



Department of Energy

Washington, DC 20585

SEP 13 2010

MEMORANDUM FOR RICHARD PROVENCHER  
MANAGER  
IDAHO OPERATIONS OFFICE

FROM: FRANK MARCINOWSKI   
HEADQUARTERS CERTIFYING OFFICIAL  
DEPUTY ASSISTANT SECRETARY FOR  
TECHNICAL AND REGULATORY SUPPORT  
OFFICE OF ENVIRONMENTAL MANAGEMENT

SUBJECT: Revision 3 to DOE CoC USA/5957/B( )F (DOE)

Revision 3 of Department of Energy (DOE) Certificate of Compliance (CoC) USA/5957/B( )F (DOE) for the BMI-1 package is issued to authorize shipments under a DOE Exemption subject to the following conditions:

1. Shipments in-commerce are prohibited.
2. Each shipment of the package must be approved in advance by the DOE Packaging Certification Program under my approval and signature.

Although no shipments of the BMI-1 package are currently planned, Revision 3 of DOE CoC 5957 is being issued to keep the BMI-1 open for potential future use.

The expiration date for Revision 3 is September 30, 2015.

If you have any questions, please call Dr. James M. Shuler at (301) 903-5513.

Attachment

cc w/att.:  
James Shuler, EM-45  
Stephen O'Connor, EM-45  
Steve Bellamy, SRNL



Printed with soy ink on recycled paper

1a. Certificate Number	1b. Revision No	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
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2. PREAMBLE

- 2a. This certificate is issued under the authority of 49 CFR Part 173.7(d)
- 2b. The packaging and contents described in Item 5 below meet the safety standards set forth in subpart E, "Package Approval Standards" and subpart F, "Package, Special Form, and LSA-III Tests" Title 10, Code of Federal Regulations, Part 71
- 2c. 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 —		
(1) Prepared by (Name and Address)	(2) Title and identification of report or application:	(3) Date:
U.S. Department of Energy Idaho Operations Office 195 Fremont Ave Idaho Falls, Idaho 83415	Safety Analysis Report for the Model BMI-1 Shipping Cask, Revision J, October 6, 1995, as supplemented [See 5.(e)]	October 1995

4. CONDITIONS  
This certificate is conditional upon fulfilling of the applicable Operational and Quality Assurance requirements of 49CFR parts 100 – 199 and 10CFR Part 71, and the conditions specified in Item 5 below

5. Description of Packaging and Authorized Contents, Model Number, Transport Index, other Conditions, and References

(a) Packaging

**NOTE: Shipments in commerce are not authorized. Shipments off a DOE Site require prior written approval from the DOE Packaging Certification Program and the Headquarters Certifying Official prior to each shipment.**

(1) Model Number: BMI-1

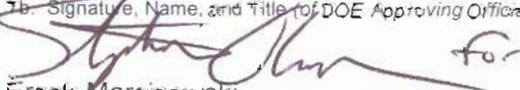
(2) Description:

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 1/2-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 23,660lbs.

6a. Date of Issuance: SEP 13 2010	6b. Expiration Date: September 30, 2015
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)  
U.S. Department of Energy  
Office of Technical and Regulatory Support, EM-40  
1000 Independence Avenue, SW  
Washington, DC 20585

7b. Signature, Name, and Title (of DOE Approving Official)  
  
Frank Marcinowski  
Headquarters Certifying Official

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(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

Product Containers. The various authorized product containers are constructed in accordance with the following Drawing Numbers:

- (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 be 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.

(b) Contents

(1) Type and Form of Radioactive 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 weight percent 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 weight percent 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 600°F. 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.

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- (v) Greater than Type A quantity of byproduct material in normal form as metal, oxides, or compounds which are thermally stable up to 600°F.
- (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 weight percent 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) Solid nonfissile irradiated hardware which may contain encapsulated fission monitors
- (xi) Irradiated uranium oxide waste enriched in the U-235 isotope up to a nominal 93 weight percent which is thermally stable up to 800°F.
- (xii) Irradiated uranium enriched in the U-235 isotope meeting the requirements of special form radioactive material.
- (xiii) 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 weight percent in the U-235 isotope. Active fuel length shall be 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 weight percent 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 weight percent 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 weight percent 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 weight percent in the U-235 isotope. Active fuel length shall be approximately 25 inches.

(2) Maximum Quantity of Radioactive 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)(3)(ii) or 12 fuel assemblies as contained in product containers specified in 5(a)(3)(v).

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- (ii) For the contents described in 5(b)(1)(ii): One (1) fuel assembly as contained in product container specified in 5(a)(3)(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)(3)(i).
- (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)(3)(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)(3)(iv). Fuel assemblies with an initial enrichment (U-235 in U) of greater than 70 weight percent U-235 are limited to 19 assemblies per product container. Shipments of less than 19 assemblies with a U-235 enrichment greater than 70 weight percent may be combined with assemblies of 70 weight percent U-235 or less provided:  $x/38 + y/19 \leq 1$ ; x = number assemblies  $\leq$  70 weight percent U-235, y = number assemblies  $>$  70 weight percent 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)(3)(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)(3)(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.
- (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)(3)(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)(3)(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)(3)(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)(3)(v).
- (xvi) For the contents described in 5(b)(1)(xvi): Forty (40) fuel sections contained in the product container specified in 5(a)(3)(x). When a shipment contains less than the maximum number of fuel sections (40), empty fuel section basket spaces must be provided with an

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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)(3)(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.

(c) Criticality Safety Index (CSI)

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): The Criticality Safety Index CSI is 0.4 i.e., CSI=0.4.

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): The Criticality Safety Index CSI is 100 i.e., CSI=100.

(d) Conditions:

- (1) 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

- (2) 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.
- (3) 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.
- (4) 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.
- (5) 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.
- (6) 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.
- (7) 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.

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- (9) Contents must be securely confined in the cask cavity to minimize movement.
- (10) 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.
- (11) Gaskets and seals (cask and fuel canister) must be replaced at least every 12 months or earlier if visible degradation occurs.
- (12) 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.
- (13) Shipments in commerce are not authorized.
- (14) Shipments off a DOE site are not authorized without prior written approval from the DOE Packaging Certification Program and the Headquarters Certifying Official prior to each shipment.
- (15) Transport by air of fissile material is not authorized.
- (16) 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

(e) References

- (1) *Safety Analysis Report for The Model BMI-1 Shipping Cask*, Revision J, October 6, 1995
- (2) DOE Application to NRC dated January 29, 1999 with the supporting documentation *BMI-1 Cask Amendment for University of Virginia LEU MTR-Type Fuel*, Revision 1,
- (3) DOE Application to NRC dated April 20, 1999 with attachments [Idaho Operations Office memo of April 7, 1999 and Idaho National Engineering and Environment Laboratory letter of April 6, 1999.

PACKAGE CERTIFICATION APPROVAL RECORD  
Certificate of Compliance USA/5957/B( )F (DOE), Revision 3  
BMI-1

Docket 10-46-5957

Revision 3 of Department of Energy (DOE) Certificate of Compliance (CoC) USA/5957/B( )F (DOE) for the BMI-1 package is issued to authorize shipments under a DOE Exemption subject to the following conditions:

1. Shipments in-commerce are prohibited.
2. Each shipment of the package must be approved in advance by the DOE Packaging Certification Program (PCP) under the DOE Headquarters Certifying Official's (HCO's) approval and signature.

Although no shipments of the BMI-1 package are currently planned, Revision 3 of DOE CoC 5957 is being issued to keep the BMI-1 open for potential future use.

Revision 3 of DOE CoC 5957 is based on Revision 28 of the Nuclear Regulatory Commission (NRC) CoC 5957 and DOE CoC 5957, Revision 2. The use of all "open paren" B( ), B( )F, and certain older Fissile CoCs are not authorized for shipments under the Department of Transportation (DOT) and NRC regulations after October 1, 2008. However, shipments using the BMI-1 package and other similar packages were authorized by the NRC and DOT, via NRC authorizations used in conjunction with DOT-SP 14722.

Any shipment made using the BMI-1 package will need to be made under a DOE Exemption issued in accordance with DOE Order 460.1C by the DOE PCP under the approval and signature of the DOE HCO. The use of a DOE Exemption to make potential future shipments from a DOE site is equivalent to the process used by NRC and DOT to extend the use of "open paren" packages for restricted controlled shipments.

The expiration date for Revision 3 is September 30, 2015.

This CoC constitutes authority for the DOE to use the BMI-1 package for shipment of the authorized contents under 49 CFR 173.7(d).



Frank Marcinowski  
Headquarters Certifying Official  
Deputy Assistant Secretary  
Office of Technical and Regulatory Support  
Office of Environmental Management  
Date: SEP 13 2010