

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	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

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|---|---|
| <p>a. ISSUED TO (<i>Name and Address</i>)
Department of Energy
Washington, D.C. 20585</p> | <p>b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION
Department of Energy application dated
April 18, 1995, as supplemented.</p> |
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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. BMI-1
- (2) Description

A steel-encased lead shielded shipping cask. The basic cask body is a cylinder 33.37 inches in diameter by 73.37 inches high formed by two concentric stainless steel shells whose annular region is filled with lead. The outer ½-inch thick shell has a 0.12-inch thick plate spot welded to it, providing a 0.06-inch thick air gap insulator. The inner shell is 15.5 inches inside diameter by 54 inches inside length. The cask lid is a stainless steel weldment having 7.75 inches of lead shielding. The cask lid is secured to the cask by twelve steel studs which are welded to the cask body. The cask is provided with a drain line with needle valve and plug, pressure gauge, and a pressure relief valve. The total cask weight, including maximum contents of 1,800 lbs, is 23,660 lbs.

(3) Drawings

The cask is constructed in accordance with the following Battelle Memorial Institute (BMI) Drawing Nos.: 43-6704-0001, Rev. B; and 41-4409-0003, Rev. B.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	2	OF 9

5.(a) Packaging (continued)

(4) Product Containers

The various authorized product containers are constructed in accordance with the following Drawing Nos.:

- (i) Inner can assembly as shown in BMI Drawing No. 00-000-421, Rev. C.
- (ii) Basket Assembly as shown in BMI Drawing Nos. BCL-000-500, Rev. A; BCL-000-501, Rev. A; and 0048, Rev. A.
- (iii) Fermi Fuel Element copper casting assembly as shown in BMI Drawing No. K5928-5 0049D, Rev. to May 12, 1966.
- (iv) Basket Assembly as shown in BMI Drawing No. 1020, Rev. B (or with alternate spacer shown in CI Drawing No. 334D2193) or GA Drawing No. 9590001, Rev. A. Failed fuel assemblies must be seal welded in aluminum or stainless steel tubes with wall and end cap thicknesses of at least 0.015 inch.
- (v) Basket Assembly defined by BMI Drawing No. BCL-000-500, Rev. A, as modified by BMI Drawing Nos. 00-000-236, Rev. C, and BCL-000-502, Rev. B.
- (vi) Basket Assembly and storage can defined by BMI Drawing No. 00-000-391, Rev. C, and Atomic International Drawing No. AIHL, S8DR 0019-01, Rev. A, respectively.
- (vii) Inner can assembly as shown in Union Carbide Corporation Drawing No. 101501, Rev. A.
- (viii) Basket Assembly as shown in University of Missouri Research Reactor (MURR) Drawing No. 2234, Sheets 1 through 5, Revision 0.
- (ix) HFBR assembly basket and spacer plate as shown in Brookhaven National Laboratory Drawing Nos.: BNL 93-001, Sheets 1, 2, and 3, Rev. 2, and BNL 93-002, Sheet 1, Rev. 2.
- (x) Basket assembly as shown in General Electric Company Drawing No. 183C8253, Rev. 1.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	3	OF 9

5.(b) Contents

(1) Type and form of material

- (i) Intact irradiated MTR- or BRR-type fuel assemblies containing not more than 200 grams U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 93.5 w/o in the U-235 isotope. Active fuel length shall be approximately 25 inches.
- (ii) Intact irradiated Enrico Fermi Core. A fuel assembly containing not more than 4.77 kgs U-235 prior to irradiation. Uranium may be enriched to 25.6 w/o in the U-235 isotope.
- (iii) Greater than Type A quantity of radioactive material which may include uranium enriched in the U-235 isotope, U-233, plutonium, as metal, oxides, or compounds which are thermally stable up to 600EF. Plutonium in excess of twenty (20) curies per package must be in the form of metal, metal alloy, or reactor elements.
- (iv) Greater than Type A quantity of byproduct material meeting the requirements of special form radioactive material.
- (v) Greater than Type A quantity of byproduct material in normal form as metal, oxides, or compounds which are thermally stable up to 600EF.
- (vi) Irradiated Triga Type fuel assemblies described in Section 6.6 of the application (pp. 6-23 through 6-27).
- (vii) Irradiated S8DR fuel elements 0.56-inch OD by 18.7 inches long by 0.010-inch wall thickness of Hastelloy-N. The fuel material is UZrH fully enriched in U-235.
- (viii) Intact irradiated CP-5 fuel assemblies containing not more than 176 grams U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 93 w/o in the U-235 isotope. Active fuel length shall be 28.5 inches.
- (ix) Solid nonfissile irradiated hardware which may contain encapsulated fission monitors.
- (x) Irradiated uranium oxide waste enriched in the U-235 isotope up to a nominal 93 w/o which is thermally stable up to 800EF.
- (xi) Irradiated uranium enriched in the U-235 isotope meeting the requirements of special form radioactive material.
- (xii) Intact irradiated MURR fuel assemblies containing not more than 775 grams of U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 93.5 w/o in the U-235 isotope. Active fuel length shall be 24 inches.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	4	OF 9

5.(b) Contents (continued)

(1) Type and form of material (continued)

- (xiii) Intact irradiated MITR-II fuel assemblies containing not more than a nominal 510 grams of U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 93.5 w/o in the U-235 isotope. Active fuel length shall be approximately 24 inches.
- (xiv) Intact irradiated High Flux Beam Reactor (HFBR) fuel assemblies containing not more than a nominal 351 grams of U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum of 93.5 w/o in the U-235 isotope. Active fuel length shall be nominal 24 inches.
- (xv) Intact irradiated MTR-type fuel assemblies containing not more than 240 grams U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 93.5 w/o in the U-235 isotope. Active fuel length shall be approximately 25 inches.
- (xvi) Irradiated MTR-type fuel sections containing not more than 176 grams U-235 per fuel section prior to irradiation. Uranium may be enriched to a maximum 93.5 w/o in the U-235 isotope. Active fuel length per fuel section shall be approximately 11 inches. The fuel assembly shall be sectioned only in the non-fuel bearing regions of the assembly.
- (xvii) Intact irradiated MTR-type fuel assemblies containing not more than 282.7 grams U-235 per assembly prior to irradiation. Uranium may be enriched to a maximum 20 w/o in the U-235 isotope. Active fuel length shall be approximately 25 inches.

(2) Maximum quantity of material per package

The minimum cooling time of each fuel assembly and rod is 90 days, maximum decay heat generation per package not to exceed 1.5 kW, and the external dose rate not to exceed 10 mrem/hr 3 feet from the external surface of the cask and:

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

Twenty-four (24) fuel assemblies as contained in product containers specified in 5(a)(4)(ii) or 12 fuel assemblies as contained in product containers specified in 5(a)(4)(v).

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

One (1) fuel assembly as contained in product container specified in 5(a)(4)(iii).

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

480 grams U-233 or 480 grams Pu-239 or 800 grams U-235 as contained in product container specified in 5(a)(4)(i).

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	5	OF 9

5.(b) Contents (continued)

(2) Maximum quantity of material per package (continued)

(iv) For the contents described in 5(b)(1)(iv):

Gamma sources securely confined in the cask cavity to preclude secondary impacts during accident conditions of transport. Thermal heat generation rate is limited to 200 watts.

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

Contained in product containers specified in 5(a)(4)(i) and limited to 200 thermal watts.

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

Thirty-eight (38) fuel assemblies as contained in product containers specified in 5(a)(4)(iv). Fuel assemblies with an initial enrichment (U-235 in U) of greater than 70 w/o U-235 are limited to 19 assemblies per product container. Shipments of less than 19 assemblies with a U-235 enrichment greater than 70 w/o may be combined with assemblies of 70 w/o U-235 or less provided: $x/38 + y/19 \leq 1$; $x =$ no. assy's ≤ 70 w/o U-235, $y =$ no. assy's > 70 w/o U-235.

(vii) For the contents described in 5(b)(1)(vii):

Twenty-four (24) fuel elements per can and six sealed cans per basket as described in 5(a)(4)(vi). Each of the six cans may contain up to 818 g U-235 and 158 g hydrogen. The cask is limited to 4.908 kg U-235.

(viii) For the contents described in 5(b)(1)(viii):

Twelve (12) fuel assemblies.

(ix) For the contents described in 5(b)(1)(ix):

Thermal heat generation rate is limited to 200 watts.

(x) For the contents described in 5(b)(1)(x):

Twenty-four (24) containers each limited to 352 grams U-235 as contained in product containers specified in 5(a)(4)(vii). The decay heat per container is limited to 20 watts. The containers must be leak tested in accordance with Union Carbide Corporation letter dated November 17, 1980.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	6 OF	9

5.(b) Contents (continued)

(2) Maximum quantity of material per package (Continued)

(xi) For the contents described in 5(b)(1)(xi):

Twenty-four (24) capsules each limited to 100 grams U-235.

(xii) For the contents described in 5(b)(1)(xii):

Eight (8) fuel assemblies as contained in the product container specified in 5(a)(4)(viii). The maximum burnup is 150 MWD/Assembly and the minimum cooling time of each fuel assembly is 150 days. The maximum radiation source term is 400,000 curies.

(xiii) For the contents described in 5(b)(1)(xiii):

Eight (8) fuel assemblies, contained in the product container specified in 5(a)(4)(viii). The maximum decay heat per package is 200 watts.

(xiv) For the contents described in 5(b)(1)(xiv):

Twenty (20) fuel assemblies contained in two baskets separated by a spacer plate as specified in 5(a)(4)(ix). Each shipment must contain twenty fuel assemblies. The maximum burnup is approximately 130 MWD/assembly, and the minimum cooling time is 470 days.

(xv) For the contents described in 5(b)(1)(xv):

Twelve (12) fuel assemblies contained in product container specified in 5(a)(4)(v).

(xvi) For the contents described in 5(b)(1)(xvi):

Forty (40) fuel sections contained in the product container specified in 5(a)(4)(x). When a shipment contains less than the maximum number of fuel sections (40), empty fuel section basket spaces must be provided with an aluminum or steel spacer in the form of an open-ended pipe with a minimum outer diameter of 2.5 inches and a minimum wall thickness of 0.125 inches. The spacer must be of sufficient length to replace the absent fuel sections.

(xvii) For the contents described in 5(b)(1)(xvii):

Eight (8) fuel assemblies contained in the peripheral locations of the basket specified in 5(a)(4)(v). The maximum burnup is 14%, the maximum decay heat is 15 watts per fuel assembly, and the minimum cool time is 120 days. Four aluminum inserts, as shown in Lockheed Martin Drawing No. 507584, Rev. 1, must be positioned in each of the four center basket locations.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
5957	28	71-5957	USA/5957/B()F	7	OF 9

5.(c) Criticality Safety Index

- (1) For the contents described in 5(b)(1)(iii) and 5(b)(1)(xv), and limited in 5(b)(2)(iii) and 5(b)(2)(xv): 0.4
- (2) For the contents described in 5(b)(1)(i), 5(b)(1)(ii), 5(b)(1)(vi), 5(b)(1)(vii), 5(b)(1)(viii), 5(b)(1)(x), 5(b)(1)(xi), 5(b)(1)(xii), 5(b)(1)(xiii), 5(b)(1)(xiv), 5(b)(1)(xvi), and 5(b)(1)(xvii), and limited in 5(b)(2)(i), 5(b)(2)(ii), 5(b)(2)(vi), 5(b)(2)(vii), 5(b)(2)(viii), 5(b)(2)(x), 5(b)(2)(xi), 5(b)(2)(xii), 5(b)(2)(xiii), 5(b)(2)(xiv), 5(b)(2)(xvi), and 5(b)(2)(xvii): 100

6. For Item 5.(b)(1)(iii), mixtures of fissile material are authorized, provided the following equation is satisfied:

$$\frac{X}{480} + \frac{Y}{480} + \frac{Z}{800} \leq 1, \text{ where}$$

X = Grams U-233 to be shipped
Y = Grams Pu-239 to be shipped
Z = Grams U-235 to be shipped

7. Except for the contents described in 5(b)(1)(ii), 5(b)(1)(iv) and 5(b)(1)(xii); and limited in 5(b)(2)(ii), 5(b)(2)(iv) and 5(b)(2)(xii), the cask must be shipped dry.
8. If the cask contents of 5(b)(1)(ii), 5(b)(1)(iv) or 5(b)(1)(xii) are shipped wet, the licensee must confirm that the pressure relief valve is operable (set pressure - 75 psig). When needed, sufficient antifreeze in the cask must be used to prevent damage of any component of the package by freezing.
9. Loading and unloading operations of the contents described in 5(b)(1)(iii) and limited in 5(b)(2)(iii) must preclude contact of water with the contents.
10. When the contents of 5(b)(1)(vi) are loaded wet, the optional 0.5-inch diameter drain hole must be present in the primary basket lower plate to assure proper draining of the basket.
11. The presence and effectiveness of the Boral poison plate in the Basket Assemblies as shown in BMI Drawing Nos. BCL-000-500, Rev, A; 0048, Rev. A; and 00-000-236, Rev. C, must be verified by neutron measurements prior to first use and records maintained of such verification. Verification of the presence of the Boral must be made in each subsequent use.
12. Contents 5(b)(1)(i) and 5(b)(1)(x) may be mixed provided the sum of the product containers and fuel assemblies does not exceed 24.

**CERTIFICATE OF COMPLIANCE
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1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	8	OF 9

13. Axial movement of fuel assemblies must be limited so that the active fuel region will remain correctly positioned with respect to the poisoned section of the basket. Removable spacers may be used in each section of the basket to limit axial movement of the assemblies.
14. Contents must be securely confined in the cask cavity to minimize movement.
15. Prior to each use, adequacy of containment vessel must be demonstrated by performance of the leak test described in Section 7.1.1.1 of the application.
16. Gaskets and seals (cask and fuel canister) must be replaced at least every 12 months or earlier if visible degradation occurs.
17. For contents described in 5(b)(1)(iii) and limited in 5(b)(2)(iii), the mass of fissile material contained in reactor fuel must be based on the mass prior to irradiation.
18. 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 Operating Procedures of Chapter 7 of the application. Additionally, for the contents described in 5(b)(1)(xvii), the package must be prepared for shipment in accordance with the procedures specified in the supplement dated January 29, 1999.
 - (b) The packaging must meet the Acceptance Tests and Maintenance Program of Chapter 8 of the application.
19. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.17.
20. Revision No. 27 of this certificate may be used until March 31, 2007.
21. Expiration date: October 1, 2008.

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FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	5957	28	71-5957	USA/5957/B()F	9	OF 9

REFERENCES

Department of Energy application dated: April 18, 1995

Department of Energy supplements dated: November 20, 1995, September 4, 1998, January 29 and April 20, 1999, December 13, 2000, and February 16, 2006.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

Robert A. Nelson, Chief
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Date: March 8, 2006

