Only one fuel element is allowed per basket location.
- (c) Criticality Safety Index (CSI): 0
6. In addition to the requirements of Subpart G of 10 CFR Part 71:
- (a) Each package shall be operated and prepared for shipment in accordance with Chapter 7 of the application, as supplemented.
  - (b) Each package shall be acceptance tested and maintained in accordance with Chapter 8 of the application.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
8. Transport by air of fissile material is not authorized.
9. Expiration date: January 22, 2015.

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REFERENCES

AREVA Federal Services LLC application dated March 25, 2009.

Supplements dated August 6, 2009 and November 5, 2009.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

**/RA/**

Eric J. Benner, Chief  
Licensing Branch  
Division of Spent Fuel Storage and Transportation  
Office of Nuclear Material Safety  
and Safeguards

Date: January 21, 2010

