

**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

- |  |   |
|--|---|
| <p>a. ISSUED TO (<i>Name and Address</i>)</p> <p>Holtec International<br/>Holtec Center<br/>555 Lincoln Drive West<br/>Marlton, NJ 08053</p> | <p>b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION</p> <p>Holtec International Report No. HI-951251, <i>Safety Analysis Report for the Holtec International Storage, Transport, And Repository Cask System (HI-STAR 100 Cask System) Revision 10</i>, dated August 21, 2003.</p> |
|--|---|

## 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 100 System
- (2) Description

The HI-STAR 100 System is a canister system comprising a Multi-Purpose Canister (MPC) inside of an overpack designed for both storage and transportation (with impact limiters) of irradiated nuclear fuel. The HI-STAR 100 System consists of interchangeable MPCs that house the spent nuclear fuel and an overpack that provides the containment boundary, helium retention boundary, gamma and neutron radiation shielding, and heat rejection capability. The outer diameter of the overpack of the HI-STAR 100 is approximately 96 inches without impact limiters and approximately 128 inches with impact limiters. Maximum gross weight for transportation (including overpack, MPC, fuel, and impact limiters) is 282,000 pounds. Specific tolerances germane to the safety analyses are called out in the drawings listed below.

**Multi-Purpose Canister**

There are five Multi-Purpose Canister (MPC) models designated as the MPC-24, MPC-24E, MPC-24EF, MPC-68, and MPC-68F. All MPCs are designed to have identical exterior dimensions, except those MPC-24E/EFs custom-designed for the Trojan plant, which are approximately nine inches shorter than the generic Holtec MPC design. A single overpack design is provided that is capable of containing each type of MPC. The two digits after the MPC designate the number of reactor fuel assemblies for which the respective MPCs are designed. The MPC-24 series is designed to contain up to 24 Pressurized Water Reactor (PWR) fuel assemblies and the MPC-68 and MPC-68F are designed to contain up to 68 Boiling Water Reactor (BWR) fuel assemblies. BWR fuel debris may be shipped only in the MPC-68F.

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

PWR spent fuel assemblies classified as fuel debris may be loaded only in MPC-24EF.

The HI-STAR 100 MPC is a welded cylindrical structure with flat ends. Each MPC is an assembly consisting of a honeycombed fuel basket, baseplate, canister shell, lid, and closure ring. The outer diameter and cylindrical height of each generic MPC is fixed. The outer diameter of the Trojan MPCs is the same as the generic MPC, but the height is approximately nine inches shorter than the generic MPC design. A steel spacer is used with the Trojan plant MPCs to ensure the MPC-overpack interface is bounded by the generic design. The fuel basket designs vary based on the MPC model. For the HI-STAR 100 System transporting fuel debris in a MPC-68F or MPC-24EF, the MPC provides the second inner container, in accordance with 10 CFR 71.63. The MPC pressure boundary is a welded enclosure constructed entirely of a stainless steel alloy.

**Overpack**

The HI-STAR 100 overpack is a multi-layer steel cylinder with a welded baseplate and bolted lid (closure plate). The inner shell of the overpack forms an internal cylindrical cavity for housing the MPC. The outer surface of the overpack inner shell is buttressed with intermediate steel shells for radiation shielding. The overpack closure plate incorporates a dual O-ring design to ensure its containment function. The containment system consists of the overpack inner shell, bottom plate, top flange, top closure plate, top closure inner O-ring seal, vent port plug and seal, and drain port plug and seal.

**Impact Limiters**

The HI-STAR 100 overpack is fitted with two impact limiters fabricated of aluminum honeycomb completely enclosed by an all-welded austenitic stainless steel skin. The two impact limiters are attached to the overpack with 20 and 16 bolts at the top and bottom, respectively.

(3) Drawings

The package shall be constructed and assembled in accordance with the following drawings or figures in Holtec International Report No. HI-951251, *Safety Analysis Report for the Holtec International Storage, Transport, And Repository Cask System (HI-STAR 100 Cask System)*, Revision 10:

- |                                 |                                  |
|---------------------------------|----------------------------------|
| (a) HI-STAR 100 Overpack        | Drawing 3913, Sheets 1-9, Rev. 5 |
| (b) MPC Enclosure Vessel        | Drawing 3923, Sheets 1-5, Rev. 8 |
| (c) MPC-24E/EF Fuel Basket      | Drawing 3925, Sheets 1-4, Rev. 4 |
| (d) MPC-24 Fuel Basket Assembly | Drawing 3926, Sheets 1-4, Rev. 5 |
| (e) MPC-68/68F/68FF Fuel Basket | Drawing 3928, Sheets 1-4, Rev. 4 |

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## 5.(a) (3) Drawings (continued)

- |     |  |   |  |
|-----|--|---|--|
| (f) | HI-STAR 100 Impact Limiter<br>CoC No. 9261, Appendix B | Drawing C1765, Sheets 1-6, Rev. 1; and Sheet<br>7, Rev. 0             |  |
| (g) | HI-STAR 100 Assembly<br>for Transport                  | Drawing 3930, Sheets 1-3, Rev. 1                                      |  |
| (h) | Trojan MPC-24E/EF Spacer Ring                          | Drawing 4111, Sheets 1-2, Rev. 0                                      |  |
| (i) | Damaged Fuel Container<br>for Trojan Plant SNF         | Drawing 4119, Sheet 1-4, Rev. 1                                       |  |
| (j) | Spacer for Trojan Failed Fuel Can                      | Drawing 4122, Sheets 1-2, Rev. 0                                      |  |
| (k) | Failed Fuel Can for Trojan                             | SNC Drawings PFFC-001, Rev. 8 and<br>PFFC-002, Sheets 1 and 2, Rev. 7 |  |

## 5.(b) Contents

## (1) Type, Form, and Quantity of Material

- (a) Fuel assemblies meeting the specifications and quantities provided in Appendix A to this Certificate of Compliance and meeting the requirements provided in Conditions 5.b(1)(b) through 5.b(1)(g) below are authorized for transportation.
- (b) The following definitions apply:

**Damaged Fuel Assemblies** are fuel assemblies with known or suspected cladding defects, as determined by review of records, greater than pinhole leaks or hairline cracks, missing fuel rods that are not replaced with dummy fuel rods, missing structural components such as grid spacers, assemblies whose structural integrity have been impaired, or those that cannot be handled by normal means. Fuel assemblies which cannot be handled by normal means due to fuel cladding damage are considered fuel debris.

**Damaged Fuel Containers (or Canisters)(DFCs)** are specially designed fuel containers for damaged fuel assemblies or fuel debris that permit gaseous and liquid media to escape while minimizing dispersal of gross particulates. The DFC designs authorized for use in the HI-STAR 100 are shown in Figures 1.2.10 and 1.2.11 of the HI-STAR 100 System SAR, Rev. 10.

**Fuel Debris** is ruptured fuel rods, severed rods, loose fuel pellets, and fuel assemblies with known or suspected defects which cannot be handled by normal means due to fuel cladding damage. Fuel debris also includes certain Trojan plant-specific fuel material contained in Trojan Failed Fuel Cans.

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5.(b)(1)(b) Definitions (continued)

**Incore Grid Spacers** are fuel assembly grid spacers located within the active fuel region (i.e., not including top and bottom spacers).

**Intact Fuel Assemblies** are fuel assemblies without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means. Fuel assemblies without fuel rods in fuel rod locations shall not be classified as intact fuel assemblies unless dummy fuel rods are used to displace an amount of water greater than or equal to that displaced by the original fuel rod(s).

**Minimum Enrichment** is the minimum assembly average enrichment. Natural uranium blankets are not considered in determining minimum enrichment.

**Non-Fuel Hardware** is defined as Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Devices (TDPs), and Rod Cluster Control Assemblies (RCCAs).

**Planar-Average Initial Enrichment** is the average of the distributed fuel rod initial enrichments within a given axial plane of the assembly lattice.

**Trojan Damaged Fuel Containers (or Canisters)** are Holtec damaged fuel containers custom-designed for Trojan plant damaged fuel and fuel debris as depicted in Drawing 4119, Rev. 1.

**Trojan Failed Fuel Cans** are non-Holtec designed Trojan plant-specific damaged fuel containers that may be loaded with Trojan plant damaged fuel assemblies, Trojan fuel assembly metal fragments (e.g., portions of fuel rods and grid assemblies, bottom nozzles, etc.), a Trojan fuel rod storage container, a Trojan Fuel Debris Process Can Capsule, or a Trojan Fuel Debris Process Can. The Trojan Failed Fuel Can is depicted in Drawings PFFC-001, Rev. 8 and PFFC-002, Rev. 7.

**Trojan Fuel Debris Process Cans** are Trojan plant-specific canisters containing fuel debris (metal fragments) and were used to process organic media removed from the Trojan plant spent fuel pool during cleanup operations in preparation for spent fuel pool decommissioning. Trojan Fuel Debris Process Cans are loaded into Trojan Fuel Debris Process Can Capsules or directly into Trojan Failed Fuel Cans. The Trojan Fuel Debris Process Can is depicted in Figure 1.2.10B of the HI-STAR100 System SAR, Rev. 10.

**Trojan Fuel Debris Process Can Capsules** are Trojan plant-specific canisters that contain up to five Trojan Fuel Debris Process Cans and are vacuumed, purged, backfilled with helium and then seal-welded closed. The Trojan Fuel Debris Process Can Capsule is depicted in Figure 1.2.10C of the HI-STAR 100 System SAR, Rev. 10.

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5.(b)(1)(b) Definitions (continued)

**ZR** means any zirconium-based fuel cladding materials authorized for use in a commercial nuclear power plant reactor.

- (c) For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the more restrictive of the decay heat limits for the stainless steel clad fuel assemblies or the applicable ZR clad fuel assemblies.
- (d) For MPCs partially loaded with damaged fuel assemblies or fuel debris, all remaining ZR clad intact fuel assemblies in the MPC shall meet the more restrictive of the decay heat limits for the damaged fuel assemblies or the intact fuel assemblies.
- (e) For MPC-68s partially loaded with array/class 6x6A, 6x6B, 6x6C, or 8x8A fuel assemblies, all remaining ZR clad intact fuel assemblies in the MPC shall meet the more restrictive of the decay heat limits for the 6x6A, 6x6B, 6x6C, and 8x8A fuel assemblies or the applicable Zircaloy clad fuel assemblies.
- (f) PWR non-fuel hardware and neutron sources are not authorized for transportation except as specifically provided for in Appendix A to this CoC.
- (g) BWR stainless-steel channels and control blades are not authorized for transportation.

5.(c) Transport Index for Criticality Control (Criticality Safety Index)

The minimum transport index to be shown on the label for nuclear criticality control: 0

6. For operating controls and procedures, in addition to the requirements of Subpart G of 10 CFR Part 71:

- (a) Each package shall be both prepared for shipment and operated in accordance with detailed written operating procedures. Procedures for both preparation and operation shall be developed. At a minimum, those procedures shall include the following provisions:
  - (1) Identification of the fuel to be loaded and independent verification that the fuel meets the specifications of Condition 5.(b) above.
  - (2) Before each shipment, the licensee or shipper shall verify and document that each of the requirements of 10 CFR 71.87 has been satisfied.
  - (3) The package must satisfy the following leak testing requirements:
    - (a) All overpack containment boundary seals shall be leak tested to show a total leak rate of not greater than  $4.3 \times 10^{-6}$  atm cm<sup>3</sup>/sec (helium). The leak test shall have a minimum sensitivity of  $2.15 \times 10^{-6}$  atm cm<sup>3</sup>/sec (helium) and shall

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6.(a) (continued)

be performed:

- (i) within the 12-month period prior to each shipment;
  - (ii) after detensioning one or more overpack lid bolts, drain port, or the vent port plug; and
  - (iii) after each seal replacement.
- (b) Within 30 days before each shipment, all overpack containment boundary seals shall be leak tested using a test with a minimum sensitivity of  $1 \times 10^{-3}$  atm cm<sup>3</sup>/sec. If leakage is detected on a seal, then the seal must be replaced and leak tested per Condition 6.(a)(3)(a) above.
- (c) Each overpack containment boundary seal must be replaced after each use of the seal.
- (4) The relief devices on the neutron shield vessel shall be replaced every 5 years.
- (5) MPC-68F and MPC-24EF shall be leak tested prior to shipment to show a leak rate of no greater than  $5 \times 10^{-6}$  atm cm<sup>3</sup>/sec (helium). The leak test shall have a minimum sensitivity of  $2.5 \times 10^{-6}$  atm cm<sup>3</sup>/sec (helium).
- (6) MPCs deployed at an ISFSI under 10 CFR Part 72 prior to transportation may be dried using the vacuum drying method or the Forced Helium Dehydration (FHD) method. MPCs placed directly into transportation service under 10 CFR 71 without first being deployed at an ISFSI must be dried using the FHD method. Water and residual moisture shall be removed from the MPC in accordance with the following specifications:

For those MPCs vacuum dried:

- (a) The MPC shall be evacuated to a pressure of less than or equal to 3 torr.
- (b) The MPC cavity shall hold a stable pressure of less than or equal to 3 torr for at least 30 minutes.

For those MPCs dried using the FHD System:

- (a) Following bulk moisture removal, the temperature of the gas exiting the demister shall be  $\leq 21^{\circ}\text{F}$  for  $\geq 30$  minutes.
- (7) Following drying, the MPC shall be backfilled with 99.995% minimum purity helium:  $> 0$  psig and  $\leq 44.8$  psig at a reference temperature of  $70^{\circ}\text{F}$ .
- (8) Water and residual moisture shall be removed from the HI-STAR 100 overpack in accordance with the following specifications:
- (a) The overpack annulus shall be evacuated to a pressure of less than or equal

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6.(a) (continued)

to 3 torr.

- (b) The overpack annulus shall hold a stable pressure of less than or equal to 3 torr for at least 30 minutes.
- (9) Following vacuum drying, the overpack shall be backfilled with helium to  $\geq 10$  psig and  $\leq 14$  psig.
- (10) The following fasteners shall be tightened to the torque values specified below:
- | <u>Fastener</u>                        | <u>Torque (ft-lbs)</u> |
|--|------------------------|
| Overpack Closure Plate Bolts           | 2895 $\pm$ 90          |
| Overpack Vent and Drain Port Plugs     | 45 +5/-2               |
| Top Impact Limiter Attachment Bolts    | 256 +10/-0             |
| Bottom Impact Limiter Attachment Bolts | 1500 +45/-0            |
- (11) Verify that the appropriate fuel spacers, as necessary, are used to position the fuel in the MPC cavity.
- (12) Appropriate monitoring for combustible gas concentration shall be performed prior to, and during MPC lid welding and weld cutting operations. The space below the MPC lid shall be exhausted or purged with inert gas prior to, and during MPC lid welding and weld cutting operations to provide additional assurance that flammable gas concentrations will not develop in this space.
- (b) All acceptance tests and maintenance shall be performed in accordance with detailed written procedures. Procedures for fabrication, acceptance testing, and maintenance shall be developed and shall include the following provisions:
- (1) The overpack lifting trunnions shall be tested at 300% of the maximum design lifting load.
- (2) The MPC shall be pressure tested in accordance with ASME Section III, Subsection NB, Article NB-6110 and applicable sub-articles. If hydrostatic testing is used, the MPC shall be pressure tested to 125% of the design pressure. The minimum hydrostatic test pressure shall be 125 psig. If pneumatic testing is used, the MPC shall be pressure tested to 120% of the design pressure. The minimum pneumatic test pressure shall be 120 psig.
- (3) The overpack shall be pressure tested to 150% of the Maximum Normal Operating Pressure (MNOP). The minimum test pressure shall be 150 psig.
- (4) The MPC lid-to-shell (LTS) weld shall be verified by either volumetric examination using the ultrasonic (UT) method or multi-layer liquid penetrant (PT) examination. The root and final weld layers shall be PT examined in either case. If PT alone is used, additional intermediate PT examination(s) shall be conducted after each

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## 6.(b) (continued)

approximately 3/8 inch of the weld is completed. The inspection of the weld must be performed by qualified personnel and shall meet the acceptance requirements of ASME B&PV Section III, NB-5350. The inspection results, including all relevant indications shall be made a permanent part of the licensee's records by video, photographic, or other means providing an equivalent retrievable record of weld integrity.

- (5) The radial neutron shield shall have a minimum thickness of 4.3 inches and the impact limiter neutron shields shall have a minimum thickness of 2.5 inches. Before first use, the neutron shielding integrity shall be confirmed through a combination of fabrication process control and radiation measurements with either loaded contents or a check source. Measurements shall be performed over the entire exterior surface of the radial neutron shield and each impact limiter using, at a maximum, a 6 x 6 inch test grid.
- (6) Periodic verification of the neutron shield integrity shall be performed within 5 years prior to each shipment. The periodic verification shall be performed by radiation measurements with either loaded contents or a check source. Measurements shall be taken at three cross sectional planes through the radial shield and at four points along each plane's circumference. The average measurement results from each sectional plane shall be compared to calculated values to assess the continued effectiveness of the neutron shield. The calculated values shall be representative of the loaded contents (i.e., fuel type, enrichment, burnup, cooling time, etc.) or the particular check source used for the measurements.
- (7) The first fabricated HI-STAR 100 overpack shall be tested to confirm its heat transfer capability. The test shall be conducted after the radial channels, enclosure shell panels, and neutron shield material have been installed and all inside and outside surfaces are painted per the Design Drawings specified in Section 5.(a)(3) of this Certificate of Compliance. A test cover plate shall be used to seal the overpack cavity. Testing shall be performed in accordance with written and approved procedures.
- The test must demonstrate that the overpack is fabricated adequately to meet the design heat transfer capability.
- (8) For each package, a periodic thermal performance test shall be performed within every 5 years or prior to next use, if the package has not been used for transport for greater than 5 years, to demonstrate that the thermal capabilities of the cask remain within its design basis.
- (9) The neutron absorber's minimum acceptable  $^{10}\text{B}$  loading is 0.0267 g/cm<sup>2</sup> for the MPC-24 and 0.0372 g/cm<sup>2</sup> for the MPC-24E, MPC-24EF, and MPC-68, and 0.01 g/cm<sup>2</sup> for the MPC-68F. The  $^{10}\text{B}$  loading shall be verified by chemistry or neutron attenuation techniques.

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(10) Flux trap sizes:

- (a) The minimum flux trap size for the MPC-24 is 1.09 inches.
- (b) The minimum flux trap sizes for the generic MPC-24E and MPC-24EF are 0.776 inch for cells 3, 6, 9, and 22; and 1.076 inch for the remaining cells.
- (c) The minimum flux trap sizes for the Trojan MPC-24E and MPC-24EF are 0.526 inch for cells 3, 6, 9, and 22; and 1.076 inch for the remaining cells.

(11) The minimum fuel cell pitch for the MPC-68 and MPC-68F is 6.43 inches.

(12) The package containment verification leak test shall be per ANSI 14.5-1997.

7. The maximum gross weight of the package as presented for shipment shall not exceed 282,000 pounds.

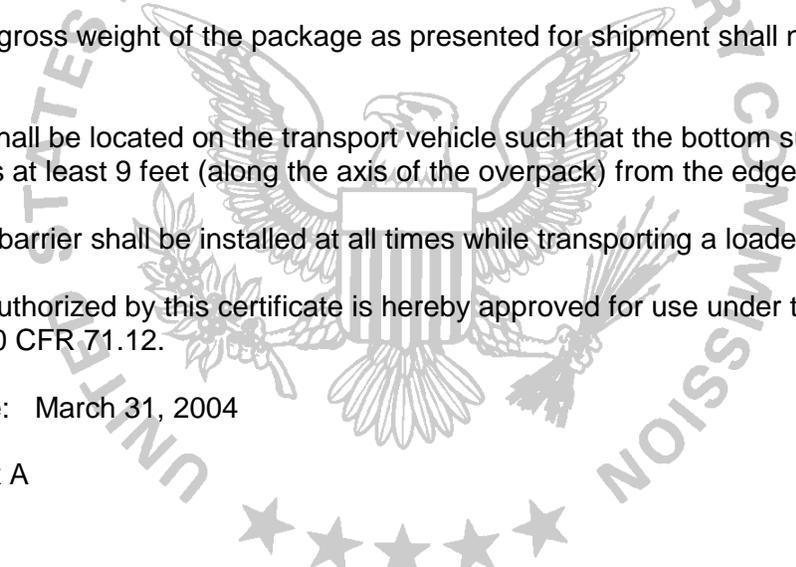
8. The package shall be located on the transport vehicle such that the bottom surface of the bottom impact limiter is at least 9 feet (along the axis of the overpack) from the edge of the vehicle.

9. The personnel barrier shall be installed at all times while transporting a loaded overpack.

10. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.12.

11. Expiration Date: March 31, 2004

Attachment: Appendix A



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Supplement dated: September 4, 10, and 17, 2003

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/  
John D. Monninger, Chief  
Licensing Section  
Spent Fuel Project Office  
Office of Nuclear Material Safety  
and Safeguards

Date: September 24, 2003

