CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9325	4	71-9325	USA/9325/B(U)F-96	1 OF	8

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)*

Holtec International
1 Holtec Blvd.
Camden, NJ 08104

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Holtec International Report No. HI-2073681,*Safety Analysis Report on the HI-STAR 180 Package,* Revision No.9, dated June 1, 2021.

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.: HI-STAR 180

(2) Description

The HI-STAR 180 package is designed for transportation of undamaged irradiated Uranium Oxide (UO_2) and Mixed Oxide (MOX) fuel assemblies in baskets, or of individual UO_2 fuel rods in quivers. The fuel basket provides criticality control and the packaging body provides the containment boundary, helium retention boundary, moderator exclusion barrier, gamma and neutron radiation shielding, and heat rejection capability. The outer diameter of the HI-STAR 180 packaging is approximately 2700 mm without impact limiters and approximately 3250 mm with impact limiters. The maximum gross weight of the loaded HI-STAR 180 package is 140 Metric Tons.

Two interchangeable fuel basket models, designated F-32 and F-37, contain either 32 or 37 Pressurized Water Reactor (PWR) fuel assemblies respectively, in regionalized and uniform loading patterns. The fuel basket, made of Metamic-HT both as structural and neutron absorber material, features a honeycomb structure and flux traps between some but not all cells. Dummy fuel assemblies, with characteristics mentioned in Table 1.c, may be used to provide supplemental shielding and/or supplemental weight. The tubular design of a dummy fuel assembly ensures its mass is spread evenly along the fuel basket length. When made from multiple pieces, its construction eliminates direct loads on welds.

A quiver is a hermetically sealed container used for individual fuel rods which may be

5.(a)(2) Description (continued)

leaking, broken or fragmented (i.e., fuel debris), or purposely punctured to relieve internal pressure.

The cylindrical steel shell containment system of the packaging body is welded to a bottom steel baseplate and a top steel forging machined to receive two independent steel closure lids, with each lid being individually designated as a containment boundary component. The outer surface of the cask inner shell is buttressed with a monolithic shield cylinder for gamma and neutron shielding. Each closure lid features a dual metallic self-energizing seal system designed to ensure its containment and moderator exclusion functions. For this package, the inner closure lid inner seal and the inner closure lid vent/drain port cover inner seals are the containment boundary components on the inner lid; the outer closure lid inner seal and the outer closure lid access port plug seal are the containment boundary components on the outer lid.

The HI-STAR 180 package is fitted with two impact limiters fabricated of aluminum honeycomb crush material completely enclosed by an all-welded austenitic stainless-steel skin. Both impact limiters are attached to the cask with 16 bolts.

(3) Drawings

The packaging shall be constructed and assembled in accordance with the following Holtec International Drawings Numbers:

(a) HI-STAR 180 Cask	Drawing No. 4845, Sheets 1-7, Rev. 15
(b) F-37 Fuel Basket	Drawing No. 4847, Sheets 1-4, Rev. 9
(c) F-32 Fuel Basket	Drawing No. 4848, Sheets 1-4, Rev. 9
(d) HI-STAR 180 Impact Limiter	Drawing No. 5062, Sheets 1-5, Rev. 8

5.(b) Contents

(1) Type, Form, and Quantity of Material

(a) Undamaged UO_2 and MOX PWR fuel assemblies with a Zr cladding type, or dummy fuel assemblies, meeting the Condition Nos. 5.b(1)(c) through 5.b(1)(n), and with the characteristics listed in Table 1.a and Table 1.c below.

(b) Undamaged UO2 and MOX PWR fuel assemblies with a Zr cladding type, or dummy fuel assemblies, meeting the Condition Nos. 5.b(1)(c) through 5.b(1)(n), and with the

5.(b)(1) continued

characteristics listed in Table 1.a and Table 1.c below, with quivers in up to 2 basket cell locations. Quivers shall have the characteristics specified in Table 1.b below and shall meet the specifications and requirements in Condition Nos. 5.b(1)(o) and 5(b)(1)(p).

Table 1.a- PWR Fuel Assembly Characteristics

Fuel Assembly Type	14x14
Design Initial Heavy Metal Mass (kg/assembly)	341 Maximum
Maximum Fuel Assembly Mass (kg)	500
No. of Fuel Rod Locations	179
Fuel Rod Clad O.D. (mm)	≥ 10.72 Nominal
Fuel Rod Clad I.D. (mm)	≤ 9.61 Nominal
Fuel Pellet Diameter (mm)	≤ 9.31 Nominal
Fuel Rod Pitch (mm)	≤ 14.224 Nominal
Active Fuel Length (mm)	≤ 3070 Nominal
Maximum Fuel Assembly Length (mm)	3524 Nominal
No. of Guide and/or Instrument Tubes	17
Guide/Instrument Tube Thickness (mm)	≥ 0.285 Nominal
Minimum Cooling Time for Assemblies with Zr Guide/Instrument Tubes (years)	2
Minimum Cooling Time for Assemblies with Stainless Steel Guide/Instrument Tubes (years)	15
Minimum Cooling Time for Assemblies with NFH insertion more than 38 cm into the active region during full power operation (years)	20

Table 1.b – Quiver Characteristics

Maximum Mass of a Loaded Quiver (kg)	500
Maximum Nominal Length (mm)	3496
Maximum Number of Separated Fuel Rods per Quiver	48
Source of Separated Fuel Rods	See Table 1.a

5.(b)(1) continued

Table 1.c – Dummy Fuel Assembly Characteristics

Maximum Mass (kg) (See Note 1)	500
Maximum Nominal Length (mm)	3496
Minimum Cross Section Dimensions (cm) (For emulated fuel region only. See Note 2)	19.768 x 19.768
Required Minimum Effective Density (g/cm^3) (For emulated fuel region only. See Note 2)	3.807
Material of Construction	Stainless Steel

Note 1: For structural purposes and with respect to Condition No. 5.b(1)(l), the overall weight of each dummy fuel assembly may be increased up to the maximum mass specified herein.

Note 2: For shielding purposes, dummy fuel assemblies, located in the regions specified in Condition Nos. 5.(b)(1)(m) and No. 5.(b)(1)(n), must emulate the active fuel length and axial location of a fuel assembly and maintain structural integrity under normal conditions of transport drop events. The emulated fuel region must comply with the specified overall cross section dimension and effective density. The dummy fuel assembly shall be identical to the structural design of the fuel assembly, as defined in Table 1.a.

(c) Damaged fuel assemblies, i.e., assemblies with known or suspected cladding defects greater than pinhole leaks or hairline cracks and which cannot be handled by normal means, as well as fuel debris, non-fuel hardware and neutron sources are not authorized contents.

(d) The maximum initial enrichment of any UO_2 assembly is 5.0 percent by weight of uranium-235.

(e) Each loaded MOX fuel assembly must meet one of the criteria sets (1-4) from Table 2 and one of the criteria sets (1-3) from Table 3. MOX fuel isotopic compositions in Table 2 are bounding for dose and decay heat and used to establish the loading patterns. MOX fuel isotopic characteristics in Table 3 are bounding for criticality purposes.

5.(b)(1) continued

Table 2
Isotopic Characteristics of MOX Fuel

	Isotopic Composition (gram/assembly)			
Criteria / Isotope	1	2	3	4
Pu238	≤ 700	≤ 202	≤ 202	≤ 202
Pu239	≥ 12808	≥ 11000	≥ 7438	≥ 8000
Pu240	≥ 5726	≥ 3800	≥ 1700	≥ 1700
Pu241	≤ 2300	≤ 1600	≤ 1250	≤ 1600
Pu242	≤ 1900	≤ 751	≤ 700	≤ 751
U235	≥ 724	≥ 720	≥ 2100	≥ 720
U238	≤ 298007	≤ 320200	≤ 326000	≤ 326000

Table 3
Isotopic Characteristics of MOX Fuel

Criteria / Composition	1	2	3
Pu-239 (g/kg-HM)	≤ 39.5	≤ 49	≤ 26
Pu-238/Pu-239 (g/g)	≥ 0.0	≥ 0.015	≥ 0.0
Pu-240/Pu-239 (g/g)	≥ 0.27	≥ 0.38	≥ 0.21
Pu-241/Pu-239 (g/g)	≤ 0.15	≤ 0.20	≤ 0.16
Pu-242/Pu-239 (g/g)	≥ 0.012	≥ 0.06	≥ 0.012
Am-241(g/kg-HM)	≥ 0.0	≥ 0.0	≥ 0.0
U-235 (g/kg-HM)	≤ 7.1	≤ 7.1	≤ 7.1

5.(b)(1) continued

(f) The post-irradiation minimum cooling time, maximum burnup, maximum decay heat load, and minimum initial enrichment per assembly are listed in Tables 1.2.8 and 1.2.9 of the application. The F-32 and F-37 fuel basket cell numbering and quadrant identification are depicted in Figures 1.2.3 and 1.2.4 of the application, respectively.

(g) Regions, cells and quadrants for regionalized loading of the F-32 and F-37 baskets are identified in Tables 1.2.6.a and 1.2.6.b of the application. Table 1.2.7.a provides the minimum burnup requirements for the F-37 basket, based on initial enrichment for various configurations, while Table 1.2.7.b provides maximum initial enrichment limits for fresh UO_2 fuel assemblies for certain configurations.

(h) In-core operating limits for those assemblies that need to meet the burnup requirements in Table 1.2.7.a of the application are as follows:

Parameter	Requirement
Assembly Average Specific Power	≤ 39.4 MW/MTU
Assembly Average Moderator Temperature	≤ 597º K
Maximum Assembly Average Fuel Temperature	1127ºK
Core Average Soluble Boron Concentration	≤ 700 ppmb

(i) For those spent fuel assemblies that need to meet the burnup requirements specified in Table 1.2.7.a of the application, a burnup verification shall be performed either in accordance with Section 6.F.3.1 or 6.F.3.2 of the application.

(j) Allowable loading patterns and fuel specifications for each basket region are referenced in Tables 1.2.8 and 1.2.9 of the application. Alternative fuel specifications for each regional loading pattern are presented in Table 1.2.10 of the application.

(k) The maximum decay heat for either the F-32 or F-37 basket model is 32 kW per basket, with 8 kW maximum decay heat per basket quadrant.

(l) Partially loaded casks must not have more than 12 empty locations. Contents must be evenly spread to the extent practicable. Dummy fuel assemblies may be used to achieve the required mass.

(m) All basket cells in regions 4 and 7 of a partially loaded cask with the F-32 basket shall contain either fuel assemblies or dummy fuel assemblies.

(n) All basket cells in regions 5 and 8 of a partially loaded cask with the F-37 basket shall contain either fuel assemblies or dummy fuel assemblies.

(o) Up to two quivers are allowed in cells Nos. 1 and 32, or 10 and 23 of the F-32 basket, or cells Nos. 4 and 34, or 8 and 30 of the F-37 basket (per Figures 1.2.3 and 1.2.4 of the application, respectively).

(p) The maximum decay heat per quiver, in either the F-32 or F-37 basket, shall be in accordance with the basket cell heat loads corresponding to the allowed quiver basket cells, per Tables 1.2.8 and 1.2.9 of the application.

5.b.(2) Maximum Quantity of Material Per Package

(a) 32 or 37 PWR fuel assemblies, as described in 5(b)(1), in the F-32 or F-37 basket respectively.

(b) 32 or 37 PWR fuel assemblies, as described in 5(b)(1), in the F-32 or F-37 basket respectively, with a maximum of 96 fuel rods, separated from 2 fuel assemblies, in quivers.

5.(c) Criticality Safety Index (CSI)= 0.0

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 Chapter 7 of the application.

(b) The package shall meet the acceptance tests and be maintained in accordance with Chapter 8 of the application.

7. The personnel barrier shall be installed and remain installed while transporting the package, if necessary, to meet package surface temperature and/or package dose rates requirements.

8. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

9. Transport by air of fissile material is not authorized.

10. The package may be used in the U.S. for shipment of UO_2 fuel meeting the above specifications.

11. Revision No. 3 of this certificate may be used until October 31, 2022.

12. Expiration Date: May 31, 2025

REFERENCES:

Holtec International application "Safety Analysis Report on the HI-STAR 180 Package", Revision No. 9, dated June 1, 2021.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

John B. McKirgan

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Date: 2021.10.15 10:39:12 -04'00'

John B. McKirgan, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: October 15, 2021

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 15, 2021

Mr. Luis Hinojosa
Corporate Adjunct Licensing Manager
Holtec International
1 Holtec Blvd
Camden, NJ 08104

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9325, REVISION NO. 4, FOR THE MODEL NO. HI-STAR 180 PACKAGE

Dear Mr. Hinojosa:

As requested by your application dated June 1, 2021 (ADAMS Accession No. ML21152A264), enclosed is Certificate of Compliance No. 9325, Revision No. 4, for the Model No. HI-STAR 180 package. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The U.S. Nuclear Regulatory Commission staff's safety evaluation report is also enclosed.

The approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of Title 49 of the *Code of Federal Regulations* 173.471.

If you have any questions regarding this certificate, please contact Pierre Saverot of my staff at 301-415-7505.

Sincerely,

John B. McKirgan

Digitally signed by John B. McKirgan
Date: 2021.10.15 10:37:50 -04'00'

John B. McKirgan, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9325
EPID L-2021-LLA-0098

Enclosures:
1. Certificate of Compliance
   No. 9325, Rev. No. 4
2. Safety Evaluation Report

cc w/encls.:
R. Boyle, Department of Transportation
J. Shuler, Department of Energy, c/o L. Gelder