October 12, 2006

Mr. Stefan Anton, Licensing Manager
Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, NJ 08053

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9261 FOR THE HI-STAR 100 SYSTEM

Dear Mr. Anton:

As requested by your application dated September 16, 2003, as supplemented July 27, 2005, February 23, March 13 and 24, and October 9, 2006, enclosed is Certificate of Compliance No. 9261, Revision No. 5, for the Model No. HI-STAR 100 System (Enclosure 1), non-proprietary Chapters 1 through 5, 7, and 8 of the Safety Evaluation Report (Enclosure 2), proprietary Chapter 6 of the Safety Evaluation Report (Enclosure 3), and the registered users list (Enclosure 4). Unless otherwise specified in this certificate, it supersedes, in its entirety, Certificate of Compliance No. 9261, Revision No. 4, dated September 29, 2005. Changes made to the enclosed certificate are indicated by vertical lines in the margin.

Holtec International has been registered as a user of the package under the general license provisions of 10 CFR 71.17. 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 49 CFR 173.471. Registered Users may request by letter to remove their names from the Registered Users List.

If you have any questions regarding this certificate, please contact me or Meraj Rahimi of my staff at (301) 415-8500.

Sincerely,

/RA/

Robert A. Nelson, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9261
TAC No. L23651
Enclosures: 1. Certificate of Compliance
No. 9261, Rev. No. 5
2. Non-proprietary Chapter 1 through 5, 7, and 8 of Safety Evaluation Report
3. Proprietary Chapter 6 of Safety Evaluation Report
4. Registered Users
cc w/encls 1 & 2: R. Boyle, Department of Transportation
James M. Shuler, Department of Energy
RAMCERTS
Registered Users

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OFC	SFPO	E	SFPO	E	SFPO	E	SFPO	E	SFPO	E
NAME	MRahimi		DTang		GHornseth		JSolis		SHelton	
DATE	9/21 /06		9/26/06		9/26/06		9/27/06		9/27/06	

OFC	SFPO	E	SFPO	E	SFPO	C	SFPO		SFPO		SFPO	
NAME	KHardin		CWithee		MDebose		LCampbell		GBjorkman		RNelson	
DATE	9/27 /06		9/29 /06		9/25/06		10/04 /06		10/06/06		10/12 /06	

C = Cover E = Cover & Enclosure N = No copy OFFICIAL RECORD COPY

Enclosure 1

Certificate of Compliance

Enclosure 2

Non-proprietary portion of

Safety Evaluation Report

SAFETY EVALUATION REPORT

Docket No. 71-9261
Model No. Hi-STAR 100
Certificate of Compliance No. 9261
Revision 5

SUMMARY

By application dated September 16, 2003, as supplemented July 27, 2005, February 23, March 13 and 24, and October 9, 2006, Holtec International (the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9261 for the Model No. HI-STAR 100 system. The applicant requested to add the Multi-Purpose Canister-32 (MPC-32) to the MPC vessel models authorized for transportation under 10 Part CFR 71. Based on the statements and representations in the application, as supplemented, and Revision 12 of the SAR, the staff concludes, per its evaluation described in Chapter 2 through Chapter 8 of this Safety Evaluation Report (SER), that the requested change does not affect the ability of the package to meet the requirements of 10 CFR Part 71.

1.0 GENERAL INFORMATION

The following sections summarize the applicant's change requests with respect to the packaging and its contents.

1.1 Packaging

As part of the packaging, the applicant is proposing to include MPC-32 to the MPC enclosure vessel models authorized for transportation. There are no changes to the overpack. A description and drawings of the MPC-32 are provided in Chapter 1 of the applicant's Safety Analysis Report.

As indicated in Section 1.2.1.2.2.4 of the Safety Analysis Report (SAR), the MPC-32 is designed to transport up to 32 Pressurized Water Reactor (PWR) intact fuel assemblies meeting the specifications in Subsection 1.2.3 of the SAR. Damaged fuel and fuel debris are not permitted to be transported in the MPC-32. The MPC-32 enclosure vessel design is structurally identical to the MPC-24/24E enclosure vessel design as shown on the Drawing 3927 of the SAR.

Based on the statements and representations in the application, as supplemented, and Revision 12 of the SAR, the staff concludes that Holtec has provided the MPC-32 designs in sufficient detail for the staff to perform an evaluation per 10 CFR Part 71.

1.2 Contents

The applicant has requested authorization for loading Westinghouse (W) 17x17 PWR and Babcock & Wilcox (B&W) 15 x 15 PWR spent fuel assemblies, or equivalent models manufactured by other fuel vendors, into MPC-32 within HI-STAR 100 overpack for transport. Holtec has analyzed different classes of W 17x17 and B&W 15 x15 which can be loaded into the burnup credit MPC-32 canister for transport. The W 17x17 classes are designated as 17x17A, B, C and the B&W 15x15 classes are 15x15D, E, F, H as described in Table 1.2.10 of the SAR. However, the MPC-32 content will be subjected to the limitations described in Tables 1.2.32 and 1.2.33 for shielding purposes and the limitations in Tables 1.2.34 and 1.2.37 of the SAR for criticality safety purposes.

The applicant has designed the MPC-32 based on the spent fuel burnup or burnup credit as part of the criticality safety system for HI-STAR 100 transport package when loaded with the MPC-32. Since the burnup credit approach relies on the reduction of fuel reactivity after it's been burned, and the burnup history affects the spent fuel reactivity, the reactor core operating parameter values to which fuel assemblies are exposed become important. These reactor core operating parameter values are average core soluble boron concentration, average core moderator temperature, and average core specific power. Table 1.2.27 of the SAR specifies the limiting parameter values based on which the MPC-32 burnp credit canister is designed. Section 1.2.3.7.1 of the SAR provides the method for assigning the average values for the core operating parameters to which spent fuel assemblies were exposed and identified for loading into MPC-32 canisters. These average core operating parameter values will be checked against the core operating parameter limits from Table 1.2.27 of the SAR which is also included in Table A.1 of Appendix A of the Certificate of Compliance.

Furthermore, since the design of MPC-32 is based on the low reactivity of spent fuel assemblies due to their burnup in reactor cores, the burnup value becomes important for the criticality safety purposes. Therefore, the burnups of spent fuel assemblies need to be verified prior to their loadings into the MPC-32 canister for transport. The reactor records are primary documents in which spent fuel assembly burnups are kept. As part of spent fuel qualifications for loading into the MPC-32 canister for transport, the applicant needs to confirm the reactor records on spent fuel assembly average burnup through the physical measurements described in Section 1.2.3.7.2 of the SAR.

The staff's review of the proposed content with respect to satisfying structural, thermal, containment, shielding, and criticality is discussed in the following sections.

1.3 Materials

Materials related changes in this amendment were limited to the incorporation of the MPC-32 spent fuel canister as an approved content for the HISTAR-100 overpack. The MPC-32 is a conventional spent fuel canister that is fabricated from one or more previously approved grades of stainless steel. In this manner, the MPC-32 is no different from the other spent fuel canisters designed and employed by the licensee. Thus, there are no materials related differences with the addition of the MPC-32 to the HI-STAR 100 system. Therefore, the staff finds that the addition of the MPC-32 is acceptable.

1.4 Drawings

Drawing 3927 provides design details of the MPC-32.

The staff reviewed the revised set of licensing drawings and finds that they are consistent with the package as described and evaluated in the SAR. The drawings provide an adequate basis for safety evaluation of the MPC-32 against 10 CFR Part 71 requirements.

2.0 STRUCTURAL

As part of the packaging, the applicant proposes to include the MPC-32 to the MPC enclosure vessel models authorized for spent fuel transportation. Section 1.2.1.2.2.4 of the Safety Analysis Report (SAR) presents a description of the MPC-32 designed to transport up to 32 Pressurized Water Reactor (PWR) intact fuel assemblies meeting the specifications in Section 1.2.3 of the SAR. Damaged fuel and fuel debris are not permitted to be transported in the MPC-32. The MPC-32 enclosure vessel design is structurally identical to the MPC-24/24E design as shown on the Drawing 3927 of the SAR. There are no changes to the overpack.

2.2 Structural Evaluation

Structural adequacy of the HI-STAR 100 system was evaluated for use of a new multi-purpose canister, MPC-32, to transport up to 32 PWR intact fuel assemblies. The structural evaluation of the MPC-32, including details of configuration, materials, etc., was submitted previously with the Amendment 2 application.

The MPC-32 is structurally identical to the currently approved MPC-24 and other MPC models, except for the fuel basket and content. The MPC-32, which is heavier (89,765 lbs) than all the other approved MPCs (maximum weight 87,171 lbs) for HI-STAR 100, is enveloped by the MPC design weight of 90,000 lbs [Tables 2.2.1, 2.2.4 of the Safety Analysis Report (SAR)] for the HI-STAR 100 system. Additionally, the center of gravity location of the MPC-32 is approximately the same as those for other MPCs (SAR Table 2.2.2). Weight of the transport package with the MPC-32 (279,893 lbs) is bounded by the approved HI-STAR 100 system design weight of 282,000 lbs (SAR Table 2.2.4). Therefore, the overpack and impact limiters of the HI-STAR 100 system with the MPC-32 would perform as satisfactorily as the currently authorized HI-STAR 100 system with the MPC-24, under the normal conditions of transport (NCT) and hypothetical accident conditions (HAC) .

The applicant continued to use computer code ANSYS to perform finite element analyses to demonstrate the structural adequacy of the enclosure vessel body (shell, base plate, lid) and fuel basket for the NCT loads. A two-dimensional basic model of unit axial length of the fuel basket and the enclosure vessel shell is used to determine the clearances required to limit the thermal stresses, and two variations of the basic model, with effects of the drop orientation and overpack shell considered, are used to determine stresses in the basket and the shell. Details of the analyses for the NCT loads are discussed in SAR Sections 2.6.1.3.1 and 2.6.1.4.1, and results are provided in Tables 2.6.2, 2.6.3, 2.6.6, 2.6.7, 2.6.8, and 2.6.10 .

Using the same ANSYS finite element models for the NCT, the applicant analyzed structural performance of the enclosure vessel body and the fuel basket for the HAC loads. The applicant also computed the buckling strength of the fuel cell plates for the 30 feet end drop by closed-form solutions. Details of the analyses for the HAC are discussed in SAR Section 2.7.1, and results of the analyses are summarized in Tables 2.7.1, 2.7.2, 2.7.4, and 2.7.7 of the SAR.

2.3 Evaluation Findings

The staff reviewed the applicant's evaluation, including method of analysis and assumptions. Based on the statements and representations in the application, as supplemented and revised, the staff has reasonable assurance to conclude that the changes in the structural design of the package, by adding the MPC-32 to the HI-STAR 100 enclosure vessel models, do not adversely affect the ability of the package to meet the 10 CFR Part 71 structural requirements.

3.0 THERMAL

The staff reviewed the HI-STAR 100 Transportation Package thermal design and evaluation to assess whether the package and fuel material temperatures will remain within their allowable values or criteria for normal conditions of transport and hypothetical accident conditions (HAC) as required in 10 CFR 71 Part (Ref. 1). This case was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 3 of NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," as well as associated Interim Staff Guidance (ISG) documents (Refs. 2 and 3).

The main change included as part of this amendment is to include a higher capacity PWR basket configuration (MPC-32).

3.1 Description of the Thermal Design

3.1.1 Packaging Design Features

The complete cell-to-cell connectivity inherent in the honeycomb basket structure provides an uninterrupted heat transmission path, making the HI-STAR 100 MPC-32 an effective heat rejection design. Vertically welded radial channels act as fins for improved heat conduction to the overpack outer enclosure shell surfaces. Optional Aluminum Heat Conduction Elements (AHCEs) can be installed along the full length of the MPC-32 to create a nonstructural connection to further enhance heat transfer from the basket to the shell. The spent nuclear fuel (SNF) decay heat is passively dissipated without mechanical or forced cooling. To meet the requirements of 10 CFR 71.43(g) for accessible surface temperature limit, the HI-STAR 100 System is shipped as an exclusive use shipment and includes an engineered personnel barrier during transport. The primary heat transfer mechanisms in the HI-STAR 100 package are conduction and radiation from the surface of the cask. The MPC-32 is initially filled with 99.995% pure helium gas at the initial backfill pressure specified in Table 3.4.15 of the SAR. The helium cover gas provides conductive heat transfer across any gap between the metal surfaces inside the MPC-32 and in the annulus between the MPC-32 and overpack. Metal conduction transfers the heat throughout the MPC-32 fuel basket, through the MPC-32 AHCEs (if installed) and MPC-32 shell, through the overpack inner shell, intermediate shells, steel connectors and Holtite-A (neutron shield) and finally, to the outer neutron shield enclosure shell.

3.1.2 Codes and Standards

Where appropriate, codes and standards were referenced by the applicant. For standard structural materials, the ASME code is referenced by the applicant.

3.1.3 Content Heat Load Specification

Design payload for the HI-STAR 100 MPC-32 is intact zircaloy or stainless steel clad fuel assemblies with the characteristics listed in Tables 1.2.10, 1.2.27, 1.2.32, 1.2.33, and 1.2.34 of the SAR. Decay heat design basis fuel is listed in Table 1.2.12 of the SAR. Axial variation in the heat emission rate in the design basis fuel is defined based on the axial burnup distribution. These distributions are summarized in Table 1.2.15 and Figure 1.2.13 of the SAR.

3.1.4 Summary Tables of Temperatures

The HI-STAR 100 System package components maximum temperatures for normal conditions of transport are listed in Tables 3.4.10 of the SAR. Maximum calculated HI-STAR 100 System component and material temperatures during and after hypothetical fire conditions are provided in Table 3.5.4 of the SAR. All temperatures during normal conditions of transport, hypothetical fire accident conditions, and design limit criteria for the package components are consistent throughout the SAR.

3.1.5 Summary Tables of Pressures in the Containment Vessel

Maximum normal operating pressure (MNOP) for horizontal transport conditions are given in Table 3.4.15 of the SAR. Maximum HI-STAR 100 System hypothetical fire condition event pressures are provided in Table 3.5.3 of the SAR. These pressures are consistent with the pressures presented throughout the SAR.

3.2 Material Properties and Component Specifications

All material properties and component specifications remain unchanged with the addition of the new MPC-32. Cladding temperature limits for normal condition of transport and for hypothetical accident conditions are based on SFPO ISG-11[3], Rev. 2 guidance.

3.3 Thermal Evaluations

A detailed analytic model for the thermal design of the HI-STAR 100 System was developed by the applicant using the FLUENT® finite volume computational fluid dynamics code and the ANSYS® modeling package. Transport of heat from the basket interior to the basket periphery is accomplished by conduction through the MPC-32 basket metal grid structure and the narrow helium gaps between the fuel assemblies and the fuel cell walls. Heat dissipation from the MPC-32 basket periphery to the MPC-32 shell gap occurs through a combination of helium conduction, radiation across the gap, and conduction through the aluminum heat conduction elements. Heat is conducted from the outer periphery of the MPC-32 shell to the overpack inner shell through a helium-filled gap and then through the overpack layers to the exterior surface of the overpack. Cooling of the exterior system surfaces occurs by natural convection and radiation to the environment.

3.4 Evaluation of Accessible Surface Temperatures

Under normal conditions, the package is designed and constructed such that the accessible surface temperatures is 142°F (61.1°C) assuming design basis heat load and no solar insolation. These temperatures are in compliance with the 10 CFR 71.43(g) requirement, under the condition that the package will be shipped as exclusive-use.

3.5 Evaluation under Normal Conditions of Transport

3.5.1 Heat and Cold

The applicant performed steady state calculations for normal conditions of transport at 100°F still air conditions, maximum design basis decay heat and full insolation. Table 3.4.10 of the SAR summarizes the maximum calculated temperatures at different locations of the HI-STAR 100 System. All materials remained below their temperature limit under normal conditions of transport. The HI-STAR 100 System was analyzed for a cold environment of -40°F with zero decay heat load and no solar input. The above analyzed conditions will result in temperature distributions which are equal to the imposed minimum ambient temperature of-40°F. All materials of construction would perform their intended function at this minimum operating temperature.

3.5.2 Maximum Normal Operating Pressure

See SER Section 3.2.5

3.5.3 Maximum Thermal Stress

Maximum thermal stresses are evaluated in Section 2.6 of the SAR. Tables 3.4.17 of the SAR summarizes the HI-STAR 100 System components temperatures under steady-state hot conditions for structural evaluation.

3.6 Thermal Evaluation under Hypothetical Accident Conditions (HAC)

3.6.1 Initial Conditions

For thermal evaluations under HAC conditions, the HI-STAR 100 System was analyzed to a 30-minute fire at 1475°F. The initial condition prior to the start of the fire is based on the bounding normal transport condition MPC-32 basket temperature distribution at an ambient temperature of 100°F and full insolation before, prior to and following the fire. The impact limiter is assumed to be crushed to the bounding maximum condition of a solid block of highly conducting aluminum, resulting in increased heat input to the overpack ends through the reduced impact limiter thickness during the duration of the fire. The effects of the puncture bar are included by conservatively reducing by 10% the neutron shield region effective thermal conductivity during the post fire cooldown phase. During the initial 30-minute fire event, a conservative value maximizing the heat input to the system is applied for the neutron shield thermal conductivity. During the post-fire cooldown phase, no credit is considered for conduction through the neutron shield material. The FLUENT® model developed for normal condition of transport is also used to determine the thermal response during the fire transient conditions.

3.6.2 Maximum Temperatures and Pressures

The maximum HI-STAR 100 System components and materials temperatures during and after HAC conditions are summarized in Table 3.5.4 of the SAR. The calculated results demonstrate that the HI-STAR 100 System is in compliance with 10 CFR Part 71 thermal requirements for HAC of transport. All temperatures are below the allowable limit for accident conditions. Maximum calculated cask internal pressures are reported in Table 3.5.3 of the SAR. The pressure analysis is based on release of 100% of the rod fill gas and 30% of the significant radioactive gases from a ruptured rod. Maximum calculated pressures are below the pressure design limit of 200 psig for accident conditions.

3.6.3 Maximum Thermal Stresses

Maximum thermal stresses during HAC conditions are reported on Section 2 of the SAR.

3.7 Evaluation Findings

3.7.1 Description of the Thermal Design

The staff has reviewed the package description and evaluation, and concludes that they satisfy the thermal requirements of 10 CFR Part 71.

3.7.2 Material Properties and Component Specifications

The staff has reviewed the material properties and component specifications used in the thermal evaluation and concludes that they are sufficient to provide a basis for evaluation of the package against the thermal requirements of 10 CFR Part 71.

3.7.3 General Considerations for Thermal Evaluations

The staff has reviewed the methods used in the thermal evaluation and concludes that they are described in sufficient detail to permit an independent review, with confirmatory calculations, of the package thermal design.

3.7.4 Evaluation of Accessible Surface Temperature

The staff has reviewed the accessible surface temperatures of the package as it will be prepared for shipment and concludes that they satisfy 10 CFR 71.43(g) for packages transported by exclusive-use vehicle.

3.7.5 Evaluation under Normal Conditions of Transport

The staff has reviewed the package thermal design and concludes that the package material and component temperatures will not extend beyond the specified allowable limits during normal conditions of transport consistent with the tests specified in 10 CFR 71.71.

3.7.6 Evaluation under Hypothetical Accident Conditions

The staff has reviewed the package thermal design and concludes that the package material and component temperatures will not exceed the specified allowable short time limits during hypothetical accident conditions consistent with the tests specified in 10 CFR 71.73.

3.8 References

1. U. S. Code of Federal Regulations, "Packaging and Transportation of Radioactive Material," Part 71, Title 10, "Energy."

2. U. S. Nuclear Regulatory Commission, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1617, March 2000.

3. U.S. Nuclear Regulatory Commission, Interim Staff Guidance No. 11, Revision 2, “Cladding Considerations for the Transportation and Storage of Spent Fuel,” July 30, 2002.

4.0 CONTAINMENT

The staff evaluated the proposed changes to the HI-STAR 100 system supplied in Amendment 3 to the SAR. The major change to the SAR was the inclusion of a new inner canister, the MPC-32, which is designed to transport up to 32 intact, Zr-clad, PWR fuel assemblies meeting the specifications in SAR Section 1.2.3. Damaged fuel and fuel debris are not permitted to be transported in the MPC-32. The MPC-32 fits inside of an overpack that provides the containment boundary.

The staff verified that the package design, with the inclusion of the MPC-32, was adequately described and meets the containment requirements of 10 CFR Part 71 under both normal conditions of transport and hypothetical accident conditions. Only those changes impacting the containment analysis are discussed in this section. The following proposed changes were considered:

- Addition of the MPC-32 to the HI-STAR cask system.

- Addition of drawing 3927, Sheets 1-4, Rev. 6, to 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 11.

- Addition of wet loading and unloading operations for MPC-32.

4.1 Description of the Containment System

The primary containment system boundary for the HI-STAR 100 packaging consists of the overpack inner shell, the bottom plate, the top flange, the closure plate, closure bolts, the overpack vent and drain port plugs, and their respective mechanical seals.

The inventory for the MPC-32 was based on the B&W 15x15 fuel assembly with a burnup of 45,000 MWd/MTU, 5 years cooling time, and an enrichment of 3.64%. The staff confirmed the adequacy of this containment source term in the analysis of Amendment 2 to the SAR.

The staff verified that the parameters used in the applicant's containment analysis were consistent with the general information, thermal, and structural sections in the SAR.

4.2 Containment under Normal Conditions of Transport

The staff has reviewed the evaluation of the containment system and concludes that the package is designed, constructed, and prepared for shipment so that under the tests specified in 10 CFR 71.71, the package satisfies the containment requirements of 10 CFR 71.43(f) and 10 CFR 71.51(a)(1) for normal conditions of transport, with no dependence on filters or a mechanical cooling system.

4.3 Containment under Hypothetical Accident Conditions

The staff has reviewed the application and has determined that the package, with the addition of the MPC-32, satisfies the containment requirements of 10 CFR 71.51(a)(2) for hypothetical accident conditions, with no dependence on filters or a mechanical cooling system.

4.4 Evaluation Findings

The staff performed confirmatory calculations of the allowable radionuclide release rates and leakage rates to verify the values for both normal conditions of transport and hypothetical accident conditions in SAR Tables 4.2.3 through 4.2.9. The staff's calculations were in very close agreement with the applicant's calculations.

Based on the review of the statements and representations in the application, the staff concludes that the containment design has been adequately described and evaluated and that the package design meets the containment criteria of ANSI N14.5 and the containment requirements of 10 CFR Part 71.

4.5 References

1. U.S. Code of Federal Regulations, "Packaging and Transportation of Radioactive Material," Part 71, Title 10, "Energy."

2. Safety Evaluation Report, Model No. HI-STAR 100, Certificate of Compliance No. 9261, Revision 2.

3. U.S. Nuclear Regulatory Commission, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1617, March 2000.

4. U.S. Nuclear Regulatory Commission, "Containment Analysis for Type B Packages Used to Transport Various Contents," NUREG/CR-6487, November 1996.

5. American National Standard for Radioactive Materials, "Leakage Tests on Packages for Shipment," ANSI N14.5-1997, February, 1998.

6. Holtec, International, "Containment Analysis for the HI-STAR 100," HI-971780, Revision 2, May 2002.

5.0 SHIELDING

The staff reviewed the application for the addition of the MPC-32 canister to the fleet of canisters as part of the Model No. HI-STAR 100 package in order to verify that the package shielding design has been described and evaluated under NCT and HAC as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 5 (Shielding Review) of NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel."

5.1 Description of the Shielding Design

5.1.1 Packaging Design Features

The applicant did not request significant changes to the HI-STAR 100 shielding design features in this SAR amendment. The HI-STAR 100 package is designed to transport different MPC designs in a single overpack design with impact limiters. This system can accommodate a wide variety of spent fuel assemblies by utilizing different MPC basket designs. Each MPC is identified by the maximum number of fuel assemblies it is capable of accommodating. This application requested the addition of the MPC-32 which is designed to receive up to 32 PWR intact fuel assemblies. This proposed change was considered for its impact on the shielding evaluation.

The MPC-32 is designed to receive up to 32 zirconium or zirconium alloy clad PWR intact fuel assemblies in array/classes 15x15D, E, F, and H and 17x17A, B, and C as specified in Table 1.2.10 with limits in Table 1.2.27 of the SAR. The MPC-32 enclosure vessel design is identical to the MPC-24/24E enclosure vessel design, and constructed and assembled in accordance with Drawing 3927, Sheets 1-4, Rev. 6 of the CoC. The fuel assembly cooling, average burnup, and minimum enrichment specifications are listed in Tables 1.2.32, 1.2.33, and 1.2.34 of the SAR. MPC-32 fuel assemblies shall not contain non-fuel hardware. The MPC-32 is not authorized to transport damaged fuel assemblies, fuel debris, or Trojan plant fuel.

The steel structure from the MPC and the primary, intermediate, and enclosure shells of the overpack provide primary gamma shielding. Additional axial gamma shielding is provided by the bottom plate and top closure plate. Holtite-A is Holtec's neutron shielding material that serves to thermalize the neutrons and then capture them with embedded Boron-10 and hydrogen. Neutron shielding is provided around the outside circumferential surface of the overpack. Additional neutron and gamma shielding is provided by the impact limiters.

The staff reviewed the description of package design features related to the amendment request and found it acceptable. The design of the shielding features did not significantly change and have been previously approved in Amendment 2 to the CoC.

5.2 Summary of Shielding Evaluation for Normal Operations

A summary of the shielding evaluation results is presented in Section 5 of the SAR. The applicant calculated dose rates for normal conditions of transport (NCT) for the new MPC-32 and revised combinations of burnup, cooling time, and enrichment. The flux-to-dose conversion factors used in the dose calculations were taken from ANSI/ANS 6.1.1, 1977 (Ref. 2), which has been previously approved for the HI-STAR shielding calculations. The applicant determined that the calculated dose rates are less than the regulatory limits in 10 CFR 71.47. The highest dose rates calculated for surface normal, 2-meter normal, and 1-meter accident conditions for the MPC-32 basket design are reported in Tables 5.1.10 - 5.1.13 of the SAR.

The applicant requested the HI-STAR 100 personnel barrier be qualified as a package in a closed vehicle in accordance with 10 CFR 71.47(b)(2), thereby allowing dose rates up to 1000 mrem/hr on the cask external surface. The exclusive use shipment requirements of 10 CFR 71.47 apply to shipments in which the dose rate on the external surface of the package during normal transport operations is between 200 mrem/hr and 1000 mrem/hr.

The staff reviewed the maximum dose rates for normal conditions of transport and determined the reported values were below the regulatory limits in 10 CFR 71.47. The shielding evaluation is consistent with the appropriate codes and standards for shielding analyses and NRC guidance and has previously been approved for this CoC. The staff determined the use of the personnel barrier to be acceptable for the MPC-32.

5.3 Summary of Shielding Evaluation for Hypothetical Accident Conditions

The applicant calculated dose rates for hypothetical accident conditions (HAC) for the new MPC-32 and revised combinations of burnup, cooling time, and enrichment. Analyses for hypothetical accident conditions serve to demonstrate HI-STAR 100's compliance with 10 CFR 71.51. The HAC shielding analyses assumes that the neutron shield is not present and is replaced by void. The applicant determined that the calculated accident dose rates are less than regulatory limits in 10 CFR 71.51. The calculated highest dose rates at one meter for accident conditions are reported in Section 5.1 and Tables 5.1.14 and 5.1.15 of the SAR.

The staff reviewed the maximum dose rates for hypothetical accident conditions and determined the reported values were below the regulatory limit in 10 CFR 71.51.

5.4 Source Specification

The applicant calculated design-basis SNF source terms for the new and revised burnup and cooling times requested in the amendment. The applicant used a previously approved method to calculate the source terms. The calculated MPC-32 PWR fuel gamma sources per assembly, Co-60 sources per assembly, and neutron sources per assembly are listed in Tables 5.2.40 through 5.2.45 of the SAR. The total dose rates for all approved burnup and cooling times are reported in SAR Section 5.4, Tables 5.4.29 through 5.4.34.

The staff reviewed the new source term analyses of the SAR. Based on information provided in the SAR amendment, the staff has reasonable assurance that the source terms for the MPC-32 fuels are acceptable for the shielding analysis. The source term method used for SNF is similar to the method previously approved in Amendment No. 2 of the CoC. The staff notes that no Trojan fuel, damaged fuel, or fuel debris is authorized for the MPC-32.

5.5 Model Specification

5.5.1 Configuration of Source and Shielding

The applicant used MCNP to calculate bounding dose rates for the different fuel conditions. The applicant used similar MCNP models as previously approved in Amendment 2 of the CoC. However, the applicant revised the shielding geometry of the MPC-32 based on the revised design of the basket cells.

The staff reviewed the configuration of source and shielding, and found it acceptable because the methods used are consistent with the accepted industry practice and standards. In addition, the configuration of source and shielding, and modeling techniques, are similar to the model specification and techniques previously approved in Revision 2 of the CoC.

5.5.2 Material properties

The composition and densities of the materials used in the shielding analysis to support this amendment are presented in Tables 5.2.1, 5.2.7, 5.2.23, 5.2.24, 5.2.26, 5.2.28, and 5.2.40 - 5.2.45 of the SAR. As discussed in Chapter 8 of the SAR, the neutron shielding material's integrity must be confirmed through a combination of fabrication process control and radiation measurements before its first use. Periodic verification of the integrity must also be confirmed within 5 years of each shipment.

The applicant submitted a supplementary proprietary report which contained some of the actual MCNP input files that give more detailed information of the material properties and dimensions. Figures 5.3.1, 5.3.4, 5.3.7, and 5.3.10 - 5.3.12 of the SAR and design drawings in the revised CoC provide additional design details on all dimensions and materials. Specifications of important material properties of Holtite-A used in the shielding analyses are listed on Drawing No. 3913. The staff reviewed the materials properties and found them acceptable. The materials and dimensions are consistent with the specifications previously approved in Revision 2 of the CoC, and the dose rates satisfy the limits of 10 CFR Part 71.

5.6 Evaluation Findings

Based on its review of the statements and representations provided in the application, including revisions and supplements, the staff has reasonable assurance that the changes to the HI-STAR 100 Package satisfy the shielding and dose limits in 10 CFR Part 71.

5.5 References

1. U.S. Code of Federal Regulations, "Packaging and Transportation of Radioactive Material," Title 10, Part 71, January 1, 2003.

2. "American National Standard Neutron and Gamma-Ray Flux-to-Dose Rate Factors," ANSI/ANS-6.1.1-1977.

Enclosure 3

Proprietary portion of

Safety Evaluation Report (Pages 15 - 26)

7.0 OPERATING PROCEDURES

With respect to MPC-32, the loading operation for HI-STAR 100 packaging has remained the same. However, as part of the spent fuel qualification, a set of parameter values for spent fuel assemblies irradiation history, as described in Sections 1.2.3.7.1 and 1.2.3.7.2, has to be checked and verified prior to their loading into the MPC-32 canister. These parameters are average in-core soluble boron concentration, average core water temperature, average assembly specific power, and assembly's final discharge burnup. There are no loading/unloading operations specific to MPC-32 that has been added to the HI-STAR 100 operating procedures.

Based on the information presented in the application regarding the operating procedures involving MPC-32 canister, the staff finds the change acceptable in accordance with the requirements of 10 CFR Part 71.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

With respect to MPC-32, the acceptance tests and maintenance program for HI-STAR 100 packaging have remained the same. There are no acceptance tests or maintenance programs specific to MPC-32 that have been added to the HI-STAR 100 acceptance tests and maintenance program.

Based on the information presented in the application, the staff finds the acceptance tests and maintenance program for HI-STAR 100 package with respect to addition of MPC-32 canister acceptable in accordance with the requirements of 10 CFR Part 71.

CONDITIONS

The changes made to the conditions in the Certificate of Compliance are described below.

- Condition 5(a)(2), was revised to add MPC-32 to the list of canisters authorized for transport in HI-STAR 100 overpack. In addition, the statement "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." was deleted. Effective October 1, 2004, Section 71.63 no longer requires a separate inner container for plutonium shipments.

- Condition 5(a)(3) was revised to add the MPC-32 drawing to the list of approved drawings.

- Conditions 5(b)(1)(h) and (I) were added to require determination of spent fuel assemblies operating history parameter values per Section 1.2.3.7.1 of the SAR, confirmation of these values, and verification of reactor records on burnup through physical measurements per Section 1.2.3.7.2 of the SAR as part of the content qualification process.

- Condition 6(a)(11) was revised to clarify the function of fuel spacers with respect to criticality safety.

- Condition 11 was added in order to authorize use of the previous revision of the certificate for a period of approximately one year.

- Table A.1 and A.2 of Appendix A was revised to include spent fuel assembly limits and characteristics for MPC-32.

- Tables A.10, A.11, A.12, and A.13 were added to Appendix A for MPC-32 contents.

- The last column headings in Tables A.4 through A.8 were changes from “Assembly Minimum Enrichment” to “Assembly Initial Enrichment” for clarification purposes.

CONCLUSION

The staff has reviewed the requested amendment to Certificate of Compliance No. 9261. Based on the statements and representations in the application, as supplemented, and Revision 12 of the SAR, the staff concludes that the requested changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71. Certificate of Compliance No. 9261 for the HI-STAR 100 transport package has been amended as requested by Holtec International.

Issued with Certificate of Compliance No. 9261, Revision No. 5,
on October 12, 2006.

Enclosure 4

Registered Users