

**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

a. ISSUED TO (*Name and Address*)

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

NAC International, Inc  
655 Engineering Drive, Suite 200  
Norcross, GA 30092

Nuclear Assurance Corporation application,  
dated February 27, 1996.

## 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.: NLI-1/2

(2) Description

A depleted uranium, water, and lead shielded shipping cask, encased in stainless steel, and equipped with balsa impact limiters. The cylindrical cask body is 195-1/4 inches long by 47-1/8 inches OD. The principal shielding consists of 2-3/4 inches of depleted uranium, 2-1/8 inches of lead, and 5 inches of (borated) water-ethylene glycol mixture.

A 7/8-inch thick stainless steel outer shell is welded to a solid stainless steel forging at each end of the cask. The outer shell of the cask is surrounded by a 1/4-inch thick steel water jacket that is also attached to the end forgings. A water expansion tank is welded to the water jacket shell. The inner cask cavity is formed by a 1/2-inch thick, stainless steel cylindrical shell; welded at its top end to the upper cask forging and its bottom end to a circular plate.

There are four separate configurations of the cask.

Configuration (A): The containment vessel is a right circular stainless steel shell, 12-5/8 inches ID by 178 inches inside length by 1/4-inch thick, located within the inner cask cavity. The containment vessel is closed and sealed by a 5-inch thick, composite steel and uranium closure head, twelve, 1-inch diameter bolts, and silver plated, metallic O-ring. Eight of the twelve closure bolts are used to secure the containment vessel to the upper cask forging. Closure of the cask cavity is by a 1-1/2-inch thick steel closure head, eight, 1-inch diameter bolts, and elastomer O-ring. The radioactive contents are positioned and supported within the containment vessel (inner container) by an aluminum basket and internal support structure.

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## 5.(a) Packaging (continued)

## (2) Description (continued)

Configuration (B): The containment vessel is the 1/2-inch thick inner cavity shell. The 1/4-inch thick inner container is not used. The cask cavity is closed by two closure heads. The inner head is a 6-inch thick, composite steel and uranium plate secured to the upper cask forging by twelve, 1-inch diameter bolts and sealed with a silver plated, metallic O-ring. The outer head is 1-1/2-inch thick steel plate secured to the top of the upper cask forging by eight, 1-inch diameter bolts and sealed with an elastomer O-ring. The radioactive contents are positioned and supported within the containment vessel (inner cask cavity) by a modified aluminum basket and internal support structure.

Configuration (C): Same as Configuration (B), above, except the radioactive contents are positioned and supported within the containment vessel (inner cask cavity) in a stainless steel structure containing Boral sheets positioned so as to provide necessary neutron absorption.

Configuration (D): Same as Configuration (B) above, except that the radioactive contents are positioned and supported within the containment vessel (inner cask cavity) in a 3-element stainless steel structure as shown in NAC Drawing No. 347-291-F12, sheet 1, Rev. 2, and the cask must be enclosed in a closed shipping container.

The package, including impact limiters, has an overall length of 237 inches and an outside diameter of 75 inches. The maximum weight of the contents is 3,000 pounds. The weight of the package is approximately 49,250 pounds.

## (3) Drawings

The Model No. NLI-1/2 shipping cask is constructed in accordance with the following National Lead Company Drawing Nos.:

General

70514F, Sheet 1, Rev. 8, Cask and Trailer General Arrangement  
 70514F, Sheet 2, Rev. 8, Cask and Trailer General Arrangement  
 70885F, Sheet 1, Rev. 3, Spent Fuel Cask Details  
 70885F, Sheet 2, Rev. 2, Spent Fuel Cask Details  
 70885F, Sheet 3, Rev. 2, Spent Fuel Cask Details  
 70885F, Sheet 4, Rev. 1, Spent Fuel Cask Details  
 70887F, Sheet 1, Rev. 1, Outer Closure Head  
 70888F, Sheet 1, Rev. 3, Spent Fuel Cask General Assembly

Configuration (A)

70516F, Sheet 1, Rev. 8, Spent Fuel Cask General Assembly  
 70562F, Sheet 1, Rev. 11, Inner Container  
 70562F, Sheet 2, Rev. 7, Inner Container  
 70562F, Sheet 3, Rev. 0, Inner Container\*  
 70562F, Sheet 4, Rev. 0, Inner Container\*

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5.(a) Packaging (continued)

(3) Drawings (continued)

Configuration (B)

70886F, Sheet 1, Rev. 2, Basket Concept  
70884F, Sheet 1, Rev. 2, Inner Closure Head

Configuration (C)

460-052-F8, Sheet 1, Rev. 4, Rockwell Fuel Basket-NLI-1/2 Cask\*  
460-052-F9, Sheet 1, Rev. 3, Container - Fermi Fuel, Rockwell Basket, NLI-1/2 Cask, Assembly of\*

Configuration (D)

347-291-F12, sheet 1, Rev. 2, Liner - 3 Element, NLI-1/2 Cask, Fuel Movement Project\*

\*Nuclear Assurance Corporation drawings.

(b) Contents

(1) Type and form of material

(i) Irradiated PWR or BWR uranium oxide fuel assemblies of the following specifications:

	<u>PWR</u>	<u>BWR</u>	<u>Consolidated Fuel Rods</u>
Fuel form	Clad UO <sub>2</sub> pellet	Clad UO <sub>2</sub> pellet	Clad UO <sub>2</sub> pellets
Cladding material	Zr or SS	Zr or SS	Zr or SS
Maximum initial fuel pin pressure at 100°F, psig	550	200	550
Maximum initial U content/assembly, kg	475	197	950
Maximum average initial U-235 enrichment, w/o	3.70	2.65	3.70
Maximum bundle cross section, inches	8.75	5.75	8.75
Fuel pin array size	14x14/15x15 16x16/17x17	7x7 8x8	Pins from 7x7, 8x8, 14x14, 15x15, 16x16, 7x17 in triangular pitch

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5.(b)(1)(i) (continued)

	<u>PWR</u>	<u>BWR</u>	<u>Consolidated Fuel Rods</u>
Maximum active fuel length, inches	144	145.25	144
Maximum specific power, kW/kgU	40	27	40
Maximum average burnup, MWD/MTU	40,000**	34,000	40,000
Maximum decay heat, kW	10.6	10.6	0.6
Minimum cooling time, days	150*	120	4,380

The PWR type assembly may be shipped either with or without burnable poison rods or control rods.

\*Four (4) fuel rods may have a minimum cooling time of 120 days.

\*\*PWR fuel assembly may have a maximum average burnup of 56,000 MWD/MTU provided the minimum cooling time prior to shipment is 450 days and the neutron shield fluid contains 1.0 weight percent boron. (The borated fluid may be left in the shielding tanks during the shipment of other contents.)

(ii) Irradiated metallic fuels of the following specifications:

	<u>Fermi-1</u>	<u>EBR-II Blanket</u>
Fuel form	Uranium-molybdenum alloy pins	Uranium metal cylindrical slugs
Cladding material	Zr	Aluminum containers
Max. initial U content/assembly, kg	18.7/assy. 300/16 assy. cask load	292/container
Max. avg. initial U-235 enrichment, w/o	26.0	0.21 (3.88 kg Pu/canister)
Max. bundle cross section, inches	2.93 sq	4.875 dia
Fuel rods per canister	140	41
Max. active fuel length, inches	30.5/assy 122/cask	157
Max. average burnup, MWD/MTU	2,840	2,400
Max. decay heat, watts	20	300
Min. cooling time, days	5,000	365

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5.(b)(1)(continued)

(iii)

Research Reactor

Fuel form	Uranium metal rods
Cladding material	Aluminum
Maximum initial U content/assembly-kg	54.5
Maximum average initial U-235 enrichment	Natural
Maximum bundle cross-section, inches	1.36
Intact fuel rods per canister, maximum	7
Canisters per cask	3 intact fuel
Max. active fuel length, inches	120.5
Maximum average burnup MWD/MTU	1,600
Maximum decay heat, watts	750
Minimum cooling time, days	365

(iv) Irradiated PWR\* or BWR uranium oxide fuel rods of the following specifications:

	<u>PWR Rods</u>	<u>BWR Rods</u>
Fuel form	Clad UO <sub>2</sub> pellets	Clad UO <sub>2</sub> pellets
Cladding material	Zr or SS	Zr or SS
Maximum initial fuel pin pressure at 100°F, psig	550	200
Maximum initial U content, kg	58.2	75
Maximum average initial U-235 enrichment, w/o	4.9	5.0
Maximum bundle cross section, inches	8.75	5.75
Maximum active fuel length, inches	150	150
Maximum specific power, kW/kgU	44	60
Maximum average burnup, MWD/MTU	60,000	75,000

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5.(b)(1)(iv) (continued)

	<u>PWR Rods</u>	<u>BWR Rods</u>
Maximum decay heat, kW	1.65	4.0
Minimum cooling time, days	150	150

\* For the shipments of irradiated PWR fuel rods, the neutron shield fluid must contain 1.0 weight percent boron (the borated fluid may be left in the shielding tanks during the shipment of other contents).

- (v) Solid, non-fissile, irradiated hardware and neutron source components.
  - (vi) Byproduct and special nuclear material in the form of irradiated uranium and plutonium oxide fuel rods. Prior to irradiation, the maximum average enrichment in U-235 plus plutonium not to exceed 3.70 w/o and the maximum enrichment not to exceed 4.0 w/o.
  - (vii) Irradiated PWR uranium oxide fuel assemblies including additional irradiated fuel rods inserted and secured in the guide thimbles. The fuel assemblies must conform to the maximum active dimensions as described in Item 5(b)(i) except that maximum initial U content must be 495 kg and the maximum average initial U-235 enrichment shall be 3.35 w/o.
  - (viii) Irradiated Connecticut Yankee fuel assembly with a maximum average initial U-235 enrichment of 4.0 w/o and each of the 15 x 15 fuel rods clad by stainless steel. 204 rods/assembly; active length of 121.4 inches.
  - (ix) Irradiated MARK 42 fuel assemblies consisting of three concentric fuel tubes with PuO<sub>2</sub>-Al powder metallurgy cores clad with type 6063 aluminum, containing a total of 3.35 kg of plutonium. The plutonium was initially enriched to contain 78.28 w/o Pu-239, 2.27 w/o Pu-241 and 0.15 w/o Pu-238.
  - (x) Irradiated MARK 22 fuel assemblies consisting of two concentric fuel tubes with uranium-aluminum cores clad with type 8001 aluminum, containing a total of 3.2 kg of uranium-235. The uranium was initially enriched to contain 66 w/o to 80 w/o uranium-235. The irradiated MARK 22 fuel assembly has an active length of 150 inches, a maximum burn-up of 1226 MWD and a minimum cooling time of 150 days.
- (2) Maximum quantity of material per package
- (i) Items 5(b)(1)(i) or 5(b)(1)(vii) above: one PWR fuel assembly; two BWR fuel assemblies; or one consolidated fuel canister. Fuel assemblies to be contained in their respective fuel baskets as shown on National Lead Company Drawing No. 70562F, Sheet 1, Rev. 11, or 70886F, Sheet 1, Rev. 2. The consolidated fuel canister to be contained in Configuration (A) fuel basket as shown on National Lead Company Drawing No. 70562F, Sheet 1, Rev. 11.
  - (ii) Item 5(b)(1)(ii) above: four canisters per cask. The fuel canisters and fuel basket must be in accordance with Configuration (C) above.

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## 5.(b)(2)(continued)

## (iii) Item 5(b)(1)(iii) above:

- (a) three canisters of unfailed fuel containing up to seven fuel rods per canister. The fuel canisters and fuel basket must be in accordance with Configuration (D) above; or
  - (b) up to six canisters containing one defective fuel rod per canister. The canisters are 2.75-inch I.D. failed fuel rod canisters as shown on Nuclear Assurance Corporation Drawing No. 340-108-D2, Rev. 10, and are placed in the six-rod capacity liner as shown on Nuclear Assurance Corporation Drawing No. 347-029-20, Rev. 1. The maximum decay heat load for a defective fuel rod is limited to 5 watts; or
  - (c) up to three canisters containing either one defective fuel rod per canister or up to 10 failed fuel filters per canister. The canisters are 4.00-inch I.D. failed fuel rod canisters as shown on Nuclear Assurance Corporation Drawing No. 340-108-D1, Rev. 10. The fuel basket is in accordance with Configuration (D) above. The weight of the filters is limited to 125 pounds per canister. The maximum decay heat load for the defective fuel rods and the failed fuel filters is limited to 5 watts per canister. Plutonium content of the filters not to exceed 20 curies plutonium per package.
- (iv) Item 5(b)(1)(iv) above, the fuel rods will be shipped in Configuration (A) or (B). PWR fuel rods with burnup in excess of 45,000 MWD/MTU and BWR fuel rods with burnup in excess of 50,000 MWD/MTU will be shipped in Configuration (A) only. The maximum initial uranium content is limited to 58.2 kg per package for PWR rods and 75 kg per package for BWR rods; and
- (a) up to 25 PWR fuel rods or up to 25 BWR fuel rods per cask. Up to 2 of the 25 PWR rods may have a maximum burnup of 65,000 MWD/MTU; or
  - (b) up to 18 PWR fuel rods, with a maximum specific power of 60 kW/kgU and a minimum cooling time of 300 days, per cask.
- (v) Item 5(b)(1)(v) above, weight not to exceed 1,600 pounds.
- (vi) Item 5(b)(1)(vi) above, the maximum mass of U-235 plus plutonium must not exceed 4.0 kg. Fuel rods must be contained in fuel baskets as shown on National Lead Company Drawing No. 70562F, Sheet 1, Rev. 11, or 70886F, Sheet 1, Rev. 2.
- (vii) Item 5(b)(1)(viii) above: One Connecticut Yankee intact irradiated fuel assembly.
- (viii) Item 5(b)(1)(ix) above: One irradiated MARK 42 fuel assembly in either intact or sectioned form, using Configuration (C) above. If sectioned, each section must be seal welded in a shipping can as shown on Martin Marietta Energy Systems Drawing Nos. M-12821-CP-105E, Rev. 0, and M-12821-CP-106E, Rev. 1. Four shipping cans will be loaded into a MARK 42 Segment Dry Shipping Canister as shown on Martin Marietta Energy Systems Drawing No. M-12821-CP-102, Rev. 1, along with a shipping canister spacer, as shown on Martin Marietta Energy Systems Drawing No. M-12821-CP-103, Rev. 1. The shipping canister will be loaded on top of a carrier spacer as shown on Martin Marietta Energy Systems Drawing No. M-12821-CP-112, Rev. 0. A maximum of 2 shipping canisters may be loaded into a cask.

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## 5.(b)(2)(viii)(continued)

Intact fuel assemblies will be shipped in a MARK 42 Element Wet Shipping Canister as shown on Martin Marietta Energy Systems Drawing No. M-12821-CP-114, Rev. 0. A maximum of one intact assembly may be loaded into a cask.

- (ix) Item 5(b)(1)(x) above: Two MARK 22 fuel assemblies or one MARK 22 fuel assembly with the two cores separated, using Configuration (C) above. Each assembly or core will be shipped in a shipping canister as shown on Sandia National Laboratory Drawing No. R21563, Sheet 1, Iss. B.
- (c) Criticality Safety Index 100
6. Irradiated fuels described in items 5(b)(1)(i), 5(b)(1)(ii), 5(b)(1)(iii), and 5(b)(1)(iv) above may not have a maximum burnup which exceeds 1.25 times the specified maximum average burnup.
  7. The cask cavity and containment vessel (inner container) must be dry (no free water) when delivered to a carrier for transport. Residual moisture must be promptly removed from the cask cavity and containment vessel by the methods described in Section XV of the application. Removal of the residual moisture from cask cavity when package is used in Configurations (B), (C), or (D) is not required providing the decay heat load does not exceed 2.0 kW.
  8. For the shipment of irradiated fuel assemblies or a canister of consolidated irradiated fuel, the cask cavity canister of consolidated irradiated fuel (if present), and containment vessel must be promptly inerted following removal of the water from the cavity. For contents not vacuum dried, the cask cavity and containment vessel must be purged at least three times with argon, nitrogen, or helium. Each purge volume must be equivalent to or greater than the cask cavity and containment vessel volume. After the final purge, or following vacuum drying, the cavity and containment vessel must be promptly filled with argon, nitrogen, or helium at 1.0 atm pressure.
  9. Known or suspected failed fuel assemblies (rods) and fuel with cladding defects greater than pin holes and hairline cracks must be shipped in Configuration (A).
  10. The consolidated fuel canister must be provided with vent and drain lines (openings) to permit free draining of the canister. No valves can be installed on the vent and drain lines.
  11. The cask may be shipped in a closed shipping container (Configuration D) provided that the closed shipping container and the transport vehicle (trailer) meet the applicable requirements of the Department of Transportation. Tie-down devices which are a structural part of the cask and the cask support structures must comply with 10 CFR 71.45.
  12. When the cask is shipped in a closed shipping container the center of gravity of the combined cask, closed shipping container and trailer must not exceed 75.0 inches.
  13. When the cask is shipped in a closed shipping container, the internal heat load must not exceed 750 watts.

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14. The neutron shielding tank must be filled with a mixture of water and ethylene glycol (52% by volume). This mixture must not freeze or precipitate in a temperature range from -40°F to 330°F. The neutron shield tank may be empty when the cask is in Configuration D.
15. The structures used to support the package on the transport vehicle must be as described in the application.
16. Any system used for cooling down the package must be provided with a pressure relief device set so that during the cool-down process, the maximum pressure in the containment vessel cannot exceed 310 psig when the package is used in Configuration (A) or 365 psig when the package is used in Configuration (B).
17. As needed, appropriate component spacers must be used in the cask cavity to limit movement of contents during shipment.
18. Shipping cans used for sectioned MARK 42 irradiated fuel assemblies must be seal welded and must be leak tested to  $1 \times 10^{-7}$  std  $\text{cm}^3/\text{sec}$ .
19. 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 in Section XV of the application, as supplemented.
  - (b) The package shall be maintained and tested in accordance with the maintenance program in Section XVI of the application, as supplemented.
  - (c) When the package is to be used for the transport of authorized contents having a decay heat load of greater than 4.0 kW, a 220 psig hydrostatic test of the containment cavity, and a 405 psig hydrostatic test of the water jacket and expansion tank shall be performed as part of the maintenance program as specified in Section XVI of the application.
20. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.17.
21. Revision No. 40 of this certificate may be used until April 30, 2007.
21. Expiration date: October 1, 2008. This certificate is not renewable.

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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 April 13, 2006

