HOLTEC
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BY OVERNIGHT MAIL

May 31, 2002

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: USNRC Docket No. 71-9261
HI-STAR 100 Certificate of Compliance 9261
HI-STAR 100 License Amendment Request 9261-2

Reference: Holtec Project 5014

Dear Sir:

Holtec International herewith submits License Amendment Request (LAR) 9261-2 proposing certain changes to HI-STAR 100 System 10 CFR 71 Certificate of Compliance (CoC) Number 9261, Revision 1 and its supporting Safety Analysis Report (SAR). A summary of the major changes requested in this LAR and the reason for those changes are provided below:

1. The generic MPC-24E/EF PWR fuel basket design is proposed to be added to the CoC for transportation of intact PWR fuel. This fuel basket design was previously approved for storage in Amendment 1 to the HI-STORM 100 10 CFR 72 CoC.

2. The Trojan plant-specific MPC-24E/EF design is proposed to be added to the CoC for transportation of all Trojan plant intact fuel, damaged fuel, and fuel debris removed from the spent fuel pool in support of plant decommissioning. This MPC design and the contents are identical to those being reviewed for storage at the Trojan ISFSI under Portland General Electric's site-specific ISFSI license (USNRC Docket No. 72-17).

3. The high-capacity MPC-32 PWR basket design, including credit for fuel assembly burnup under certain accident conditions is proposed to be added to the CoC. MPC-32 was previously reviewed for transportation in the HI-STAR 100 System in ca. 1998, including two rounds of RAIs, but was voluntarily removed from the application before the CoC was granted. This canister design has also been reviewed under 10 CFR 72 as part of Amendment 1 to the HI-STORM 100 System storage CoC. That amendment is currently in the final rulemaking process to authorize its use for dry fuel storage at ISFSIs under the general license provisions of 10 CFR 72.

   Including appropriate credit for fuel burnup in the criticality analysis of the moderator inleakage accident will allow transportation of greater than 90% of the fuel currently stored in spent fuel pools at nuclear power plants throughout the country in MPC-32. While the moderator intrusion accident is required to be postulated by 10 CFR 71.55(b), it should be noted that the all-welded design of the MPC enclosure vessel precludes moderator intrusion into the fuel cavity under all normal and accident conditions of transportation. Furthermore, the outer overpack (the Part 71 containment boundary) also precludes moderator intrusion by design up to a water submersion depth of over 650 feet. Burnup credit is not required for criticality control under normal conditions of transportation (dry, helium-filled MPC).

1 Prop Version
1 Non Prop Version

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The burnup credit analytical work was performed in accordance with Interim Staff Guidance (ISG) Document 8, Revision 1, to the extent practical, using reactor critical data for benchmarking as suggested by the NRC in our May, 2001 meeting with SFPO on this subject. Certain unavoidable exceptions to ISG-8, clearly delineated and justified in Chapter 6 of the SAR, were taken to ensure the results of the work yielded realistic minimum burnup limits that did not unduly exclude a large percentage of PWR fuel already stored in spent fuel pools. MPC-32 allows the most effective use of regionalized fuel storage to minimize the dose rate from the transport package and minimize overall occupational exposure during fuel loading operations in the plant and storage at the ISFSI.

4. The method of securing the HI-STAR 100 overpack to the transport vehicle is modified to reduce the width of the package on the vehicle and to provide better structural stability by lowering the center-of-gravity of the package on the vehicle.

5. Other design changes to the MPC and overpack previously implemented for storage under the provisions of 10 CFR 72.48 have been added to the licensing drawings, to the extent the level of detail affected by the changes still exists on the drawings (see Item 6). On the whole, these changes are the last group of minor fabrication improvements, such as weld geometry modifications, that occurred during the first-of-a-kind fabrication of these components.

6. The existing, overly-detailed certificate drawing of the MPCs and overpack are proposed to be replaced with more appropriately detailed licensing drawings. We would be pleased to submit the proprietary, detailed design drawings for these components to the SFPO under separate cover, if deemed necessary to support the review effort.

7. The detailed calculations contained in the appendices to SAR Chapter 2 have been relocated to the supporting calculation packages. As is appropriate for a SAR document, the applicable calculations previously documented in these appendices to demonstrate compliance with 10 CFR 71 are now summarized in the text of the SAR chapter.

To facilitate the staff's review, a comprehensive summary of changes contemplated in this amendment request is provided in a document entitled "Summary of Proposed Changes", which is further described below. This change summary document provides a listing of the proposed changes to the CoC and SAR as well as the reason and a summary of the justification for each CoC change. This document should be used by the reviewers as a "road map" to other documents that provide the detailed descriptions and justifications for the proposed changes.

The changes to the CoC are presented in two formats: a markup version of the CoC showing new and deleted text, and a revised version of the CoC showing the changes incorporated. The new licensing drawings show the modifications to the overpack and MPC designs at a level of detail that supports the safety analyses described in the SAR. Fabrication details not germane to the safety

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This submittal contains the following attachments, designed to make the submittal a stand-alone package for the reviewers:

Attachment 1: Summary of Proposed Changes, including a description, reason, and justification for each proposed CoC change. The reason and justification for SAR changes is included in the particular change description, as necessary.

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Attachment 3: Final version of CoC with changes incorporated.

Attachment 4: Drawings. This section contains the new overpack and MPC licensing drawings that are proposed to replace the existing SAR certificate drawings for these components. For completeness, the unmodified impact limiter certificate drawings are also included.

Attachment 5: Proposed SAR Revision 10 changes are provided which include both changes in support of the proposed CoC changes and all other SAR changes requiring NRC approval. The proposed SAR changes are presented in accordance with the following protocol:

(i) The baseline SAR used for these proposed changes is Revision 9 to Holtec Report HI-951251, which is referenced in the current CoC (9261, Revision 1). Changes made under proposed SAR Revision 10 have been incorporated into the attached documents (labeled "Proposed Revision 10" in the document footer). Entire sections are replaced with Proposed Revision 10 if the section contains any change at all. New figures and figures that have been modified are noted as such with "Proposed Rev. 10" in the footer.

(ii) A complete proposed Revision 10 SAR (including material not affected by these proposed changes), a revised SAR Table of Contents, and a revised SAR List of Effective Pages are provided to avoid any confusion with previous revisions of the SAR. Any modifications to the proposed Revision 10 SAR changes that may be made during the NRC's review of this amendment request will be identified alpha-numerically (i.e., Proposed Rev. 10A, 10B, 10C, etc.) until the review is complete and the CoC amendment is ready to be issued. At that time, a final Revision 10 to the SAR will be issued.

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This submittal contains information in Section 6.4.11 of the proposed SAR changes in Attachment 5 (noted with shading and appropriate proprietary notations) that is commercially sensitive to Holtec International and is treated by us with strict confidentiality. This information is of the type described in 10 CFR 2.790(b)(4) and is considered proprietary to Holtec. The affidavit provided as Attachment 6 herein sets forth the bases for which the information is required to be withheld from public disclosure at this time, consistent with these considerations and pursuant to the provisions of 10 CFR 2.790(b)(1). It is therefore requested that the proprietary information enclosed be withheld from public disclosure in accordance with applicable NRC regulations until such time as the final version of SAR Revision 10 is issued just prior to the issuance of the CoC amendment. At that time, this information will be released to the public.

A number of our users will be deploying MPC-32 in storage in the near future. Certainty of the ability to transport MPC-32 is of utmost import to them before they beginning loading fuel into MPC-32 and deploying these canisters at their ISFSIs. To that end, we request approval of this amendment by January 31, 2004. If you have any questions or require additional information, please contact us.

Sincerely,

Brian Gutherman, P.E.
Licensing Manager

Approved:

K.P. Singh/Nlm

K.P. Singh, Ph.D, P.E.
President and CEO

Attachments: 1-6, As Stated.

Document ID: 5014462

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HOLTEC INTERNATIONAL

HI-STAR 100 CERTIFICATE OF COMPLIANCE 71-9261

LICENSE AMENDMENT REQUEST 9261-2

REVISION 0

VOLUME 1 OF 2

MAY, 2002

(NON-PROPRIETARY VERSION)

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SUMMARY OF PROPOSED CHANGES

SECTION I – PROPOSED CHANGES TO CERTIFICATE OF COMPLIANCE 9261

Proposed Change No. 1

Certificate of Compliance, Section 5.a.(2), "Description", CoC Appendix A, and all chapters of the SAR:

Modify the description of MPCs to include the generic Holtec MPC-24E and MPC-24EF, the Trojan plant-specific MPC-24E/EF[1], and the MPC-32. Add appropriate limits for contents in these MPC models in Appendix A to the CoC. Add/modify appropriate sections of the SAR to describe the safety analyses performed to justify adding these new MPCs and contents to the CoC.

Damaged fuel, fuel debris, non-fuel hardware, and neutron sources from the Trojan plant are requested for transportation approval in the Trojan plant-specific MPC-24E/EF design. The type and characteristics of the authorized contents for the generic MPC-24E/EF and MPC-32 differ from those previously approved for storage in the HI-STORM 100 System under 10 CFR 72 in the following ways:

- No generic PWR non-fuel hardware or neutron sources is being proposed for transportation in the generic MPC-24E/EF at this time. Only Trojan plant non-fuel hardware and neutron sources are included for transportation in the Trojan plant-specific MPC-24E/EF design.

- The allowable heat loads and therefore, the limits on cooling time, burnup, and decay heat for the MPCs do not exactly match those previously authorized for storage.

- The contents requested for approval for transportation in the MPC-32 include certain intact, Zircaloy-clad 15x15 and 17x17 array/class PWR fuel as specified in proposed changes to CoC Appendix A. Stainless steel clad fuel and damaged fuel, fuel debris, and neutron sources of any kind are not being requested to be authorized for transportation in the MPC-32.

[1] The Holtec generic and Trojan plant-specific MPC-24E/EF designs are not listed separately in Appendix A to the CoC. The differences between the generic MPC-24E/EF design and the Trojan plant-specific MPC-24E/EF design are described in this proposed change and in the proposed changes to the SAR. The designs are only distinguished in this document and in the CoC and SAR as necessary to address differences in design features or contents and the supporting safety analyses.

Reason for Proposed Changes

These MPC models are requested for approval for transportation in the HI-STAR 100 System under its 10 CFR 71 CoC to complement the approval of these same MPC models for storage under 10 CFR 72. Storage approval has been, or will be obtained either generically under Docket 72-1014 (Certificate Amendment 1) or site specifically under Docket 72-17 (Trojan ISFSI LCA 72-02, currently).

Justification for Proposed Changes

The MPC-24E/EF fuel basket is an enhanced version of the MPC-24 basket, which allows higher enrichment fuel without the need to take credit for fuel burnup in the criticality analysis. In addition, the Trojan plant-specific version of the MPC-24E/EF is included. The Trojan MPC-24E/EF design differs from the generic Holtec design in two ways:

- The corner cell sizes are larger (and the flux traps are correspondingly smaller) in order to accommodate the Sierra Nuclear Corporation (SNC)-designed Trojan Failed Fuel Can, which is larger than the generic Holtec designed PWR DFC.

- The height of the Trojan MPC-24E/EF basket and enclosure vessel is approximately nine inches shorter than the generic design. This is because the Trojan MPC was custom-designed for storage at the Trojan plant ISFSI in a Sierra Nuclear Corporation concrete cask, which is shorter than the HI-STORM 100 and HI-STAR 100 overpack designs. (see LCA 72-02 to Portland General Electric's site specific 10 CFR 72 license, Docket 72-17). A spacer is employed for transportation of the Trojan MPC-24E/EF in the HI-STAR 100 System overpack to preclude the need to modify the overpack design (see SAR Figure 1.1.5 and Chapter 2).

The MPC-32 is the high capacity PWR basket that requires credit for fuel burnup in the criticality analysis to satisfy the moderator inleakage condition of 10 CFR 71.55(b). The inleakage of moderator into the overpack and the MPC is precluded by design. Nevertheless, this hypothetical accident is evaluated for defense-in-depth and appropriate enrichment dependent, minimum assembly burnup limits are provided in Appendix A to the CoC to reflect the criticality analysis.

Appropriate limits on fuel assembly and non-fuel hardware physical parameters, maximum uranium mass, minimum and maximum enrichment, minimum cooling time, maximum burnup, minimum burnup (MPC-32 only) are established, as appropriate, in Appendix A to the CoC. These limits are consistent with the safety analyses described in the SAR. See proposed Revision 10 to the HI-STAR

100 System SAR in Attachment 5 to this submittal package for specific information in each of the technical disciplines that provide the justification for approving these new MPC models and contents.

Proposed Change No. 2

Certificate of Compliance, Section 5.a.(3), "Drawings" and SAR Section 1.4:

The drawing list in the CoC is revised to replace the previous Holtec Certificate ("C") drawings for the overpack and the MPCs with new licensing drawings. These licensing drawings become the set of drawings which are an integral part of the CoC, incorporated by reference. The "C" drawings of the impact limiter are unaffected. Please see Section II of this attachment for additional discussion of the new licensing drawings.

Proposed Change No. 3

Certificate of Compliance, Section 5.b.(1).(b), Definitions, and SAR Table 1.0.1:

a. The definition of **Damaged Fuel Assemblies** is revised as shown in the attached marked-up pages of the CoC and SAR to clarify the definition with regard to empty fuel rod locations.

b. The definition of **Damaged Fuel Containers** is revised as shown in the attached marked-up pages of the CoC and SAR to clarify that "container" and "canister" are synonymous, and to update the revision level of the SAR.

c. The definition of **Fuel Debris** is revised as shown in the attached marked-up pages of the CoC and SAR to add clarity, to provide consistency between the two documents, and to recognize the unique Trojan plant fuel debris created from the spent fuel pool cleanup project and already placed in Trojan Failed Fuel Cans.

d. The definition of **Intact Fuel Assemblies** is revised as shown in the attached marked-up pages of the CoC and SAR to clarify the wording regarding fuel rod locations.

e. The definitions of **Non-Fuel Hardware, Trojan Damaged Fuel Containers (or Canisters), Trojan Failed Fuel Cans, Trojan Fuel Debris Process Cans,** and **Trojan Fuel Debris Process Can Capsules** are added.

Reason for Proposed Changes

a. through d. The current definitions of these terms are inconsistent between the transportation certificate of compliance and the Amendment 1 of HI-STORM 100 storage certificate of compliance.

e. These new definitions are required to be consistent with the HI-STORM 100 storage CoC and to address the addition of Trojan plant-specific non-fuel hardware, damaged fuel and fuel debris to the certificate.

Justification for Proposed Changes

a. through d. Required for editorial consistency.

e. The definition of non-fuel hardware is consistent with the version previously approved by the NRC for the HI-STORM storage CoC, Amendment 1. The specific types and quantities of non-fuel hardware authorized for transportation are specifically listed in Appendix A to the CoC and evaluated in the SAR. At this time, only non-fuel hardware from the Trojan plant is being proposed for transportation in the Hi-STAR 100 System. The definitions for the Trojan plant-specific containers are consistent with the site-specific 10 CFR 72 SAR for the Trojan plant ISFSI (Docket 72-17).

Proposed Change No. 4

Certificate of Compliance, Section 5.b.(1)(e) and CoC Appendix A, Table A.1, Section II.A.d:

Add fuel assembly array/class 7x7A to these sections of the CoC.

Reason and Justification for Proposed Change

Editorial. Fuel assembly array/class 7x7A has previously been authorized for transportation in the HI-STAR 100 System. This array/class was inadvertently omitted from these sections of the CoC.

Proposed Change No. 5

Certificate of Compliance, Section 5.b.(1)(f):

Modify the statement regarding non-fuel hardware as shown in the attached markup of the CoC to clearly state that only non-fuel hardware and neutron sources specifically listed in Appendix A to the CoC is authorized for transportation.

Reason and Justification for Proposed Change

This is clarifying editorial change. Since "non-fuel hardware" is now a defined term, there is no need to list the individual items.

Proposed Change No. 6

Certificate of Compliance, Section 6.a.(3):

a. Delete item 6.a.(3)(a)(i) and modify item (ii) of the same section as shown in the attached markup of the CoC to clarify the requirements for overpack seal leak rate testing.

b. Modify item 6.a.(3)(a)(b) as shown in the attached markup of the CoC to establish a specific time frame defining "before each shipment."

c. Modify items 6.a.(3)(b) and (c) to add the word "overpack" as shown in the attached markup of the CoC.

Reason for Proposed Changes

a. Items (i) and (ii) of the current CoC are redundant and can be combined into one requirement with a minor editorial change.

b. This change provides clarification for the required timing of this overpack containment boundary seal leak test.

c. This is a clarifying editorial change that makes these sections consistent with the previous section (item 6.a.(3).(a)).

Justification for Proposed Changes

a. There is currently no time frame specified for the high sensitivity (10^{-6}) testing of the overpack containment boundary seals before the first shipment. The requirement for testing the seal 12 months prior to each successive shipment was therefore modified to also be applicable to the first shipment, allowing the "first shipment" requirement to be absorbed into one seal testing requirement.

b. There is currently no time frame specified for this "gross sniff" (10^{-3}) test of the overpack containment boundary seals prior to each shipment. Given the

12-month requirement for the high sensitivity leak test required in Section 6.a.(3).(a), 30 days is a reasonable time frame within which to conduct this test. This allows sufficient time to take corrective action if leakage is detected on a seal, while still maintaining the fuel shipment date and providing reasonable assurance that the boundary will not degrade before shipping.

c. Editorial.

Proposed Change No. 7

Certificate of Compliance, Section 6.a.(5):

Change the units of the leak test sensitivity from "std cm^3/sec" to "atm cm^3/sec."

Reason and Justification for Proposed Change

This is an editorial correction to make this unit consistent with other leak rate testing units found elsewhere in the CoC and the SAR.

Proposed Change No. 8

Certificate of Compliance, Section 6.a.(7):

Modify the MPC helium backfill pressure requirements as shown in the attached markup of the CoC.

Reason for Proposed Change

To make the transportation MPC helium backfill requirements consistent with, or bound, those used in storage.

Justification for Proposed Change

In order to maintain dual-purpose capability of the MPCs, the helium backfill requirements specified for storage must also be acceptable for transportation. Based on the transportation thermal analysis described in Chapter 3 of the SAR, there is no particular MPC helium backfill requirement other than ensuring the presence of helium. Raising the upper limit of helium backfill pressure to 44.8 psig at a reference temperature of 70°F is consistent with the value proposed in HI-STORM 100 Amendment Request 1014-2, submitted for NRC review on March 4, 2002. This value also bounds the maximum values currently permitted under HI-STORM storage CoC Amendment 1 and HI-STAR storage CoC, Amendment 2. See Chapter 3 of the SAR in Attachment 5 ot this submittal package for additional information regarding the MPC helium environment and its use in the thermal model.

Proposed Change No. 9

Certificate of Compliance, Section 6.a.(8).(a):

Change "MPC" to "overpack cavity" as shown in the attached markup of the CoC.

Reason and Justification for Proposed Change

Editorial correction. This section addresses the overpack. MPC vacuum drying requirements are specified in the previous section.

Proposed Change No. 10

Certificate of Compliance, Section 6.a.(10):

a. Revise the overpack closure plate bolt torque as shown in the attached markup of the CoC.

b. Revise the lower tolerance for the overpack vent and drain port plug torque as shown in the attached markup of the CoC.

c. Delete the torque requirements for the tie-down and transport frame bolts.

Reason for Proposed Changes

a. This change is required to maintain consistency between the 10 CFR 71 and 10 CFR 72 certifications for the HI-STAR 100 System. The reduction in torque was made under 10 CFR 72.48 for the HI-STAR 100 storage certification. The torque was reduced as part of lessons learned during deployment of a HI-STAR cask at a general licensee's ISFSI.

b. This is an editorial correction of a typographical error to make the transportation information consistent with the storage information.

c. These torque requirements are no longer applicable based on the new design concept for securing the packaging on the transport vehicle.

Justification for Proposed Changes

a. The closure bolt analysis follows NUREG-6007. A key input to that analysis is the initial preload. The initial value was originally set high to provide maximum preload. Based on field experience, it was determined that the preload did not need to be as high as previously specified. All calculations involving the preload have been modified; it has been verified that applicable safety factors remain greater than 1.0

b. The lower tolerance of -2 ft-lbs is consistent with the HI-STAR storage FSAR, Revision 0. The lower tolerance value in the HI-STAR storage FSAR, Revision 0 was reviewed and approved by the NRC as part of a change to the torque value itself included in storage amendment request 1008-1, submitted in November 1999 and approved in 2000. This same torque value was submitted and approved under transportation, but the lower tolerance was inadvertently left as zero.

c. These attachment points no longer exist for the new vehicle tie-down concept for the HI-STAR 100 overpack. See Proposed Change Number 26.h and proposed revisions to SAR Section 2.5 in Attachment 5 to this submittal package for a detailed discussion of this change.

Proposed Change No. 11

Certificate of Compliance, Section 6.b.(4):

The phrase "inspection process, including all findings (indications)" is revised to read "inspection results, including all relevant indications."

Reason and Justification for Proposed Change

Editorial clarification. The revised wording matches the wording in ISG-4, "Cask Closure Weld Inspections."

Proposed Change No. 12

Certificate of Compliance, Section 6.b.(6) and SAR Sections 8.1.5.2 and 8.2.5:

These CoC and SAR sections are revised as shown in the attached markups to replace the periodic 5-year neutron shielding verification test with a single requirement that dose rates are required to be verified to meet the limits in 10 CFR 71 prior to each shipment of a loaded HI-STAR 100 System.

Reason for Proposed Change

Since there are no known mechanisms that could degrade the shielding effectiveness of the Holtite neutron shield material over time, periodic testing over the life of the package is not meaningful and exposes personnel to unnecessary additional occupational radiation exposure.

Justification for Proposed Change

During fabrication, the material composition of each manufactured lot of Holtite neutron shield material is verified to meet the design requirements. Mixing and pouring of the material is controlled by a QA-validated procedure. For each overpack, neutron shielding effectiveness is verified before first use through the performance of a radiation shielding test using actual contents or a check source (see CoC Section 6.b.(5)). This check verifies that the fabrication controls were adequate to ensure that the neutron shield material was installed properly and will perform as designed.

Users are required to demonstrate that the loaded HI-STAR 100 Package meets all regulatory requirements, including the dose rate limits in 10 CFR 71, prior to releasing the package for transportation. This check would be required notwithstanding any previous periodic shielding effectiveness testing of the package (using a different radiation source) because each set of packaging contents to be transported is unique. Meeting the regulatory limits on dose rate is a function of the effectiveness of the shielding material and the contents of the package. Although highly unlikely due to the lack of known degradation mechanisms, the package could theoretically lose some of its shielding effectiveness, yet still provide sufficient shielding to meet the dose rate requirements of 10 CFR 71, depending on the source term of the material contained inside. The package can only be shipped if the regulatory dose rate limits are met for that set of contents. Therefore, a periodic check of shielding effectiveness using a fictitious source is not a meaningful test and creates unnecessary personnel radiation exposure.

Proposed Change No. 13

Certificate of Compliance, Section 6.b.(7):

This section is proposed to be deleted.

Reason and Justification for Proposed Change

The requirements of this section were applicable only to the first fabricated HI-STAR 100 overpack. The first fabricated HI-STAR 100 overpack (serial number 1020-001) was successfully tested in accordance with these CoC requirements. Therefore, this requirement may be deleted.

Proposed Change No. 14

Certificate of Compliance, Section 6.b.(9):

Add the minimum ^{10}B loading requirements for the Boral neutron absorber as shown in the attached CoC markup to reflect those used in the design and safety analyses for the generic and Trojan plant-specific MPC-24E/EF and the MPC-32.

Reason and Justification for Proposed Changes

These new minimum ^{10}B loading requirements are consistent with the information already contained in the CoC for other, previously approved MPC models. These minimum values are consistent with the values used in the criticality safety analyses described in Chapter 6 of the SAR.

Proposed Change No. 15

Certificate of Compliance, Section 6.b.(10):

Add minimum flux trap sizes for the generic and Trojan plant-specific MPC-24E/EF and a minimum fuel cell pitch requirement for MPC-32.

Reason for and Justification Proposed Change

These new minimum flux trap/pitch requirements are consistent with the information already contained in the CoC for other, previously approved MPC models. These minimum values are consistent with the values shown on the drawings and those used in the criticality safety analyses described in Chapter 6 of the SAR.

Proposed Change No. 16

Certificate of Compliance, Section 6.b.(12):

Correct the call-out for the leak test standard to read ANSI N14.5, and add the applicable edition.

Reason and Justification for Proposed Change

Editorial correction and clarification of the applicable edition of the standard.

Proposed Change No. 17

Certificate of Compliance, Appendix A, Table A.1, Section I (MPC-24):

a. In Subsection A.1, delete reference to decay heat from item 'c' and create a at limits. Re-letter other items accordingly.

b. Modify Subsection C to refer to non-fuel hardware and neutron sources rather than control components.

c. Modify item 'D' to change "loading" to "transport."

d. Create new item "E" to prohibit Trojan plant fuel from being transported in the MPC-24.

Reason and Justification for Proposed Changes

a. Decay heat limits are now specified in new Table A.11. This is a formatting change. The decay heat limits are modified to reflect the design basis values used in the thermal analysis. See proposed revisions to SAR Chapter 3 in Attachment 5 to this submittal package for detailed discussion of the thermal design basis.

b. This is a nomenclature change to be consistent with terminology defined and used elsewhere in the transportation licensing basis. Non-fuel hardware consists of control components as well as a number of other devices. Non-fuel hardware is now a defined term in CoC Section 5.b.1.(b).

c. Editorial.

d. Trojan plant fuel is being authorized for transportation in custom-designed versions of the MPC-24E/EF. The custom design was created for the Trojan site-specific ISFSI license (Docket 72-17) and will be the only MPC design used to store and transport Trojan plant fuel. Therefore, Trojan plant fuel is not authorized for transportation in the generic MPC-24.

Proposed Change No. 18

Certificate of Compliance, Appendix A, Table A.1, Section II (MPC-68):

a. In Subsection A.1, delete reference to decay heat from item 'd' and create a new item 'e' for decay heat limits. Move the decay limit for array/class 8x8F -letter other items accordingly.

b. In Subsections A.2.g, and A.4.g modify the "Fuel Assembly Weight" limit to be 550 lbs and add "and damaged fuel container."

c. In Subsection A.5, change the referenced SAR revision from 9 to 10.

Reason and Justification for Proposed Changes

a. General decay heat limits are now specified in new Table A.11. This is a formatting change. The decay heat limits are modified to reflect the design basis values used in the thermal analysis. See proposed revisions to SAR Chapter 3 in Attachment 5 to this submittal package for detailed discussion of the thermal design basis.

b. This is an editorial clarification. The MPC-68 canister was previously analyzed and certified for transportation assuming a lumped mass of 700 lbs in each fuel storage location. The only BWR damaged fuel permitted for transportation at this time is Dresden Unit 1 and Humboldt Bay fuel in array/classes 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A. The weight of these smaller fuel assemblies, including channels and damaged fuel container, is bounded by the 550 lb value.

c. Editorial.

Proposed Change No. 19

Certificate of Compliance, Table A.1, Section III (MPC-68F):

a. In Subsections A.2.g, A.3.g, A.5.g, and A.6.g modify the "Fuel Assembly Weight" limit to be 550 lbs and add "and damaged fuel container."

b. In Subsection A.7, change the referenced SAR revision from 9 to 10.

Reason for and Justification Proposed Changes

a. This is an editorial clarification. The MPC-68F canister was previously analyzed and certified for transportation assuming a lumped mass of 700 lbs in each fuel storage location. The only BWR damaged fuel permitted for transportation at this time is Dresden Unit 1 and Humboldt Bay fuel in array/classes 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A. The weight of these smaller fuel assemblies, including channels and damaged fuel container, are bounded by the 550 lb value.

b. Editorial.

Proposed Change No. 20

Certificate of Compliance, Appendix A, Tables A.1, A.4, A.5, A.6, and A.11:

Add new Sections IV and V to Table A.1 and add appropriate fuel assembly limits to the remaining tables to permit transportation of the MPC-24E and MPC-24EF models, respectively, as described in the attached markup of the CoC. Provide appropriate notations and restrictions that require Trojan plant intact fuel, damaged fuel, fuel debris, non-fuel hardware, and neutron sources to be transported only in the custom-designed Trojan plant MPC-24E/EF. At this time, only intact PWR fuel from plants other than Trojan is being proposed for transportation in the generic MPC-24E/EF.

Reason for Proposed Change

The MPC-24E/EF MPC models were previously reviewed and approved for storage at an ISFSI under the general license provisions of 10 CFR 72 as part of Amendment 1 to the HI-STORM 100 System 10 CFR 72 certification (Docket 72-1014). The Trojan plant-specific MPC-24E/EF models are currently under review as part of a site-specific ISFSI license amendment for the Trojan plant (Docket 72-17). These MPC models are designed for dual purpose certification for storage and transportation. Therefore, they must be certified for transportation in the HI-STAR 100 System under CoC 71-9261.

It should be noted that the contents of the generic MPC-24E/EF being proposed for transportation are not as extensive as those previously approved for storage under 10 CFR 72 Amendment 1 to the HI-STORM 100 System. Specifically, no generic PWR damaged fuel, fuel debris, or non-fuel hardware is included in this amendment request, even though the MPC-24E/EF models are certified to store this material under 10 CFR 72. Furthermore, the generic fuel assembly cooling time, decay heat, and burnup limits reflect a lower heat load duty for transportation that previously authorized for storage. A future 10 CFR 71 amendment request will include additional contents changes to ensure the transportability of the generic MPC-24E/EF with all contents authorized for storage.

Justification for Proposed Change

The MPC-24E/EF models have been evaluated for transportation in the HI-STAR 100 System in each of the technical disciplines. The proposed changes to the SAR included in Attachment 5 to this submittal package reflect those evaluations. Where necessary (e.g., in the criticality discipline), the evaluations performed for the Trojan plant-specific MPC-24E/EF design are discussed separately from the evaluations of the generic MPC-24E/EF design.

Appropriate limits on fuel assembly cooling time, decay heat, maximum burnup, and minimum and maximum initial enrichment have been proposed in the CoC, consistent with the supporting safety analyses. Similar limits, as applicable, have been established for Trojan plant non-fuel hardware to be transported in the custom-design Trojan plant MPC-24E/EF.

Proposed Change No. 21

Certificate of Compliance, Appendix A, Tables A.1, A.8, A.9, A.10, and A.11:

Add new Section VI to Table A.1 and add appropriate fuel assembly limits to the remaining tables to permit transportation of the MPC-32 model as described in the attached markup of the CoC. The contents authorized for transportation in the MPC-32 are limited to intact Zircaloy-clad fuel in array/classes 15x15D, E, F, and H and 17x17A, B, and C.

Reason for Proposed Changes

The MPC-32 has been approved for storage under 10 CFR 72 for the HI-STORM 100 System (Docket 72-1014). To ensure the continued dual purpose capability of the MPC-32, it must be certified for transportation in the HI-STAR 100 System under 10 CFR 71.

Justification for Proposed Changes

The MPC-32 model has been evaluated for transportation in the HI-STAR 100 System in each of the technical disciplines. The proposed changes to the SAR included in this submittal package reflect those evaluations. The MPC-32 evaluations include credit for fuel burnup, using ISG-8, Revision 1 as a guideline. However, certain exceptions to ISG-8 are proposed and are clearly described in Chapter 6 of the SAR.

Appropriate limits on fuel assembly cooling time, decay heat, maximum burnup, and minimum and maximum initial enrichment have been proposed in the CoC, consistent with the supporting safety analyses. In addition, minimum burnup requirements are established in the CoC consistent with the burnup credit analysis described in Chapter 6 of the SAR. The fuel assembly limits on cooling time, burnup, and decay heat reflect a lower package decay heat duty than was approved under HI-STORM storage for MPC-32. A future amendment request will ensure all contents approved for storage in the MPC-32 can also be transported in the HI-STAR 100 System.

Proposed Change No. 22

Certificate of Compliance, Appendix A, Table A.2:

a. New fuel assembly array/class 14x14E is added to the table. This array/class represents only Indian Point Unit 1 fuel.

b. Maximum enrichment limits are added for transportation of fuel in the MPC-24E/EF and the MPC-32.

c. Editorial changes are made to certain row headers in the table.

d. An editorial change is made to Note 3.

e. Note number 5 is added.

f. Note 6 is added.

g. Note 7 is added.

Reason for Proposed Changes

a. This array/class has been previously approved for storage under 10 CFR 72 in the HI-STORM 100 System and must be approved for transportation to preserve the dual purpose function of the MPC.

b. These MPC models require unique maximum enrichment limits for transportation based on their design.

c. through f. These notes are added to provide clarification and make this table consistent with the same changes approved under the HI-STORM 100 10 CFR 72 CoC. Note 5 differs between storage and transportation because soluble boron credit in the spent fuel pool is used for storage and burnup credit is used for transportation.

g. Note 7 provides specific requirements that Trojan fuel must be stored in the custom-designed Trojan MPC-24E/EF and is limited to a maximum initial enrichment of 3.7 wt.% ^{235}U.

Justification for Proposed Changes

a. New fuel assembly array/class 14x14E is the stainless-steel clad Indian Point Unit 1 fuel assembly. This array/class has been previously approved for storage under 10 CFR 72 in the HI-STORM 100 System. The proposed revisions to the SAR chapters in Attachment 5 to this submittal package include appropriate changes supporting the addition of this new array/class.

b. These enrichment limits are consistent with the supporting safety analyses. The attached proposed SAR revisions provide the appropriate changes supporting these enrichment limits.

c. through f. Editorial.

g. These limits are necessary to reflect the unique limits on Trojan fuel that have been analyzed for the Trojan-specific MPC-24E/EF design. The enrichment limit of 3.7 wt.% ^{235}U bounds all Trojan plant fuel being stored at their ISFSI and ultimately to be transported to the permanent repository or another interim storage facility. Since the Trojan plant has permanently ceased operation and is being decommissioned, the quantity and characteristics (e.g., physical dimensions, enrichment, burnup) of the fuel to be transported will not change from the current state. Longer cooling times than those analyzed will result in lower decay heat loads and lower radiation source terms, which are bounded by the design basis assumptions.

Proposed Change No. 23

Certificate of Compliance, Appendix A, Table A.3:

a. Editorial changes are made to certain row headers in the table.

b. The maximum enrichment limit for fuel assembly array/class 8x8F is increased to 4.0 wt.% ^{235}U.

c. New fuel assembly array/class 9x9G is added to the table. This array/class represents only the ANF-9X fuel assembly.

d. An editorial correction is made to Note 5.

Reason for Proposed Changes

a. Editorial.

b. This change makes the initial enrichment limit for this array/class consistent with that previously approved under 10 CFR 72 for the HI-STORM 100 System in Amendment 1.

c. This array/class has been previously approved for storage under 10 CFR 72 in the HI-STORM 100 System and must be approved for transportation to preserve the dual purpose function of the MPC.

d. Editorial.

Justification for Proposed Changes

a. Editorial.

b. This higher enrichment is bounded by the safety analyses described in the attached proposed changes to the SAR.

c. The justifications for authorizing this fuel assembly array/class for transportation are provided in the proposed changes to the SAR in Attachment 5 to this submittal package.

d. Editorial.

Proposed Change No. 24

Certificate of Compliance, Appendix A, Tables A.4, A.5, and A.7:

Minor changes to the minimum cooling times, maximum burnups, and minimum enrichments are made for the MPC-24 series and MPC-68 canisters.

Reason and Justification for Proposed Changes

See Proposed Change No. 29, Item 'f'.

SECTION II – PROPOSED CHANGES TO THE SAR

The following proposed changes to Revision 9 of the HI-STAR 100 SAR are those significant changes for which NRC review and approval is requested. In addition, there are a number of editorial improvements and minor corrections to the SAR text and figures not specifically called out in this section. However, all SAR changes, no matter what their source, are recognizable in the attached Proposed Revision 10 SAR documents with the following convention used[2]:

- New text is shown in italic font.
- Deleted text is shown in strikeout.
- All text changes are indicated with a revision bar in the page margin.
- Any section containing a text change will have "Proposed Rev. 10" in the footer and the List of Effective pages will also indicate Revision 10 for these pages. Subsequent modifications to these proposed SAR changes occurring during the NRC review will be noted alpha-numerically (i.e., 10A, 10B, 10C, etc.).
- New and revised figures show "Rev. 10" or "Proposed Rev. 10" in the footer.

Proposed Change No. 25 - SAR Chapter 1

a. The chapter is revised throughout, as necessary, to change "TSAR" to "FSAR" when referring to the HI-STAR storage certification SAR.

b. The last paragraph of Section 1.0 is revised to better describe the transportation SAR document revision process.

c. Table 1.0.1 is revised to add, delete, and modify definitions to be consistent with this CoC, the Holtec storage CoCs, and other sections of the SAR (see also Proposed Change No. 3).

d. The definition of Holtite™ and Holtite™-A in Table 1.0.1, and the description of Holtite in Section 1.2.1.4.2 and Appendix 1.B are revised to match the analogous information in the HI-STAR 100 storage FSAR (Docket 72-1008). These changes fulfill a commitment made by Holtec via letter to the NRC dated August 18,2000.

e. Section 1.1 is revised to address the new MPC models and the Trojan MPC spacer.

f. Figure 1.1.2 is revised to indicate that the pocket trunnions are optional (See Proposed Change No. 26 for additional discussion of this change).

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[2] For clarity, deleted text is not shown in SAR Section 1.4 or 2.5 due to the magnitude of the changes. For clarity, only new text, in italic fonts, is shown in these sections.

g. Figure 1.1.3 is revised to call out the cover plates for the vent and drain ports.

h. Figure 1.1.4 is revised to change "rupture disk" to "relief device", indicate the pocket trunnions as optional, and to remove the neutron shield radial expansion foam from the design.

i. New Figure 1.1.5 is added to depict the Trojan MPC spacer.

j. Sections 1.2.1.2 and 1.2.1.6 and Table 1.3.3 are revised to indicate that the aluminum heat conduction elements (ACHEs) are optional equipment for MPC-68/68F. The ACHES have only been installed in certain early vintage MPC-68 and -68F canisters and will not be installed in any MPC-24, MPC-24E/EF, or MPC-32 canisters.

k. Section 1.2.1.3.1 is revised to replace "rupture disks" with "relief devices" to allow flexibility to use any appropriately engineered relief device in this application. "Rupture disk" is retained as an acceptable type of relief device.

l. Section 1.2.1.3.1 is revised to remove reference to the coatings used on the overpack being specified on the drawings. This information has been removed from the drawings. The coatings permitted to be used are discussed in the SAR.

m. Sections 1.2.1.3.1 and 1.2.1.5 are revised to indicate that the pocket trunnions are removed from the overpack design after serial number 1020-007.

n. Section 1.2.1.2.2 is revised to add discussion of the new MPC models, including MPC-24E, MPC-24EF, MPC-32, and the Trojan plant-specific MPC-24E/EF.

o. Section 1.2.1.4 is revised to delete the statement that no credit for stand-off distance provided by the personnel barrier is taken in the shielding analysis. Chapter 5 describes how credit for this stand-off distance is taken.

p. Section 1.2.1.5 is revised to indicate that the lifting trunnion locking pads are optional devices. Considering the design of the lifting trunnions and the inspections performed on the overpack prior to use, the locking pads are not necessary to prevent the lifting trunnions from backing out of the threaded hole in the top flange.

q. Section 1.2.1.8 is revised to add a tolerance for the relief device setpoint.

r. Section 1.2.2 is revised to eliminate unnecessary detail that is more appropriate for the users' implementing procedures and to provide clarification in certain areas. This section is also revised to modify the MPC cooldown requirements for re-flooding to take due consideration of the wide range of decay heat rates in the

MPCs that will be in service. The required action, if any, to be taken to ensure the MPC cavity gas temperature meets the temperature limit prior to re-flooding is dependent upon the decay heat level in the canister.

s. Section 1.2.3.1 is revised to address the Trojan plant-specific fuel spacers. Due to the shorter length of the Trojan MPCs, only lower fuel spacers are required, and only for fuel assemblies no containing control rod assemblies.

t. Section 1.2.3.3 is revised to address the specific types of damaged fuel and fuel debris authorized for transportation.

u. Section 1.2.3.5 is revised to remove detailed information pertaining to the thermal characteristics of the fuel. This information is redundant to the information in Chapter 3.

v. Section 1.2.3.7 is revised to address burnup credit.

w. New Section 1.2.3.8 is created to address Trojan non-fuel hardware.

x. Old Section 1.2.3.8 is re-numbered to 1.2.3.9 and is revised to clarify the information.

y. Table 1.2.1 is deleted because this information is redundant to information in Chapter 2, Table 2.2.1.

z. Tables 1.2.2, 1.2.3, 1.2.8, 1.2.10, 1.2.11, 1.2.12, 1.2.13, 1.2.14, 1.2.16, 1.2.17, and 1.2.19 are revised to reflect the changes to the authorized contents, fuel spacers, etc.

aa. Tables 1.2.4 through 1.2.6 are deleted because they contain information that is unnecessary to maintain in the SAR after initial certification.

bb. Figure 1.2.3 is modified to show the aluminum heat conduction elements as optional equipment for MPC-68/68F.

cc. New Figure 1.2.4 is added for MPC-32.

dd. Figure 1.2.5 is modified to include MPC-24E and -EF and to depict the modified cell layout for MPC-24.

ee. Figure 1.2.8 is modified to depict the change to the package tie-down design.

ff. Figures 1.2.9 and 1.2.16 are revised to depict the change to the package tie-down design.

gg. Figure 1.2.10 is revised to reflect a minor change to the upper closure assembly of the damaged fuel container made under the provisions of 10 CFR 72.48 for storage. The change was to replace the pipe originally contemplated for use in fabricating the lead-in of the assembly with a solid bar, machined and drilled as necessary to accommodate the operating handle.

hh. New Figures 1.2.10A through 1.2.10D are added to depict the Trojan Failed Fuel Can, Trojan Fuel Debris Process Can, Trojan Fuel Debris Process Can Capsule, and the Holtec Damaged Fuel Container for Trojan Plant SNF in MPC-24E/EF. These new canisters are being proposed for authorization to transport Trojan plant damaged fuel and fuel debris in the HI-STAR 100 System. These damaged/failed fuel canisters are the same as those being licensed for use in storing fuel at the Trojan plant ISFSI.

ii. Figure 1.2.12 is deleted because this information became too difficult to clearly present in figure format. This information is more clearly provided in Appendix A to the CoC.

jj. Figure 1.2.15 is revised to remove the specific value for the gap between the fuel and the fuel spacer and remove the dimension showing the location of active fuel from the bottom. The first change is made because the 2"gap is specified elsewhere in the SAR (Tables 1.2.16 and 1.2.17). The second change is made because the dimension showing the active fuel region already conveys this information.

kk. New Figure 1.2.17 is added to clearly depict the differences between the standard and "F" model MPC shell and lid designs.

ll. Table 1.3.1 is revised to clarify that, with the removal of the pocket trunnions from the design, only the lifting trunnions are constructed to the stated codes.

mm. Table 1.3.2 is revised to add the HI-STAR 100 ASME Code alternatives that were previously reviewed and approved by the NRC for storage (Ref. NRC letter to Holtec dated May 9, 2002, TAC L23414).

nn. Table 1.3.3 is revised in a number of areas to provide clarification (e.g., changing "confinement" to "containment"), to reflect a number of changes made to the HI-STAR 100 System under 10 CFR 72.48 for storage, and to add the Trojan MPC spacer, which performs an important-to-safety design function. The MPC lift lug and lift lug baseplate are removed from the table because they are not used in transportation.

oo. Section 1.5 is revised to indicate that the drawings in Section 1.4 are not design drawings. They are licensing drawings.

pp. Section 1.6 is revised to correct and add several references.

Proposed Change No. 26 - SAR Chapter 2

a. All appendices containing detailed calculations are removed and the information relocated to the supporting Holtec in-house, QA calculation packages. The information currently in these appendices contains a level of calculational detail that is inappropriate for a SAR document. Two appendices remain: Appendix 2.A, addressing the impact limiters (re-located from Appendix 2.H), and new Appendix 2.B addressing damaged fuel container structural evaluations.

b. The chapter is revised throughout to remove references to the now-deleted appendices. In several instance where appendices are deleted, text is added to the body of the chapter to ensure an adequate description of the analyses remains in the SAR.3

c. The chapter is revised at appropriate locations to include discussion of the structural evaluations for MPC-24 (modified basket design), generic and Trojan MPC-24E/EF, and MPC-32.

d. The chapter is revised at appropriate locations to recognize the elimination of the pocket trunnions as the qualified means of support for the package on the transport vehicle. The pocket trunnions are recognized as being installed on the first seven HI-STAR 100 overpacks and may hereafter be used for upending and downending the overpack.

e. Table 2.1.1 is revised to recognize an increase in the MPC accident internal pressure from 125 psig to 200 psig. This change is consistent with that approved under HI-STORM storage Amendment 1 (Docket 72-1014).

f. Section 2.2 is revised to add new MPC's (MPC-32, MPC-24E/EF, and Trojan MPC-24E/EF) to the weight tables and updated all weights as applicable.

g. Section 2.3 is revised to correct minor errors in material properties that were not consistent with the values in the ASME Code. These changes has an insignificant effect on calculated safety factors

h. Section 2.5 is revised in its entirety to recognize a modified method of securing the package on the transport vehicle without the use of pocket trunnions.

i. Section 2.5.1 is revised to add text at end of the section to point to Appendix 2.B for discussion of the lifting of DFC's. The safety factors for pocket trunnions in existing units used for lifting are provided.

j. Section 2.5.2 is revised to reflect the fact that the qualified package tie-down no longer relies upon pocket trunnion and shear ring. The pocket trunnion is removed from the overpack design and the shear ring remains in the design on future units for shielding purposes. Discussion, methodology, and results are all changed.

k. Subsection 2.5.3 is revised to reflect the fact that no tie-down devices are a permanent part of the package.

l. Figures 2.5.3 through 2.5.11 are deleted and new Figures 2.5.12 and 2.5.13 are added to reflect the new package tie-down scheme.

m. Section 2.6 is revised throughout to remove references to deleted appendices, to address new MPC models, and to delete reference to pocket trunnions for transport service.

n. Section 2.6.1.3.1.2 is revised to address the structural adequacy of the optional two-piece MPC lid design.

o. Section 2.7 is revised throughout to address the new MPC models and to remove cross-references to now-deleted appendices.

p. Section 2.7.1.1 is revised to reflect the optional two-piece MPC lid design and to include a bullet item to address the Trojan MPC spacer.

Proposed Change No. 27 - SAR Chapter 3

a. Chapter 3 is revised throughout to address certain global changes, viz.: (i) Aluminum Heat Conduction Elements (AHCE) are optional hardware, (ii) Nominal helium fill pressure limit is raised to 42.8 psig, (iii) Include MPC-32, MPC-24 (revised fuel cell geometry) and MPC-24E/EF (generic and shortened height for Trojan) PWR MPCs for transport, (iv) Relax certain elements of excessive conservatism in the mathematical model.

b. Section 3.1 is revised to eliminate of reference to Bisco NS-4-FR neutron shield from. Thermophysical properties tables are expanded to include Boral emissivity data.

c. Section 3.3 is revised to correct an error in the number of fuel rods listed for GE-8x8R fuel (Table 3.3.5, Row 6 & column "Rods per assembly": delete 60, insert 62). This change has an insignificant effect on the thermal analyses.

d. Section 3.3.2 is revised to include the evaluation of stainless steel fuel in the MPC-24E/EF and MPC-32 canisters.

e. Section 3.4.1 and cited tables are revised to include an evaluation of Trojan fuel and MPC changes requested for transport certification (MPC-24E/EF, MPC-32 and MPC-24).

f. Section 3.4.2 and cited tables are revised to evaluate normal transport thermal (fuel and package temperature) results.

g. Section 3.4.3 and cited tables are revised to evaluate containment boundary pressures as a result of increased helium fill pressure and MPC changes.

h. Section 3.5 and cited tables are revised to: (i) address the hypothetical fire accident, (ii) remove reference to Bisco NS-4-FR neutron shielding material and (iii) remove reference to deleted structural appendices in Chapter 2.

Proposed Change No. 28 - SAR Chapter 4

a. Chapter 4 is revised appropriately throughout to reflect: the addition of the MPC-24E, MPC-24EF and MPC-32 canisters and the addition of Trojan PWR damaged fuel and fuel debris to the acceptable contents of the MPC-24EF. The MPC is now recognized as the secondary containment vessel for both MPC-68F and MPC-24EF.

b. Section 4.0 is revised to add Trojan plant PWR damaged fuel and fuel debris to the allowable contents in the MPC-24EF, to change "Dresden Unit 1 and Humboldt Bay" to "BWR", and to remove plant specific reference to allow all fuel debris that falls under the allowable contents section of the CoC to be transported.

c. Section 4.1 is revised to correct references to the tables.

d. Section 4.1.1, 4.1.3.1, 4.1.3.2 are revised to change "Bill of Materials" to materials are now integrated into the licensing drawings.

e. Section 4.1.5 is revised to describe the allowable number of DFCs containing either fuel debris or damaged fuel assemblies in each MPC design.

f. Figure 4.1.4 is revised to refer to the secondary containment boundary generically (MPC versus MPC-68F).

g. Section 4.2.4 is revised to modify the following assumptions used in the containment analysis to be consistent with the assumptions used in the HI-STORM 100 storage confinement analysis:

Assumption 2: Revised to include all radioactive gases.

Assumption 8: Revised to describe the allowable number of DFCs containing either fuel debris or damaged fuel assemblies in each MPC design.

Assumption 12: Added ^{89}Sr, ^{103}Ru, ^{135}Cs.

Assumption 11: Removed reference to plant specific BWR fuel.

Assumption 20: Added to describe assumption that only 10% of fines released to the MPC cavity are available for release.

h. Section 4.2.5.1 is revised to add description of the shorter Trojan baskets, and assumptions used in calculating the internal free volume of these baskets for the primary and secondary containment.

i. Section 4.2.5.2: Revised description of source term.

j. Section 4.2.5.2B is revised to clarify that only 10% of the fines released to the MPC cavity are available for release. Equation 4-3 is split into 4-3a and 4-3b for the MPC-24EF and MPC-68F, respectively.

k. Section 4.2.5.7 is revised to reflect calculation of the allowable leakage rate to be consist with ANSI-N14.5-1997.

l. Section 4.2.5.8 is revised to re-number Equation 4-14 to 4-14a. Equation 4-1b and methodology for using Equation 4-14b are added to determine the allowable leakage rate criteria under test conditions. The calculation of leakage rate acceptance criteria is updated methodology and source term.

m. Section 4.2.5.9 is revised to add a secondary containment evaluation for the MPC-24EF and the MPC-68F with uranium oxide fuel. The calculation of the allowable leakage rate from the secondary containment boundary is revised.

n. Table 4.2.1 is revised to add MPC-24E, MPC-24EF, Trojan MPC-24E, Trojan MPC-24EF and MPC-32.

o. Table 4.2.2: Revised for updated source term. Added ^{81}Kr, ^{127}Xe, ^{89}Sr, ^{103}Ru, ^{135}Cs, ^{110m}Ag, ^{137m}Ba, ^{144}Pr, ^{144m}Pr, ^{106}Rh, ^{119m}Sn, and ^{125m}Te.

p. Tables 4.2.3 through Table 4.2.14 are revised for updated methodology and source term.

q. Section 4.3, item 5 is revised to refer to fuel debris needing a secondary containment boundary.

r. Section 4.4 is revised to add Reference [4.2.5].

Proposed Change No. 29 - SAR Chapter 5

a. Chapter 5 is revised in various locations to no longer present the dose rates for every burnup and cooling time combination listed in the CoC. Rather, the combinations that produce the highest dose for a particular MPC and a particular dose location are presented.

b. Section 5.0 is revised to reflect the new MPC-24E/EF, MPC-32, and Trojan contents and to make an editorial change to reflect the fact that DFCs may not always be loaded prior to insertion into the MPC.

c. Section 5.1 is revised to discuss the use of SCALE 4.4 for the Trojan contents and to reflect the addition of the MPC-32.

d. Section 5.1 and Figure 5.1.1 are revised to reflect credit for the personnel barrier in demonstrating compliance with the dose rate limits of 10CFR71.47. This change is consistent with the guidance in NUREG-1617. The personnel barrier will be attached to the transport vehicle. This will serve to enclose the main body of the overpack, thereby raising the dose rate limits for the main body of the overpack. Since the impact limiters, which are part of the package, are not covered by the personnel barrier, the dose rate limits for these devices are the lower limits as described in Section 5.1. This change was made to provide additional flexibility in determining allowable burnup and cooling times based on compliance with the regulatory limits in 10 CFR 71.

e. The results in Tables 5.1.1 through 5.1.9 are revised to provide results for the two-meter locations during normal conditions and the one-meter location during accident conditions for the MPC-24, MPC-32, and MPC-68. New Table 5.1.10 is added. Results are presented for both PWR fuel assemblies with Zircaloy grid spacers and non-Zircaloy grid spacers. This approach is consistent with current revision of the SAR.

f. Section 5.2 is revised to reflect the minor modifications to the allowable burnup and cooling time for the MPC-24 and MPC-68. The burnup and cooling time for the MPC-24 and MPC-68 were modified to provide additional flexibility to the users and to increase the maximum allowable burnups. The burnup and cooling times are now strictly based on radiation shielding considerations and demonstration of compliance with the requirements of 10CFR71. Subsection 5.2.5.3 is modified to reflect this change. The allowable decay heat limits were not used in determining the allowable burnup and cooling times. The results for the MPC-68 were also changed slightly to reflect the revised analysis with the ½" thinner MPC-68 lid (see Drawing 3923).

   Additional flexibility for the users in transporting stored fuel is required to be able to transport fuel stored under 10 CFR 72 in the HI-STORM 100 Systems as soon as practical. Calculating the allowable burnup and cooling times strictly based on radiation shielding requirements is acceptable because users will have to demonstrate compliance with the decay heat limits separately prior to transportation. Therefore, it is not necessary to impose additional conservatism on the users by calculating the allowable burnup and cooling times based on both radiation shielding and decay heat limits. Chapter 5 has been modified to reflect these changes.

g. Section 5.2 is revised to reflect the use of SCALE 4.4 for the Trojan contents and to reflect the use of a different design basis assembly for Trojan fuel.

h. Section 5.2 is revised to address Indian Point Unit 1 fuel. No additional analysis was performed.

i. Section 5.2 is revised to reflect the addition of the MPC-32.

j. Subsection 5.2.2 is revised to discuss the minimum enrichment for the Trojan fuel.

k. Subsection 5.2.4 is revised to include Trojan plant non-fuel hardware. Subsections 5.2.4.1 and 5.2.4.2 are added to discuss the Trojan BPRAs, TPDs, and RCCAs. The analysis approach presented in these subsections is consistent with the approach licensed in the HI-STORM FSAR for generic non-fuel hardware. Currently, authorization of non-fuel hardware from plants other than Trojan is not being requested for transportation.

l. Section 5.2.7 is revised to discuss the Trojan neutron sources.

m. Section 5.2.8 is added to discuss Trojan non-fuel bearing components, damaged fuel, and fuel debris.

n. Table 5.2.1 is revised to change a reference.

o. Tables 5.2.3 through 5.2.5 and 5.2.8 through 5.2.13 are revised to reflect the changes in the source terms due to changes in burnup and cooling times and the addition of the MPC-32.

p. Table 5.2.23 is revised to reflect the change in the allowable burnup and cooling times and the addition of the MPC-32.

q. New Tables 5.2.32 through 5.2.38 are added to include the source terms from the Trojan fuel assemblies and non-fuel hardware.

r. Subsection 5.3.1 was modified to reflect the addition of the Trojan plant-specific versions of the MPC-24E.

s. Additional discussion was added in Subsection 5.3.1 concerning the MPC-24 modeling in MCNP and a change in the baseplate of the MPCs to add an optional sump.

t. Subsection 5.3.1 was modified to reflect the addition of the MPC-32 and the reduction in the thickness of the MPC-68 lid from 10 inches to 9.5 inches. In addition, the aluminum heat conduction elements are now referred to as optional.

u. Section 5.3 is revised and new Figure 5.3.13 is added to present a comparison the older and newer MPC-24 fuel cell layouts with justification as to why analyzing the older configuration is still acceptable. No new analysis was performed.

v. Section 5.3.1.2 is revised to address the elimination of the pocket trunnion from the overpack design. The analysis in Chapter 5 still reflects the existence of the pocket trunnions. This is conservative compared to the no pocket trunnion configuration as discussed in Section 5.3.1.2, because the increased neutron streaming through the pocket trunnion is analyzed. Neutron streaming is higher to the pocket trunnion design because the "no pocket trunnion" design includes Holtite neutron shield material where the pocket trunnions were previously located. For those serial number overpacks that do have pocket trunnions, a shield plug will have to be placed in the pocket trunnion during transportation if a rotation trunnion is not present (see Dwg. 3913). This requirement maintains the configuration the of the HI-STAR consistent with the analysis in Chapter 5.

w. Table 5.3.4 was added to show the configuration of the Trojan fuel assembly.

x. New Figure 5.3.1 is added to represent the MPC-32 in the overpack.

y. New Figure 5.3.4 is added to show the modeling of the basket in the MPC-32.

z. Figure 5.3.10 is revised to reflect the reduction in the minimum thickness of the MPC-68 lid to 9.5 inches. This makes all MPC lids consistent at 9.5 inches thick (minimum). Therefore, Figure 5.3.10 no longer distinguishes the different MPCs for the lid thickness. All MPC-68 analyses in Chapter 5 were rerun to reflect the change in the minimum lid thickness.

aa. Section 5.4 is revised reflect the addition of Trojan fuel and the MPC-32.

bb. Subsections 5.4.2 and 5.4.3 are revised to reflect a change in the design basis BWR source terms.

cc. Subsections 5.4.7 and 5.4.8 are added to discuss the Trojan fuel contents.

dd. Tables 5.4.2 through 5.4.9 are revised to provide results for the MPC-24, MPC-32, and MPC-68 and the MPC-24E/EF with Trojan fuel.

ee. Tables 5.4.10 through 5.4.13 and 5.4.16 through 5.4.21 are deleted.

ff. The dose location labels in Tables 5.4.14, 5.4.15, 5.4.22, 5.4.23, and 5.4.24 are modified to be consistent with revised Figure 5.1.1.

gg. Table 5.4.25 is revised due to a change in the design basis BWR fuel assemblies.

hh. Section 5.5 is revised to reflect new peak dose rates due to the change in the burnup and cooling times, change in the dose locations, and addition of the MPC-32.

ii. Section 5.6 is revised to add new references and make an editorial change.

Proposed Change No. 30 - SAR Chapter 6

a. Chapter 6 is revised throughout to support the change in the MPC-24 design. Calculated results in all Sections of Chapter 6, and in Appendix 6.C are revised accordingly. Figures 6.3.1 and 6.3.4 are revised to show the new design. Appendix 6.D is revised to show sample input files for the new design.

b. Chapter 6 is revised throughout to support the new MPC-24E and the MPC-24E/EF Trojan basket designs. New Tables 6.1.5 and 6.1.6 were added to present calculated results for these baskets. Figure 6.3.1a was added to show the basket design. Section 6.4.9 and Figures 6.4.11 and 6.4.12 are added to address the criticality evaluations for damaged fuel and fuel debris in the MPC-24E/EF and the MPC-24E/EF Trojan. Note that evaluations with damaged fuel and fuel debris are presented for both the MPC-24E/EF and the MPC-24E/EF Trojan, although currently only the Trojan baskets are qualified for damaged fuel and fuel debris. Result tables are added to Appendix 6.C.

c. Chapter 6 is revised throughout to support the MPC-32 with burnup credit. In Section 6.1, Table 6.1.7 shows results for the MPC-32. Cell and basket cross sections used in the criticality analyses are shown in Figures 6.3.2 and 6.3.5. Section 6.4.11 with the corresponding Tables 6.4.12 through 6.4.22 and Figures 6.4.13 through 6.4.20, and Appendices 6.E through 6.M are added to present and discuss the burnup credit methodology and evaluations.

d. Section 6.4.10 was added to address PWR non-fuel hardware in Trojan MPC-24E/EF.

e. Subsection 6.4.2.4 was expanded to address the potential of preferential flooding in DFCs.

Proposed Change No. 31 - SAR Chapter 7

a. A number of general changes are made in the operational guidelines throughout the chapter to reflect lessons learned in the initial HI-STAR 100 loading campaigns. These changes are not all listed specifically below but are clearly indicated in the text. In some cases, detail more appropriately contained in the users procedures (and not deemed essential to the safe use of the packaging) is removed completely

b. Section 7.0 is revised to clarify the intent of the chapter as it relates to users' procedures.

c. Section 7.1.1 is revised to clarify the intent of the instructions in Subsection 7.1.2.

d. Section 7.1 is revised in various locations to remove reference to "transport frame" since this piece of equipment may vary from site to site.

e. The note preceding Step 7.1.2.1 is revised for clarity.

f. Steps 7.1.2.h and 7.1.3.e and h are deleted to recognize the removal of the overpack pocket trunnion from the design. Those users with overpack having the pocket trunnion may still use it for downending, but it is no longer the method of attachment qualified for transportation loads.

g. The warning preceding Step 7.1.5.19.a and Step 7.1.5.19 are revised to delete the specific dose rate value. "Expected" dose rates will vary based on contents and will be governed by users' procedures.

h. Steps 7.1.5.26. e and f and 7.1.5.27.a and c are revised to delete the helium/nitrogen supply set pressures. These are operational details that belong in the users' procedures.

i. Steps 7.1.5.30 and 31 are revised to reflect the holes installed in the vent and drain port cover plates to facilitate helium leak testing.

j. Steps 7.1.6.5 and 7.1.6.5.a are revised to recognize the MPC-24EF.

k. Step 7.1.7 is revised to update the impact limiter installation guidelines.

Proposed Change No. 32 - SAR Chapter 8

a. Chapter 8 is revised in various locations to recognize MPC-24EF, to eliminate the term "design drawings" as it relates to the drawings in the SAR, and to clarify the applicability of the ASME Code and refer to the list of approved alternatives in Table 1.3.2.

b. Section 8.0 is revised to clarify that Chapter 7 identifies the sequence of tests and inspections, but not the conduct of those tests and inspections. The conduct of test and inspections is governed by codes and standards and the users' implementing procedures.

c. Section 8.1.1.14 is revised to clarify the types of records that are included in the quality documentation record package.

d. Section 8.1.1.1.4 is revised to call out the larger lid-to-shell weld size for the "F" model MPC.

e. Section 8.1.2.2.2 is revised to remove the specificity regarding where the MPC cavity may be vented. This is an implementation detail that is determined by each user based on their plant's needs and capabilities.

f. Sections 8.1.2.4 8.1.4.1, and 8.2.4, and Tables 8.1.2 and 8.2.1 are revised to replace "rupture disks" with "relief devices" to allow the flexibility to choose other appropriately engineered relief devices, if desired.

g. Section 8.1.4.1 is revised to remove the detail regarding rupture disk testing. Verification of the functionality of rupture disks (or other relief devices) is part of the procurement process under the Holtec QA program and need not be included in the SAR.

h. Section 8.1.4.3 is revised to eliminate duplicate information and provide clarity.

i. Section 8.1.5.1 is revised to remove the requirement to document the thickness measurement locations and measurement results because this is an implementation detail governed by the material control portion of the QA program.

j. Sections 8.1.5.2 and 8.2.5 and Table 8.2.1 are revised to modify the shielding effectiveness test requirements to require only the one-time test after manufacture using actual contents or a check source, and a verification of compliance with 10 CFR 71 prior to each shipment thereafter. See Proposed Change No. 12 for detailed discussion of this change.

-STAR storage SAR.

Section III – DRAWINGS

Proposed Change No. 33

The existing overpack and MPC "certificate" drawings referred to in Section 5.a.(3) of CoC 9261 and contained in Section 1.4 of Revision 9 of the HI-STAR SAR are proposed to be replaced with licensing drawings, which have the appropriate amount of detail for inclusion in the SAR and incorporation by reference into the CoC.

The following old drawings will be removed and new licensing drawings will be added to SAR Section 1.4 in Revision 10. The new licensing drawings (as well as the unmodified impact limiter certificate drawimngs) are included in Attachment 4 to this submittal package:

Old Drawing No.	Superseded by New Drawing Number
C1395 (4 Sheets)	3926 (3 Sheets)
C1396 (6 Sheets)	3923 (4 Sheets)
C1397 (7 Sheets)	3913 (8 Sheets)
C1398 (3 Sheets)	3913 (8 Sheets)
C1399 (3 Sheets)	3913 (8 Sheets)
C1401 (4 Sheets)	3928 (3 Sheets)
C1402 (6 Sheets)	3923 (4 Sheets)
C 1782 (1 Sheet)	3930 (2 Sheets)
BM-C1476 (2 Sheets)	3913 (8 Sheets)
BM-C1478 (2 Sheets)	3923 and 3926
BM-C1479 (2 Sheets)	3923 and 3928
None (MPC-24E/EF)	3925 (3 Sheets)
None (MPC-32)	3927 (3 Sheets)

Key issues regarding the licensing drawings are discussed below:

a. The new proposed drawings reflect a number of changes implemented to the overpack and MPC designs during first-time fabrication in the 1999 - 2002 time frame, which were not available at the time Holtec submitted Amendment Request 1 to the transportation certificate in November, 1999. These changes were implemented for storage under the provisions of 10 CFR 72.48 (Docket 72-1008) and rendered the affected MPCs and overpacks not certifiable under for transportation because they deviated from the existing Part 71certificate of compliance drawings[3]. Many of these MPCs and all of the overpacks are currently in service at ISFSIs under the general license provisions of 10 CFR 72.

b. The drawings reflect several design enhancements for the future (e.g., removal of the overpack pocket trunnion from the design after serial number 1020-007)[4]. In creating the licensing drawings, the details affected by the design enhancements have either been modified appropriately or, if not germane to the safety analyses for the packaging, removed from the drawing. For example, in many cases fabrication tolerances have been removed from the licensing drawings since either nominal dimensions were used in the safety analyses or the required tolerance is specified elsewhere in the CoC (e.g., minimum fuel cell pitch). See also Item 'c' below.

c. Holtec continues to maintain the detailed design drawings that are used in the fabrication shop, which include all necessary tolerances and other information to ensure quality fabrication, consistent with the design basis. Deviating from the nominal dimensions on the licensing drawings during fabrication is self-limiting. That is, the components will not physically fit together outside of a small range beyond the tolerance on the design drawing. However, the flexibility of using only nominal dimensions on the licensing drawings is desired to avoid the unnecessary administrative burden of a CoC amendment for small, non-safety-significant, out-of-tolerance deviations that may be dispositioned "accept-as-is" on a case-specific basis for a particular piece of hardware. This approach is preferred over expanding the tolerance ranges across the board and keeping them on the licensing drawings because a wholesale tolerance expansion would allow all as-built dimensions to vary more broadly, resulting in unacceptable overall tolerance stickups and components that may not fit together when assembled, even though the subcomponents may be built to tolerance..

In summary, accepting a one-time out-of-tolerance deviation "as-is" for a particular certified component is self-limited by equipment fit-up. and the disposition of that deviation through the Holtec design control process ensures the components will ultimately fit together when assembled.

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[3] The 10 CFR 72.48 screenings and evaluations, as applicable, were originally performed site-specifically by Holtec's licensee users and later re-evaluated for generic implementation by Holtec when 72.48 authority was granted to CoC holders in April, 2001.

[4] The details of the significant design enhancements that affect certification for transportation and their technical justifications are addressed specifically elsewhere in this document.

d. In those instances where one-time fabrication deviations were already dispositioned for the first seven HI-STAR 100 overpacks and MPCs as "accept-as-is" or "repair" under the Holtec QA program (and implemented under 10 CFR 72.48 for storage), the transportation drawing details against which the deviations were written have either been:

- removed from the drawing because they were of an unnecessary level of detail for a licensing drawing (thereby restoring Part 71 CoC compliance upon approval of the licensing drawings by the NRC) , or

- supplemented by a note describing the one-time deviation as acceptable and identifying the specific serial number component(s) to which the deviation applies.

e. The specific NDE information pertaining to ASME Code implementation in the fabrication shop (e.g., details of nondestructive examination techniques and acceptance criteria) have been replaced with references to the same information in the SAR. The NDE inspections that are required for each weld remain on the drawings.

f. Weld size have been removed from the drawings. In most cases, the sizes of the steel pieces to be joined and the Code itself mandate the sizes of the welds. The Code also offers relief for certain as-fabricated weld size deviations. Removing the weld sizes from the drawings eliminates the problem of having a non-certifiable component due to a minor weld deviation.

g. The following design enhancements, reflected in the licensing drawings, warrant specific mention (the technical justifications for these changes may be found in the proposed revisions to the SAR, as they pertain to the safety analyses):

- The fuel basket layout for MPC-24 is revised to increase the cell size and optimize the layout for criticality control purposes (Dwg. 3926).

- An option to fabricate the MPC lid from two pieces (split top and bottom) is added to provide flexibility in fabrication (Dwg 3923). If the two-piece option is used, the top piece acts as the structural lid and the bottom piece acts as a shield plug. The pieces are attached to each other with a non-pressure retaining, non-structural weld. The composite lid is functionally identical to the one piece lid. There is no change to materials or the MPC lid-to-shell weld joint.

- The MPC-68/68F lid thickness dimension is modified to be 9 ½" thick, minimum (Dwg 3923). This makes the BWR MPC-68/68F lid thickness the same as the PWR lid thicknesses. This change is reflected in the shielding analyses.

- Holes with plug welds are added to the MPC vent and drain port cover plates (Dwg. 3923). The holes are necessary to permit helium leak testing of the cover plates after welding.

- The MPC-68/68F/68FF fuel basket drawing (Dwg. 3928) shows the aluminum heat conduction elements (ACHEs) as optional equipment since they have been removed from the design, but have already been installed in some early vintage MPC-68/68F canisters. No ACHEs have been, or will be installed in any MPC-24s, MPC-24E/EFs, or MPC-32s, so those basket drawings do not show these components.

- Notes have been added to the MPC-68/68F/68FF and MPC-24E/24EF fuel basket drawings (Dwgs. 3925 and 3926) to allow limited defects in the Boral neutron absorber, which have been previously analyzed and found to be acceptable as one-time fabrication deviations. Note that these allowances are only for deviations occurring in the MPC fabrication shop and would not be acceptable in material received from the Boral supplier.

- The MPC enclosure vessel drawings for each MPC fuel basket have been consolidated into a single enclosure vessel design (Dwg. 3923).

- The overpack pocket trunnions are now depicted as an optional design feature (Dwgs. 3913 and 3930).

- The locking pads for the overpack lifting trunnions are now designated as optional equipment (Dwg. 3913).

- A provision to modify the lifting trunnion end caps as necessary to permit engagement of the lift yoke links has been added to the overpack drawing (Dwg. 3913).

- The call-out for "rupture disks: has been replaced with "relief devices to allow flexibility if choosing the relief device (Dwg. 3913).

Reason and Justification for Proposed Changes

The "C" drawings for the overpack and MPCs referenced in the current, approved transportation CoC include more detail than is appropriate or required for 10 CFR 71 certification of the HI-STAR 100 System. This extraneous detail results in the inability to certify the fabricated hardware for use under 10 CFR 71 for even the most minor of fabrication deviations (i.e., minor, accept-as-is tolerance or weld size deviations). This proposed change will remove extraneous detail and prevent the need to amend he certificate for minor, non safety significant deviations from the drawings that occur during fabrication. These proposed new licensing drawings are now more in line with what is customary for such drawings, while fabrication is still performed in accordance with more detailed design drawings.

Dimensions remaining on the licensing drawings are designated as nominal, except as specifically noted. Tolerances or minimum/maximum dimensions are included if they are germane to the safety analyses and are not specified elsewhere in the CoC.

The proposed new licensing drawings of the HI-STAR overpack, MPC enclosure vessel, and MPC fuel baskets include an appropriate amount of detail, consistent with the supporting safety analyses described in the SAR and consistent with the licensing drawings of other Part 71-certified packakings. Commitments to codes and standards, such as the ASME Boiler and Pressure Vessel Code (including certain approved alternatives) are adequately delineated in the SAR such that they need not be repeated on the drawings. A note on the drawing refers the reader to the SAR for applicability of codes and standards. Since the overpack and MPCs are dual-purpose designs, deviations from the Code commitments as described in the transportation SAR cannot be implemented without prior NRC approval due to restrictions in the 10 CFR 72 CoC.

NRC FORM 618

(3-96)
10cfr71

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1.a CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
9261	~~1~~2	USA/9261/B(U)F-85	1	~~7~~9

2. PREAMBLE

   a. This certificate is issued to certify that the 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 and 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:
Holtec International Holtec Center 555 Lincoln Drive West Marlton, NJ 08053	Holtec International application dated October 23, 1995, as supplemented c. DOCKET NUMBER 71-9261

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10CFR Part 71, as applicable, and the conditions specified below.

5.

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 ~~which~~ *that* house the spent nuclear fuel and an overpack ~~which~~ *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 203 1/8 inches without impact limiters and approximately 305 7/8 inches with impact limiters. Maximum gross weight for transportation (including overpack, MPC, fuel, and impact limiters) is approximately 282,000 pounds. Specific ~~tolerances~~ *nominal dimensions germane to the safety analyses for the package* are called out in drawings listed below.

Multi-Purpose Canister

There are ~~three~~ *six* Multi-Purpose Canister (MPC) models, designated the MPC-24, *MPC-24E, MPC-24EF, MPC-32,* 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 ~~which~~ *that* is capable of containing each type of MPC. The two digits after the MPC designate the number of

5. a. (2) Description (continued)

reactor fuel assemblies for which the respective MPCs are designed. The MPC-24 *series and the MPC-32 are* ~~is~~ designed to contain up to 24 *and 32* Pressurized Water Reactor (PWR) fuel assemblies, *respectively,* and the MPC-68 and MPC-68F are designed to contain up to 68 Boiling Water Reactor (BWR) fuel assemblies. Any MPC-68 loaded with material classified as fuel debris is designated as MPC-68F. *Any MPC-24E loaded with material classified as fuel debris is designated as 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.* ~~However, the number of spent fuel storage locations in each of the MPCs depends on the fuel assembly characteristics.~~ 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 10CFR71.63. The MPC pressure boundary is a strength-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 109:

(a) HI-STAR 100 MPC-24 *Fuel Basket* — Drawing *3926*~~C1395~~, Sheets *1-*~~3~~*4*, Rev. ~~1~~*0*
~~Drawing C1396, Sheets 1-4, 6, Rev. 1; and Sheet 5, Rev. 0~~
~~Drawing BM-C1478, Sheets 1&2, Rev. 1~~

5. a. (3) Drawings (continued)

(b) HI-STAR 100 MPC-24E/EF Fuel Basket	*Drawing 3925, Sheets 1-3, Rev. 0*
(c) HI-STAR 100 MPC-32 Fuel Basket	*Drawing 3927, Sheets 1-3, Rev. 0*
(*d*~~b~~) HI-STAR 100 MPC-68/68F/68FF *Fuel Basket*~~and MPC-68F~~	Drawing *3928*~~C1401~~, Sheets *1-3*~~4~~, Rev. ~~1~~*0* ~~Drawing C1402, Sheets 1-4, 6, Rev. 1; and Sheet 5, Rev. 0~~ ~~Drawing BM-C1479, Sheets 1 & 2, Rev. 1~~
(e) HI-STAR 100 MPC Enclosure Vessel	*Drawing 3923, Sheets 1-4, Rev. 0*
(*f*~~e~~) HI-STAR 100 Overpack	Drawing *3913,* ~~C1397~~, ~~Sheet 1, Rev. 2; and~~ Sheets *1-8*~~2-7~~, Rev. *0*~~1~~ ~~Drawing C1398, Sheets 1-3, Rev. 1~~ ~~Drawing C1399, Sheets 1-2, Rev. 1; and Sheet 3, Rev. 2~~ ~~Drawing BM-C1476, Sheet 1, Rev.1; and Sheet 2, Rev. 2~~
(*g*~~d~~) HI-STAR 100 Impact Limiters	Drawing C1765, Sheets 1-6, Rev. 1; and Sheet 7, Rev. 0
(*h*~~e~~) HI-STAR 100 Assembly for Transport	Drawing *3930*~~C1782~~, *Sheets 1 and 2,* Rev. *0*~~1~~

5. b. Contents

(1) Type and 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, *empty* ~~missing~~ fuel rods~~s~~ *locations* that are not *filled* ~~replaced~~ with dummy fuel rods, 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 which 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,* ~~Holtec International Report No. HI-951251,~~ Rev. *10* ~~9.~~

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

Fuel Debris is ruptured fuel rods, severed *fuel* rods, loose fuel pellets, *or* ~~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.*

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* ~~Partial fuel assemblies, that is fuel assemblies from which fuel rods are missing,~~ 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 (TPDs), Control Rod Assemblies (CRAs), Axial Power Shaping Rods (APSRs), Wet Annular Burnable Absorbers (WABAs), Rod Cluster Control Assemblies (RCCAs), Control Element Assemblies (CEAs),water displacement guide tube plugs, orifice rods assemblies, and vibration suppressor inserts.*

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 Figure 1.2.10D of the HI-STAR 100 System SAR, Rev. 10.*

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 Figure 1.2.10A of the HI-STAR 100 System SAR, Rev. 10.*

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-STAR 100 System SAR, Rev. 10.*

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

***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.*

(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 two limits for the stainless steel clad fuel assemblies or the applicable Zircaloy clad fuel assemblies.

(d) For MPCs partially loaded with damaged fuel assemblies or fuel debris, all remaining Zircaloy clad intact fuel assemblies in the MPC shall meet the more restrictive of the two limits for the damaged fuel assemblies or the intact fuel assemblies.

(e) For MPC-68s partially loaded with array/class 6x6A, 6x6B, 6x6C, *7x7A,* or 8x8A fuel assemblies, all remaining Zircaloy clad intact fuel assemblies in the MPC shall meet the more restrictive of the two limits for the 6x6A, 6x6B, 6x6C, *7x7A,* and 8x8A fuel assemblies or the applicable Zircaloy clad fuel assemblies.

(f) PWR ~~control rods, burnable poison rod assemblies, thimble plugs, and other~~ 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.

c. Transport Index for Criticality Control

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.

6.a (continued)

(3) The package must satisfy the following leak testing requirements:

(a) All overpack containment boundary seals shall be leak tested to show a leak rate of not greater than 4.3 x 10^{-6} atm cm^3/sec (helium). The leak test shall have a minimum sensitivity of 2.15 x 10^{-6} atm cm^3/sec (helium) and shall be performed:

~~(i) before the first shipment;~~
(i) within the 12-month period prior to each ~~successive~~ shipment;
(ii) after detensioning one or more overpack lid bolts 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 x 10^{-3} atm cm^3/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 rupture discs on the neutron shield vessel shall be replaced every 5 years.

(5) All MPCs shall be leak tested at the time of closure to show a leak rate of no greater than 5 x 10^{-6} atm cm^3/sec (helium). The leak test shall have a minimum sensitivity of 2.5 x 10^{-6} ~~std~~*atm* cm^3/sec (helium).

(6) Water and residual moisture shall be removed from the MPC in accordance with the following specifications:

(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.

(7) Following vacuum-drying, the MPC shall be backfilled with 99.995% minimum purity helium: $\geq$ 1 atm and $\leq$ *44.8* ~~28.3~~ psig *at a reference temperature of 70°F.* ~~for the MPC-24 and ≥ 1 atm and ≤ 28.5 psig for the MPC-68 and MPC-68F.~~

(8) Water and residual moisture shall be removed from the HI-STAR 100 overpack in accordance with the following specifications:

(a) The *overpack cavity* ~~MPC~~ shall be evacuated to a pressure of less than or equal to 3 torr.

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

6.a (continued)

(9) Following vacuum drying, the overpack shall be backfilled with helium to ≥ 10 psig and ≤ 14 psig.

(10) The following fasteners shall be tightened to the torque values specified below:

Fastener	Torque (ft-lbs)
Overpack Closure Plate Bolts	~~2895 ± 90~~ *2000 +250/-0*
Overpack Vent and Drain Port Plugs	45 +5/~~-0~~ -2
Top Impact Limiter Attachment Bolts	256 +10/-0
Bottom Impact Limiter Attachment Bolts	1500 +45/-0
~~Tie-down Bolts~~	~~250 +20/-0~~
~~Transport Frame Bolts~~	~~250 +20/-0~~

(11) Verify that the appropriate fuel spacers, as necessary, are used to position the fuel in the MPC cavity.

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 to 125% of the design pressure. The minimum test pressure shall be 125 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 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 ~~process~~*results*, including *all relevant* ~~findings~~ 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.b (continued)

(6) *Prior to each shipment of a loaded HI-STAR 100 Package, radiation dose rates shall be measured to verify compliance with the dose rate limits of 10 CFR 71.*~~Periodic verification of the neutron shield integrity shall be performed within 5 years of each shipment. The periodic verification shall be performed by radiation measurements with either loaded contents or a check source. Measurements shall be performed at a minimum of 12 locations on the radial neutron shield and at a minimum of 4 locations on each impact limiter~~

(7) *Deleted.*~~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 1.4 of the SAR, Rev. 9. 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 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 *MPC* neutron absorber's minimum acceptable ^{10}B loading is 0.0267 g/cm^2 for the MPC-24 and 0.0372 g/cm^2 for the *MPC-24E, MPC-24EF, MPC-32, and* MPC-68; and 0.01 g/cm^2 for the MPC-68F. The ^{10}B loading shall be verified by chemistry or neutron attenuation techniques.

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

b. *The minimum fuel cell pitch for the MPC-32 is 9.158 inches.*

(12) The package containment verification leak test shall be per ANSI *N14.5-1997.*

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 6 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

REFERENCES:

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* ~~9~~, dated *TBD*~~April 20, 2000~~.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

E. William Brach, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Date: *TBD*

APPENDIX A

CERTIFICATE OF COMPLIANCE NO. 9261, REVISION 12

MODEL NO. HI-STAR 100 SYSTEM

Appendix A - Certificate of Compliance 9261

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Table A.1(Page 1 of 20)
Fuel Assembly Limits

I. MPC MODEL: MPC-24

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, average burnup, ~~decay heat~~ and minimum initial enrichment per assembly	
i. Zr Clad:	An assembly post-irradiation cooling time, average burnup, ~~decay heat,~~ and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
ii. SS Clad:	An assembly post-irradiation cooling time, average burnup, ~~decay heat,~~ and minimum initial enrichment as specified in Table A.6, as applicable.
d. Decay heat per assembly	*An assembly decay heat as specified in Table A.11*
e~~d~~. Fuel assembly length:	≤ 176.8 inches (nominal design)
f~~e~~. Fuel assembly width:	≤ 8.54 inches (nominal design)
g~~f~~. Fuel Assembly Weight:	≤ 1,680 lbs

B. Quantity per MPC: Up to 24 PWR fuel assemblies.

C. Fuel assemblies shall not contain *non-fuel hardware or neutron sources*~~control components~~.

D. Damaged fuel assemblies and fuel debris are not authorized for *transport in*~~loading into~~ the MPC-24.

E. Trojan plant fuel is not permitted to be transported in the MPC-24.

Table A.1 (Page 2 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies listed in Table A.3, with or without Zircaloy channels, and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.3 for the applicable fuel assembly array/class.
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, ~~decay heat~~ and minimum initial enrichment per assembly:	
i. Zr Clad:	An assembly post-irradiation cooling time, average burnup, ~~decay heat~~ and minimum initial enrichment as specified in Table A.7, except for (1) array/class 6x6A, 6x6C, *7x7A*, and 8x8A fuel assemblies, which shall have a cooling time ≥ 18 years, an average burnup ≤ 30,000 MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U and (2) array/class 8x8F fuel assemblies, which shall have a cooling time ≥ 10 years, an average burnup ≤ 27,500 MWD/MTU, ~~a decay heat ≤ 183.5 Watts,~~ and a minimum initial enrichment ≥ 2.4 wt% ^{235}U.
ii. SS Clad:	An assembly cooling time after discharge ≥ 16 years, an average burnup ≤ 22,500 MWD/MTU, and a minimum initial enrichment ≥ 3.5 wt% ^{235}U.
e. Decay heat per assembly	*An assembly decay heat as specified in Table A.11, except for array/class 8x8F fuel assemblies, which shall have a decay heat ≤ 183.5 Watts.*
f~~e~~. Fuel assembly length:	≤ 176.2 inches (nominal design)
g~~f~~. Fuel assembly width:	≤ 5.85 inches (nominal design)
h~~g~~. Fuel assembly weight	≤ 700 lbs, including channels

Table A.1 (Page 3 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1 (Page 4 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

3. Mixed oxide (MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Planar-Average Initial Enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 5 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

4. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1(Page 6 of *20*)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

5. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1Thoria Rod Canisters (as shown in Figure 1.2.11A of Holtec International Report No. HI-951251, Revision *10*~~9~~) and meeting the following specifications:

a. Cladding Type:	Zircaloy (Zr)
b. Composition:	98.2 wt.% ThO_2, 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U.
c. Number of rods Per Thoria Rod Canister:	$\leq$ 18
d. Decay heat per Thoria Rod Canister:	$\leq$ 115 Watts
e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister:	A fuel post-irradiation cooling time $\geq$ 18 years and an average burnup $\leq$ 16,000 MWD/MTIHM.
f. Initial heavy metal weight:	$\leq$ 27 kg/canister
g. Fuel cladding O.D.:	$\geq$ 0.412 inches
h. Fuel cladding I.D.:	$\leq$ 0.362 inches
i. Fuel Pellet O.D.:	$\leq$ 0.358 inches
j. Active fuel length:	$\leq$ 111 inches
k. Canister weight:	$\leq$ 550 lbs, including fuel

B. Quantity per MPC: Up to one (1) Dresden Unit 1 Thoria Rod Canister plus any combination of damaged fuel assemblies in damaged fuel containers and intact fuel assemblies, up to a total of 68.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C, or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68. The Antimony-Beryllium neutron source material shall be in a water rod location.

Table A.1 (Page 7 of *20*)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies, with or without Zircaloy channels. Uranium oxide BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U.
e. Fuel assembly length:	$\leq$ 176.2 inches (nominal design)
f. Fuel assembly width:	$\leq$ 5.85 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 8 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1 (Page 9 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

3. Uranium oxide, BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the uranium oxide BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the original fuel assembly.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1 (Page 10 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

4. Mixed oxide(MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
c. Initial maximum rod enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 11 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

5. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1 (Page 12 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

6. Mixed oxide (MOX), BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the MOX BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time ≥ 18 years, an average burnup ≤ 30,000 MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods in the original fuel assembly.
e. Fuel assembly length:	≤ 135.0 inches (nominal design)
f. Fuel assembly width:	≤ 4.70 inches (nominal design)
g. Fuel assembly weight	≤ ~~400~~*550* lbs, including channels *and damaged fuel container*

Table A.1(Page 13 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

7. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters (as shown in Figure 1.2.11A of Holtec International Report No. HI-951251, Revision 109) and meeting the following specifications:

a. Cladding Type:	Zircaloy (Zr)
b. Composition:	98.2 wt.% ThO_2, 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U.
c. Number of rods per Thoria Rod Canister:	$\leq$ 18
d. Decay heat per Thoria Rod Canister:	$\leq$ 115 Watts
e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister:	An assembly post-irradiation cooling time $\geq$ 18 years and an average burnup $\leq$ 16,000 MWD/MTIHM.
f. Initial heavy metal weight:	$\leq$ 27 kg/canister
g. Fuel cladding O.D.:	$\geq$ 0.412 inches
h. Fuel cladding I.D.:	$\leq$ 0.362 inches
i. Fuel pellet O.D.:	$\leq$ 0.358 inches
j. Active fuel length:	$\leq$ 111 inches
k. Canister weight:	$\leq$ 550 lbs, including fuel

Table A.1(Page 14 of *20*)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

B. Quantity per MPC:

Up to four (4) damaged fuel containers containing uranium oxide or MOX BWR fuel debris. The remaining MPC-68F fuel storage locations may be filled with array/class 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A fuel assemblies of the following type, as applicable:

1. Uranium oxide BWR intact fuel assemblies;
2. MOX BWR intact fuel assemblies;
3. Uranium oxide BWR damaged fuel assemblies placed in damaged fuel containers;
4. MOX BWR damaged fuel assemblies placed in damaged fuel containers; or
5. Up to one (1) Dresden Unit 1 Thoria Rod Canister.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68F.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C, or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68F. The Antimony-Beryllium neutron source material shall be in a water rod location.

Table A.1(Page 15 of 20)
Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	*Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class*
b. Maximum Initial Enrichment:	*As specified in Table A.2 for the applicable fuel assembly array/class.*
c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly	
i. Zr Clad:	*Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.*
ii. SS Clad:	*An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.6, as applicable.*
iii. Trojan plant fuel	*Cooling Time: ≥ 16 years* *Burnup: ≤ 42,000 MWD/MTU* *Minimum Enrichment: ≥ 2.10 wt% ^{235}U*
iv. Trojan plant non-fuel hardware	*BPRAs: Cooling Time ≥ 24 years* *TPDs: Cooling Time ≥ 11 years* *RCCAs: Cooling Time ≥ 9 years*
d. Decay heat per assembly	*Except for Trojan plant fuel, an assembly decay heat as specified in Table A.11. Trojan plant fuel decay heat: ≤ 725 Watts*
e. Fuel assembly length:	*≤ 176.8 inches (nominal design)*
f. Fuel assembly width:	*≤ 8.54 inches (nominal design)*
g. Fuel Assembly Weight:	*≤ 1,680 lbs*

Table A.1(Page 16 of 20)
Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

a. Cladding type:	*Zircaloy (Zr)*
b. Maximum Initial Enrichment:	*3.7% ^{235}U*
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	*Cooling Time: ≥ 16 years* *Burnup: ≤ 42,000 MWD/MTU* *Decay Heat: ≤ 725 Watts* *Minimum Enrichment: ≥ 2.10 wt% ^{235}U*
ii. Non-Fuel Hardware:	*BPRAs: Cooling Time ≥ 24 years* *TPDs: Cooling Time ≥ 11 years* *RCCAs: Cooling Time ≥ 9 years*
d. Fuel assembly length:	*≤ 169.3 inches (nominal design)*
e. Fuel assembly width:	*≤ 8.43 inches (nominal design)*
f. Fuel Assembly Weight:	*≤ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can*

B. Quantity per MPC: Except for Trojan plant fuel, up to 24 PWR intact fuel assemblies. For Trojan plant fuel, up to four (4) damaged fuel assemblies may be stored in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24E fuel storage locations may be filled with Trojan plant intact fuel assemblies.

C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.

D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware. Trojan fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.

E. Trojan plant damaged fuel assemblies must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan plant fuel.

F. Up to six (6) Trojan plant Sb-Be and/or Cf neutron sources may be transported in any fuel storage location.

G. Fuel debris is not authorized for transport into the MPC-24E.

Table A.1(Page 17 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly	
i. Zr Clad:	Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
ii. SS Clad:	An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.6, as applicable.
iii. Trojan plant fuel	Cooling time: ≥ 16 years Burnup: ≤ 42,000 MWD/MTU Minimum Enrichment: ≥ 2.10 wt% ^{235}U
iv. Trojan plant non-fuel hardware	BPRAs: Cooling Time ≥ 24 years TPDs: Cooling Time ≥ 11 years RCCAs: Cooling Time ≥ 9 years
d. Decay heat per assembly	Except for Trojan plant fuel, an assembly decay heat as specified in Table A.11. Trojan plant fuel decay heat: ≤ 725 Watts
e. Fuel assembly length:	≤ 176.8 inches (nominal design)
f. Fuel assembly width:	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	≤ 1,680 lbs

Table A.1(Page 18 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

a. Cladding type:	*Zircaloy (Zr)*
b. Maximum Initial Enrichment:	*3.7% ^{235}U*
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	*Cooling Time: ≥ 16 years* *Burnup: ≤ 42,000 MWD/MTU* *Decay Heat: ≤ 725 Watts* *Minimum Enrichment: ≥ 2.10 wt% ^{235}U*
ii. Non-fuel hardware	*BPRAs: Cooling Time ≥ 24 years* *TPDs: Cooling Time ≥ 11 years* *RCCAs: Cooling Time ≥ 9 years*
d. Fuel assembly length:	*≤ 169.3 inches (nominal design)*
e. Fuel assembly width:	*≤ 8.43 inches (nominal design)*
f. Fuel Assembly Weight:	*≤ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can*

Table A.1(Page 19 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

3. Trojan Fuel Debris Process Can Capsules and/or Trojan plant fuel assemblies classified as fuel debris, for which the original fuel assemblies meet the applicable criteria listed in Table A.2 and meet the following specifications:

a. Cladding type:	*Zircaloy (Zr)*
b. Maximum Initial Enrichment:	*3.7% ^{235}U*
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	*Cooling Time: ≥ 16 years* *Burnup: ≤ 42,000 MWD/MTU* *Decay Heat: ≤ 725 Watts* *Minimum Enrichment: ≥ 2.10 wt% ^{235}U*
ii. Non-fuel hardware	*BPRAs: Cooling Time ≥ 24 years* *TPDs: Cooling Time ≥ 11 years* *RCCAs: Cooling Time ≥ 9 years*
d. Fuel assembly length:	*≤ 169.3 inches (nominal design)*
e. Fuel assembly width:	*≤ 8.43 inches (nominal design)*
f. Fuel Assembly Weight:	*≤ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can*

B. Quantity per MPC: Except for Trojan plant fuel, up to 24 PWR intact fuel assemblies. For Trojan plant fuel, up to four (4) damaged fuel assemblies, fuel assemblies classified as fuel debris, and/or Trojan Fuel Debris Process Can Capsules may be transported in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24EF fuel storage locations may be filled with Trojan plant intact fuel assemblies.

C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.

D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware or neutron sources. Trojan fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.

E. Trojan plant damaged fuel assemblies, fuel assemblies classified as fuel debris, and Fuel Debris Process Can Capsules must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan plant fuel.

F. Up to six (6) Sb-Be and/or Cf neutron sources may be transported in any fuel storage location.

Table A.1(Page 20 of 20)
Fuel Assembly Limits

VI. MPC MODEL: MPC-32

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies in array/classes 15x15D, E, F, and H and 17x17A, B, and C listed in Table A.2 and meeting the following specifications:

a. Cladding type:	*Zircaloy (Zr)*
b. Maximum Initial Enrichment:	*As specified in Table A.2 for the applicable fuel assembly array/class.*
c. Post-irradiation cooling time, maximum average burnup, maximum and minimum initial enrichment per assembly	*An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.8 or A.9, as applicable.*
d. Minimum average burnup per assembly	*Calculated value as a function of initial enrichment. See Table A.10*
e. Decay heat per assembly	*An assembly decay heat as specified in Table A.11.*
f. Fuel assembly length:	*≤ 176.8 inches (nominal design)*
g. Fuel assembly width:	*≤ 8.54 inches (nominal design)*
h. Fuel Assembly Weight:	*≤ 1,680 lbs*

B. Quantity per MPC: Up to 32 PWR intact fuel assemblies.

C. Fuel assemblies shall not contain non-fuel hardware.

D. Damaged fuel assemblies and fuel debris are not authorized for loading into the MPC-32.

E. Trojan plant fuel is not permitted to be transported in the MPC-32.

Table A.2 (Page 1 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**14x14A**	**14x14B**	**14x14C**	**14x14D**	***14x14E***
Clad Material (Note 2)	Zr	Zr	Zr	SS	*SS*
Design Initial U (kg/assy.) (Note 3)	≤ 407	≤ 407	≤ 425	≤ 400	*≤ 206*
Initial Enrichment *(MPC-24, 24E, and 24EF)* (wt % ^{235}U)	≤ 4.6 *(24)* *≤ 5.0 (24E/EF)*	≤ 4.6 *(24)* *≤ 5.0 (24E/EF)*	≤ 4.6 *(24)* *≤ 5.0 (24E/EF)*	≤ 4.0 *(24)* *≤ 5.0 (24E/EF)*	*≤ 5.0*
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
No. of Fuel Rod *Locations*	179	179	176	180	*173*
Fuel Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.422	*≥ 0.3415*
Fuel Clad I.D. (in.)	≤ 0.3514	≤ 0.3734	≤ 0.3880	≤ 0.3890	*≤ 0.3175*
Fuel Pellet Dia. (in.)	≤ 0.3444	≤ 0.3659	≤ 0.3805	≤ 0.3835	*≤ 0.3130*
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 0.580	≤ 0.556	*Note 6*
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 144	*≤ 102*
No. of Guide *and/or Instrument* Tubes	17	17	5 (Note 4)	16	*0*
Guide/*Instrument* Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.038	≥ 0.0145	*N/A*

Table A.2 (Page 2 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**15x15A**	**15x15B**	**15x15C**	**15x15D**	**15x15E**	**15x15F**
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 464	≤ 464	≤ 464	≤ 475	≤ 475	≤ 475
Initial Enrichment *(MPC-24, 24E, and 24EF)* (wt % ^{235}U)	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*	≤ 4.1 *(24)* *≤ 4.5 (24E/EF)*
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	*N/A*	*N/A*	*N/A*	*≤ 5.0*	*≤ 5.0*	*≤ 5.0*
No. of Fuel Rod *Locations*	204	204	204	208	208	208
Fuel Clad O.D. (in.)	≥ 0.418	≥ 0.420	≥ 0.417	≥ 0.430	≥ 0.428	≥ 0.428
Fuel Clad I.D. (in.)	≤ 0.3660	≤ 0.3736	≤ 0.3640	≤ 0.3800	≤ 0.3790	≤ 0.3820
Fuel Pellet Dia. (in.)	≤ 0.3580	≤ 0.3671	≤ 0.3570	≤ 0.3735	≤ 0.3707	≤ 0.3742
Fuel Rod Pitch (in.)	≤ 0.550	≤ 0.563	≤ 0.563	≤ 0.568	≤ 0.568	≤ 0.568
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide *and/or Instrument* Tubes	21	21	21	17	17	17
Guide/*Instrument* Tube Thickness (in.)	≥ 0.0165	≥ 0.015	≥ 0.0165	≥ 0.0150	≥ 0.0140	≥ 0.0140

Table A.2 (Page 3 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	**15x15G**	**15x15H**	**16x16A**	**17x17A**	**17x17B**	**17x17C**
Clad Material (Note 2)	SS	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 420	≤ 475	≤ 443	≤ 467	≤ 467	≤ 474
Initial Enrichment *(MPC-24, 24E, and 24EF)* (wt % ^{235}U)	≤ 4.0 *(24)* *≤ 4.5 (24E/EF)*	≤ 3.8 *(24)* *≤ 4.2 (24E/EF)*	≤ 4.6 *(24)* *≤ 5.0 (24E/EF)*	≤ 4.0 *(24)* *≤ 4.4 (24E/EF)*	≤ 4.0 *(24)* *≤ 4.4 (24E/EF) (Note 7)*	≤ 4.0 *(24)* *≤ 4.4 (24E/EF)*
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	*N/A*	*≤ 5.0*	*N/A*	*≤ 5.0*	*≤ 5.0*	*≤ 5.0*
No. of Fuel Rod *Locations*	204	208	236	264	264	264
Fuel Clad O.D. (in.)	≥ 0.422	≥ 0.414	≥ 0.382	≥ 0.360	≥ 0.372	≥ 0.377
Fuel Clad I.D. (in.)	≤ 0.3890	≤ 0.3700	≤ 0.3320	≤ 0.3150	≤ 0.3310	≤ 0.3330
Fuel Pellet Dia. (in.)	≤ 0.3825	≤ 0.3622	≤ 0.3255	≤ 0.3088	≤ 0.3232	≤ 0.3252
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.568	≤ 0.506	≤ 0.496	≤ 0.496	≤ 0.502
Active Fuel Length (in.)	≤ 144	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide *and/or Instrument* Tubes	21	17	5 (Note 4)	25	25	25
Guide/*Instrument* Tube Thickness (in.)	≥ 0.0145	≥ 0.0140	≥ 0.0400	≥ 0.016	≥ 0.014	≥ 0.020

Table A.2 (Page 4 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.

2. Zr. Designates cladding material made of Zirconium or Zirconium alloys.

3. Design initial uranium weight is the *nominal* uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each PWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with users' fuel records to account for manufacturer tolerances.

4. Each guide tube replaces four fuel rods.

5. *Minimum burnup required per Table A.10.*

6. *This fuel assembly array/class includes only the Indian Point Unit 1 fuel assembly. This fuel assembly has two pitches in different sectors of the assembly. These pitches are 0.441 inches and 0.453 inches.*

7. *Trojan plant-specific fuel is governed by the limits specified for array/class 17x17B and will be transported in the custom-designed Trojan MPC-24E/EF canisters. The Trojan MPC-24E/EF design is authorized to store only Trojan plant fuel with a maximum initial enrichment of 3.7 wt.%* ^{235}U.

Table A.3 (Page 1 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**6x6A**	**6x6B**	**6x6C**	**7x7A**	**7x7B**	**8x8A**
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 110	≤ 110	≤ 110	≤ 100	≤ 195	≤ 120
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 2.7	≤ 2.7 for the UO_2 rods. See Note 4 for MOX rods	≤ 2.7	≤ 2.7	≤ 4.2	≤ 2.7
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 4.0	≤ 4.0	≤ 4.0	≤ 5.5	≤ 5.0	≤ 4.0
No. of Fuel Rod *Locations*	35 or 36	35 or 36 (up to 9 MOX rods)	36	49	49	63 or 64
Fuel Clad O.D. (in.)	≥ 0.5550	≥ 0.5625	≥ 0.5630	≥ 0.4860	≥ 0.5630	≥ 0.4120
Fuel Clad I.D. (in.)	≤ 0.5105	≤ 0.4945	≤ 0.4990	≤ 0.4204	≤ 0.4990	≤ 0.3620
Fuel Pellet Dia. (in.)	≤ 0.4980	≤ 0.4820	≤ 0.4880	≤ 0.4110	≤ 0.4910	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.710	≤ 0.710	≤ 0.740	≤ 0.631	≤ 0.738	≤ 0.523
Active Fuel Length (in.)	≤ 120	≤ 120	≤ 77.5	≤ 80	≤ 150	≤ 120
No. of Water Rods (Note 11)	1 or 0	1 or 0	0	0	0	1 or 0
Water Rod Thickness (in.)	≥ 0	≥ 0	N/A	N/A	N/A	≥ 0
Channel Thickness (in.)	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.120	≤ 0.100

Table A.3 (Page 2 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**8x8B**	**8x8C**	**8x8D**	**8x8E**	**8x8F**	**9x9A**
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 185	≤ 185	≤ 185	≤ 185	≤ 185	≤ 177
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ ~~3.6~~*4.0*	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod *Locations*	63 or 64	62	60 or 61	59	64	74/66 (Note 5)
Fuel Clad O.D. (in.)	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930	≥ 0.4576	≥ 0.4400
Fuel Clad I.D. (in.)	≤ 0.4295	≤ 0.4250	≤ 0.4230	≤ 0.4250	≤ 0.3996	≤ 0.3840
Fuel Pellet Dia. (in.)	≤ 0.4195	≤ 0.4160	≤ 0.4140	≤ 0.4160	≤ 0.3913	≤ 0.3760
Fuel Rod Pitch (in.)	≤ 0.642	≤ 0.641	≤ 0.640	≤ 0.640	≤ 0.609	≤ 0.566
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 or 0	2	1 - 4 (Note 7)	5	N/A (Note 12)	2
Water Rod Thickness (in.)	≥ 0.034	> 0.00	> 0.00	≥ 0.034	≥ 0.0315	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.055	≤ 0.120

Table A.3 (Page 3 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	9x9B	9x9C	9x9D	9x9E (Note 13)	9x9F (Note 13)	9x9G
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.1	≤ 4.1	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod *Locations*	72	80	79	76	76	72
Fuel Clad O.D. (in.)	≥ 0.4330	≥ 0.4230	≥ 0.4240	≥ 0.4170	≥ 0.4430	≥ 0.4240
Fuel Clad I.D. (in.)	≤ 0.3810	≤ 0.3640	≤ 0.3640	≤ 0.3640	≤ 0.3860	≤ 0.3640
Fuel Pellet Dia. (in.)	≤ 0.3740	≤ 0.3565	≤ 0.3565	≤ 0.3530	≤ 0.3745	≤ 0.3565
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 (Note 6)	1	2	5	5	1 (Note 6)
Water Rod Thickness (in.)	> 0.00	≥ 0.020	≥ 0.0300	≥ 0.0120	≥ 0.0120	≥ 0.0320
Channel Thickness (in.)	≤ 0.120	≤ 0.100	≤ 0.100	≤ 0.120	≤ 0.120	≤ 0.120

Table A.3 (Page 4 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**10x10A**	**10x10B**	**10x10C**	**10x10D**	**10x10E**
Clad Material (Note 2)	Zr	Zr	Zr	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 186	≤ 186	≤ 186	≤ 125	≤ 125
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5
No. of Fuel Rod *Locations*	92/78 (Note 8)	91/83 (Note 9)	96	100	96
Fuel Clad O.D. (in.)	≥ 0.4040	≥ 0.3957	≥ 0.3780	≥ 0.3960	≥ 0.3940
Fuel Clad I.D. (in.)	≤ 0.3520	≤ 0.3480	≤ 0.3294	≤ 0.3560	≤ 0.3500
Fuel Pellet Dia. (in.)	≤ 0.3455	≤ 0.3420	≤ 0.3224	≤ 0.3500	≤ 0.3430
Fuel Rod Pitch (in.)	≤ 0.510	≤ 0.510	≤ 0.488	≤ 0.565	≤ 0.557
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 83	≤ 83
No. of Water Rods (Note 11)	2	1 (Note 6)	5 (Note 10)	0	4
Water Rod Thickness (in.)	≥ 0.0300	> 0.00	≥ 0.031	N/A	≥ 0.022
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.055	≤ 0.080	≤ 0.080

Table A.3 (Page 5 of 5)
BWR FUEL CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.

2. Zr designates cladding material made from Zirconium or Zirconium alloys.

3. Design initial uranium weight is the uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each BWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 1.5% for comparison with users' fuel records to account for manufacturer's tolerances.

4. $\leq$ 0.635 wt. % ^{235}U and $\leq$ 1.578 wt. % total fissile plutonium (^{239}Pu and ^{241}Pu), (wt. % of total fuel weight, i.e., UO_2 plus PuO_2).

5. This assembly class contains *745* total fuel rods; 66 full length rods and 8 partial length rods.

6. Square, replacing nine fuel rods.

7. Variable

8. This assembly class contains 92 total fuel rods; 78 full length rods and 14 partial length rods.

9. This assembly class contains 91 total fuel rods, 83 full length rods and 8 partial length rods.

10. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.

11. These rods may be sealed at both ends and contain Zr material in lieu of water.

12. This assembly is known as "QUAD+."It has four rectangular water cross segments dividing the assembly into four quadrants.

13. For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or 9x9F set of limits for clad O.D., clad I.D., and pellet diameter.

Table A.4

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/*24E/24EF* PWR FUEL WITH ZIRCALOY CLAD AND
WITH NON-ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)	~~Decay Heat (Watts)~~
≥ 10	≤ 24,500	≥ 2.3	~~≤ 411~~
≥ 12	≤ 29,500	≥ 2.6	~~≤ 473~~
≥ 14	≤ 34,500	≥ 2.9	~~≤ 540~~
≥ 15	≤ ~~37~~*39,500*	≥ 3.2	~~≤ 579~~
≥ *19*	≤ *44,500*	≥ *3.4*	

Note 1: Linear interpolation between points is permitted.

Table A.5

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/*24E/24EF* PWR FUEL WITH ZIRCALOY CLAD AND
WITH ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)	~~Decay Heat (Watts)~~
≥ 7	≤ 24,500	≥ 2.3	~~≤ 496~~
≥ 8	≤ 29,500	≥ 2.6	~~≤ 562~~
≥ *9*~~10~~	≤ 34,500	≥ 2.9	~~≤ 610~~
≥ 12	≤ 39,500	≥ 3.2	~~≤ 667~~
≥ 15	≤ *44,500*~~100~~	≥ 3.4	~~≤ 704~~

Note 1: Linear interpolation between points is permitted.

Table A.6

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/*24E*/*24EF* PWR FUEL WITH STAINLESS STEEL CLAD (Note 1)

Post-irradiation Cooling Time (years)	**Assembly Burnup (MWD/MTU)**	**Assembly Minimum Enrichment (wt. % U-235)**	~~**Decay Heat (Watts)**~~
≥ 19	≤ 30,000	≥ 3.1	~~≤ 377~~
≥ 24	≤ 40,000	≥ 3.1	~~≤ 475~~

Note 1: Linear interpolation between points is permitted.

Table A.7

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-68 (Note 1)

Post-irradiation Cooling Time (years)	**Assembly Burnup (MWD/MTU)**	**Assembly Minimum Enrichment (wt. % U-235)**	~~**Decay Heat (Watts)**~~
≥ 8	≤ 24,500	≥ 2.1	~~≤ 179~~
≥ 9	≤ 29,500	≥ 2.4	~~≤ 208~~
≥ ~~12~~*11*	≤ 34,500	≥ 2.6	~~≤ 222~~
≥ ~~15~~*14*	≤ *39,500*~~*400*~~	≥ 2.9	~~≤ 238~~
≥ *19*	≤ *44,500*	≥ *3.0*	

Note 1: Linear interpolation between points is permitted.

Table A.8

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT MPC-32 PWR FUEL WITH ZIRCALOY CLAD AND WITH NON-ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 12	≤ 24,500	≥ 2.3
≥ 14	≤ 29,500	≥ 2.6
≥ 16	≤ 34,500	≥ 2.9
≥ 19	≤ 39,500	≥ 3.2
≥ 20	≤ 42,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.9

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT MPC-32 PWR FUEL WITH ZIRCALOY CLAD AND WITH ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 10	≤ 24,500	≥ 2.3
≥ 11	≤ 29,500	≥ 2.6
≥ 12	≤ 34,500	≥ 2.9
≥ 14	≤ 39,500	≥ 3.2
≥ 18	≤ 44,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.10

FUEL ASSEMBLY MINIMUM BURNUP REQUIREMENTS FOR MPC-32

Fuel Assembly Array/Class	***Minimum Burnup (B) as a Function of Initial Enrichment** (Note 1)* ***(GWD/MTU)***
15x15D, E, F and H (Initial enrichment ≤ 4.0 wt. % ^{235}U)	$B \geq (1.1018)\,E^3 - (14.3434)\,E^2 + (71.3106)\,E - 89.1034$
15x15D, E, F and H (Initial enrichment > 4.0 and ≤ 5.0 wt. % ^{235}U)	$B \geq (1.1018)\,E^3 - (14.3434)\,E^2 + (81.3106)\,E - 129.1034$
17x17A, B, and C (Initial enrichment ≤ 4.0 wt. % ^{235}U)	$B \geq (0.4483)\,E^3 - (6.3861)\,E^2 + (42.401)\,E - 58.9255$
17x17A, B, and C (Initial enrichment > 4.0 and ≤ 5.0 wt. % ^{235}U)	$B \geq (0.4483)\,E^3 - (6.3861)\,E^2 + (52.401)\,E - 98.9255$

NOTES:

1. *E = Initial enrichment from the fuel vendor's data sheet, i.e., for 4.05 wt.%, E = 4.05*

Table A.11

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT

Post-irradiation Cooling Time (years)	***Assembly Decay Heat (MPC-24/24E/24EF) (kW)***	***Assembly Decay Heat (MPC-32) (kW)***	***Assembly Decay Heat (MPC-68) (kW)***
≥ 7	*≤ 0.751*	*NP (Note 1)*	*NP*
≥ 8	*≤ 0.745*	*NP*	*≤ 0.249*
≥ 9	*≤ 0.739*	*NP*	*≤ 0.247*
≥ 10	*≤ 0.733*	*≤ 0.549*	*≤ 0.245*
≥ 11	*≤ 0.727*	*≤ 0.546*	*≤ 0.244*
≥ 12	*≤ 0.722*	*≤ 0.542*	*≤ 0.242*
≥ 13	*≤ 0.717*	*≤ 0.538*	*≤ 0.241*
≥ 14	*≤ 0.712*	*≤ 0.534*	*≤ 0.240*
≥ 15	*≤ 0.707*	*≤ 0.530*	*≤ 0.238*
≥ 16	*≤ 0.702*	*≤ 0.526*	*≤ 0.237*
≥ 17	*≤ 0.696*	*≤ 0.522*	*≤ 0.236*
≥ 18	*≤ 0.691*	*≤ 0.518*	*≤ 0.234*
≥ 19	*≤ 0.686*	*≤ 0.515*	*≤ 0.233*
≥ 20	*≤ 0.681*	*≤ 0.511*	*≤ 0.232*

Note 1: "NP" means not permitted.

REFERENCE:

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* ~~9~~ dated *TBD* ~~April 20, 2000~~

NRC FORM 618
(3-96)
10cfr71

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1.a CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
9261	2	USA/9261/B(U)F-85	1	9

2. PREAMBLE

a. This certificate is issued to certify that the 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 and 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:
Holtec International Holtec Center 555 Lincoln Drive West Marlton, NJ 08053	Holtec International application dated October 23, 1995, as supplemented c. DOCKET NUMBER 71-9261

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10CFR Part 71, as applicable, and the conditions specified below.

5.

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 203 1/8 inches without impact limiters and approximately 305 7/8 inches with impact limiters. Maximum gross weight for transportation (including overpack, MPC, fuel, and impact limiters) is approximately 282,000 pounds. Specific nominal dimensions germane to the safety analyses for the package are called out in drawings listed below.

Multi-Purpose Canister

There are six Multi-Purpose Canister (MPC) models, designated the MPC-24, MPC-24E, MPC-24EF, MPC-32, 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

5. a. (2) Description (continued)

assemblies for which the respective MPCs are designed. The MPC-24 series and the MPC-32 are designed to contain up to 24 *and 32* Pressurized Water Reactor (PWR) fuel assemblies, respectively, and the MPC-68 and MPC-68F are designed to contain up to 68 Boiling Water Reactor (BWR) fuel assemblies. Any MPC-68 loaded with material classified as fuel debris is designated as MPC-68F. Any MPC-24E loaded with material classified as fuel debris is designated as 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 10CFR71.63. The MPC pressure boundary is a strength-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*9:

(a) HI-STAR 100 MPC-24 Fuel Basket	Drawing 3926, Sheets 1-3, Rev. 0

5. a. (3) Drawings (continued)

(b) HI-STAR 100 MPC-24E/EF Fuel Basket	Drawing 3925, Sheets 1-3, Rev. 0
(c) HI-STAR 100 MPC-32 Fuel Basket	Drawing 3927, Sheets 1-3, Rev. 0
(d) HI-STAR 100 MPC-68/68F/68FF Fuel Basket	Drawing 3928, Sheets 1-3, Rev. 0
(e) HI-STAR 100 MPC Enclosure Vessel	Drawing 3923, Sheets 1-4, Rev. 0
(f) HI-STAR 100 Overpack	Drawing 3913, Sheets 1-8, Rev. 0
(g) HI-STAR 100 Impact Limiters	Drawing C1765, Sheets 1-6, Rev. 1; and Sheet 7, Rev. 0
(h) HI-STAR 100 Assembly for Transport	Drawing 3930, Sheets 1 and 2, Rev. 0

5. b. Contents

(1) Type and 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, empty fuel rod locations that are not filled with dummy fuel rods, 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 which 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.

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

Fuel Debris is ruptured fuel rods, severed fuel rods, loose fuel pellets, or 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.

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 (TPDs), Control Rod Assemblies (CRAs), Axial Power Shaping Rods (APSRs), Wet Annular Burnable Absorbers (WABAs), Rod Cluster Control Assemblies (RCCAs), Control Element Assemblies (CEAs),water displacement guide tube plugs, orifice rods assemblies, and vibration suppressor inserts.

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 Figure 1.2.10D of the HI-STAR 100 System SAR, Rev. 10.

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 Figure 1.2.10A of the HI-STAR 100 System SAR, Rev. 10.

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-STAR 100 System SAR, Rev. 10.

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

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.

(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 two limits for the stainless steel clad fuel assemblies or the applicable Zircaloy clad fuel assemblies.

(d) For MPCs partially loaded with damaged fuel assemblies or fuel debris, all remaining Zircaloy clad intact fuel assemblies in the MPC shall meet the more restrictive of the two limits for the damaged fuel assemblies or the intact fuel assemblies.

(e) For MPC-68s partially loaded with array/class 6x6A, 6x6B, 6x6C, *7x7A,* or 8x8A fuel assemblies, all remaining Zircaloy clad intact fuel assemblies in the MPC shall meet the more restrictive of the two limits for the 6x6A, 6x6B, 6x6C, *7x7A,* 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.

c. Transport Index for Criticality Control

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.

6.a (continued)

(3) The package must satisfy the following leak testing requirements:

(a) All overpack containment boundary seals shall be leak tested to show a leak rate of not greater than 4.3 x 10^{-6} atm cm^3/sec (helium). The leak test shall have a minimum sensitivity of 2.15 x 10^{-6} atm cm^3/sec (helium) and shall be performed:

(i) within the 12-month period prior to each shipment;
(ii) after detensioning one or more overpack lid bolts 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 x 10^{-3} atm cm^3/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 rupture discs on the neutron shield vessel shall be replaced every 5 years.

(5) All MPCs shall be leak tested at the time of closure to show a leak rate of no greater than 5 x 10^{-6} atm cm^3/sec (helium). The leak test shall have a minimum sensitivity of 2.5 x 10^{-6} atm cm^3/sec (helium).

(6) Water and residual moisture shall be removed from the MPC in accordance with the following specifications:

(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.

(7) Following vacuum-drying, the MPC shall be backfilled with 99.995% minimum purity helium: $\geq$ 1 atm and $\leq$ 44.8 psig at a reference temperature of 70°F.

(8) Water and residual moisture shall be removed from the HI-STAR 100 overpack in accordance with the following specifications:

(a) The overpack cavity shall be evacuated to a pressure of less than or equal to 3 torr.

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

6.a (continued)

(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:

Fastener	Torque (ft-lbs)
Overpack Closure Plate Bolts	2000 +250/-0
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.

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 to 125% of the design pressure. The minimum test pressure shall be 125 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 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.b (continued)

(6) Prior to each shipment of a loaded HI-STAR 100 Package, radiation dose rates shall be measured to verify compliance with the dose rate limits of 10 CFR 71.

(7) Deleted.

(8) For each package, a periodic thermal performance test shall be performed 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 MPC neutron absorber's minimum acceptable ^{10}B loading is 0.0267 g/cm^2 for the MPC-24 and 0.0372 g/cm^2 for the MPC-24E, MPC-24EF, MPC-32, and MPC-68; and 0.01 g/cm^2 for the MPC-68F. The ^{10}B loading shall be verified by chemistry or neutron attenuation techniques.

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

b. The minimum fuel cell pitch for the MPC-32 is 9.158 inches.

(12) The package containment verification leak test shall be per ANSI N14.5-1997.

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 6 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

REFERENCES:

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, dated TBD.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

E. William Brach, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Date: TBD

APPENDIX A

CERTIFICATE OF COMPLIANCE NO. 9261, REVISION 2

MODEL NO. HI-STAR 100 SYSTEM

Appendix A - Certificate of Compliance 9261

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Appendix A - Certificate of Compliance 9261

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A-10		MPC-68: Mixed oxide (MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B.
A-11		MPC-68: Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels placed in damaged fuel containers. MOX BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B.
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Table A.1(Page 1 of 20)
Fuel Assembly Limits

I. MPC MODEL: MPC-24

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly	
i. Zr Clad:	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
ii. SS Clad:	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.6, as applicable.
d. Decay heat per assembly	An assembly decay heat as specified in Table A.11,
e. Fuel assembly length:	$\leq$ 176.8 inches (nominal design)
f. Fuel assembly width:	$\leq$ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	$\leq$ 1,680 lbs

B. Quantity per MPC: Up to 24 PWR fuel assemblies.

C. Fuel assemblies shall not contain non-fuel hardware or neutron sources.

D. Damaged fuel assemblies and fuel debris are not authorized for transport in the MPC-24.

E. Trojan plant fuel is not permitted to be transported in the MPC-24.

Table A.1 (Page 2 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies listed in Table A.3, with or without Zircaloy channels, and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.3 for the applicable fuel assembly array/class.
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	
i. Zr Clad:	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.7, except for (1) array/class 6x6A, 6x6C, 7x7A, and 8x8A fuel assemblies, which shall have a cooling time ≥ 18 years, an average burnup ≤ 30,000 MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U and (2) array/class 8x8F fuel assemblies, which shall have a cooling time ≥ 10 years, an average burnup ≤ 27,500 MWD/MTU, and a minimum initial enrichment ≥ 2.4 wt% ^{235}U.
ii. SS Clad:	An assembly cooling time after discharge ≥ 16 years, an average burnup ≤ 22,500 MWD/MTU, and a minimum initial enrichment ≥ 3.5 wt% ^{235}U.
e. Decay heat per assembly	An assembly decay heat as specified in Table A.11, except for array/class 8x8F fuel assemblies, which shall have a decay heat ≤ 183.5 Watts
f. Fuel assembly length:	≤ 176.2 inches (nominal design)
g. Fuel assembly width:	≤ 5.85 inches (nominal design)
h. Fuel assembly weight	≤ 700 lbs, including channels

Table A.1 (Page 3 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time ≥ 18 years, an average burnup ≤ 30,000 MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U.
e. Fuel assembly length:	≤ 135.0 inches (nominal design)
f. Fuel assembly width:	≤ 4.70 inches (nominal design)
g. Fuel assembly weight	≤ 550 lbs, including channels and damaged fuel container

Table A.1 (Page 4 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

3. Mixed oxide (MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Planar-Average Initial Enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 5 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

4. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 550 lbs, including channels and damaged fuel container

Table A.1(Page 6 of 20)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

5. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1Thoria Rod Canisters (as shown in Figure 1.2.11A of Holtec International Report No. HI-951251, Revision 10) and meeting the following specifications:

a. Cladding Type:	Zircaloy (Zr)
b. Composition:	98.2 wt.% ThO_2, 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U.
c. Number of rods Per Thoria Rod Canister:	$\leq$ 18
d. Decay heat per Thoria Rod Canister:	$\leq$ 115 Watts
e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister:	A fuel post-irradiation cooling time $\geq$ 18 years and an average burnup $\leq$ 16,000 MWD/MTIHM.
f. Initial heavy metal weight:	$\leq$ 27 kg/canister
g. Fuel cladding O.D.:	$\geq$ 0.412 inches
h. Fuel cladding I.D.:	$\leq$ 0.362 inches
i. Fuel Pellet O.D.:	$\leq$ 0.358 inches
j. Active fuel length:	$\leq$ 111 inches
k. Canister weight:	$\leq$ 550 lbs, including fuel

B. Quantity per MPC: Up to one (1) Dresden Unit 1 Thoria Rod Canister plus any combination of damaged fuel assemblies in damaged fuel containers and intact fuel assemblies, up to a total of 68.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C, or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68. The Antimony-Beryllium neutron source material shall be in a water rod location.

Table A.1 (Page 7 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies, with or without Zircaloy channels. Uranium oxide BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U.
e. Fuel assembly length:	$\leq$ 176.2 inches (nominal design)
f. Fuel assembly width:	$\leq$ 5.85 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 8 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTU, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 550 lbs, including channels and damaged fuel container

Table A.1 (Page 9 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

3. Uranium oxide, BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the uranium oxide BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for the applicable fuel assembly array/class.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time ≥ 18 years, an average burnup ≤ 30,000 MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the original fuel assembly.
e. Fuel assembly length:	≤ 135.0 inches (nominal design)
f. Fuel assembly width:	≤ 4.70 inches (nominal design)
g. Fuel assembly weight	≤ 550 lbs, including channels and damaged fuel container

Table A.1 (Page 10 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

4. Mixed oxide(MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
c. Initial maximum rod enrichment:	As specified in Table A.3 for fuel assembly array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 400 lbs, including channels

Table A.1 (Page 11 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

5. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 550 lbs, including channels and damaged fuel container

Table A.1 (Page 12 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

6. Mixed oxide (MOX), BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the MOX BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table A.3 for array/class 6x6B.
d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time $\geq$ 18 years, an average burnup $\leq$ 30,000 MWD/MTIHM, and a minimum initial enrichment $\geq$ 1.8 wt% ^{235}U for the UO_2 rods in the original fuel assembly.
e. Fuel assembly length:	$\leq$ 135.0 inches (nominal design)
f. Fuel assembly width:	$\leq$ 4.70 inches (nominal design)
g. Fuel assembly weight	$\leq$ 550 lbs, including channels and damaged fuel container

Table A.1(Page 13 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

7. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters (as shown in Figure 1.2.11A of Holtec International Report No. HI-951251, Revision 10) and meeting the following specifications:

a. Cladding Type:	Zircaloy (Zr)
b. Composition:	98.2 wt.% ThO_2, 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U.
c. Number of rods per Thoria Rod Canister:	$\leq$ 18
d. Decay heat per Thoria Rod Canister:	$\leq$ 115 Watts
e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister:	An assembly post-irradiation cooling time $\geq$ 18 years and an average burnup $\leq$ 16,000 MWD/MTIHM.
f. Initial heavy metal weight:	$\leq$ 27 kg/canister
g. Fuel cladding O.D.:	$\geq$ 0.412 inches
h. Fuel cladding I.D.:	$\leq$ 0.362 inches
i. Fuel pellet O.D.:	$\leq$ 0.358 inches
j. Active fuel length:	$\leq$ 111 inches
k. Canister weight:	$\leq$ 550 lbs, including fuel

Table A.1(Page 14 of 20)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

B. Quantity per MPC:

Up to four (4) damaged fuel containers containing uranium oxide or MOX BWR fuel debris. The remaining MPC-68F fuel storage locations may be filled with array/class 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A fuel assemblies of the following type, as applicable:

1. Uranium oxide BWR intact fuel assemblies;
2. MOX BWR intact fuel assemblies;
3. Uranium oxide BWR damaged fuel assemblies placed in damaged fuel containers;
4. MOX BWR damaged fuel assemblies placed in damaged fuel containers; or
5. Up to one (1) Dresden Unit 1 Thoria Rod Canister.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68F.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C, or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68F. The Antimony-Beryllium neutron source material shall be in a water rod location.

Table A.1(Page 15 of 20)
Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly	
i. Zr Clad:	Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
ii. SS Clad:	An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.6, as applicable.
iii. Trojan plant fuel	Cooling Time: $\geq$ 16 years Burnup: $\leq$ 42,000 MWD/MTU Minimum Enrichment: $\geq$ 2.10 wt% ^{235}U
iv. Trojan plant non-fuel hardware	BPRAs: Cooling Time $\geq$ 24 years TPDs: Cooling Time $\geq$ 11 years RCCAs: Cooling Time $\geq$ 9 years
d. Decay heat per assembly	Except for Trojan plant fuel, an assembly decay heat as specified in Table A.11. Trojan plant fuel decay heat: $\leq$ 725 Watts
e. Fuel assembly length:	$\leq$ 176.8 inches (nominal design)
f. Fuel assembly width:	$\leq$ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	$\leq$ 1,680 lbs

Table A.1(Page 16 of 20)
Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Initial Enrichment:	3.7% ^{235}U
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	Cooling Time: $\geq$ 16 years Burnup: $\leq$ 42,000 MWD/MTU Decay Heat: $\leq$ 725 Watts Minimum Enrichment: $\geq$ 2.10 wt% ^{235}U
ii. Non-Fuel Hardware:	BPRAs: Cooling Time $\geq$ 24 years TPDs: Cooling Time $\geq$ 11 years RCCAs: Cooling Time $\geq$ 9 years
d. Fuel assembly length:	$\leq$ 169.3 inches (nominal design)
e. Fuel assembly width:	$\leq$ 8.43 inches (nominal design)
f. Fuel Assembly Weight:	$\leq$ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can

B. Quantity per MPC: Except for Trojan plant fuel, up to 24 PWR intact fuel assemblies. For Trojan plant fuel, up to four (4) damaged fuel assemblies may be stored in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24E fuel storage locations may be filled with Trojan plant intact fuel assemblies.

C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.

D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware. Trojan fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.

E. Trojan plant damaged fuel assemblies must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan plant fuel.

F. Up to six (6) Trojan plant Sb-Be and/or Cf neutron sources may be transported in any fuel storage location.

G. Fuel debris is not authorized for transport into the MPC-24E.

Table A.1(Page 17 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr) or Stainless Steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly	
i. Zr Clad:	Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
ii. SS Clad:	An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.6, as applicable.
iii. Trojan plant fuel	Cooling time: ≥ 16 years Burnup: ≤ 42,000 MWD/MTU Minimum Enrichment: ≥ 2.10 wt% ^{235}U
iv. Trojan plant non-fuel hardware	BPRAs: Cooling Time ≥ 24 years TPDs: Cooling Time ≥ 11 years RCCAs: Cooling Time ≥ 9 years
d. Decay heat per assembly	Except for Trojan plant fuel, an assembly decay heat as specified in Table A.11. Trojan plant fuel decay heat: ≤ 725 Watts
e. Fuel assembly length:	≤ 176.8 inches (nominal design)
f. Fuel assembly width:	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	≤ 1,680 lbs

Table A.1(Page 18 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Initial Enrichment:	3.7% ^{235}U
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	Cooling Time: ≥ 16 years Burnup: ≤ 42,000 MWD/MTU Decay Heat: ≤ 725 Watts Minimum Enrichment: ≥ 2.10 wt% ^{235}U
ii. Non-fuel hardware	BPRAs: Cooling Time ≥ 24 years TPDs: Cooling Time ≥ 11 years RCCAs: Cooling Time ≥ 9 years
d. Fuel assembly length:	≤ 169.3 inches (nominal design)
e. Fuel assembly width:	≤ 8.43 inches (nominal design)
f. Fuel Assembly Weight:	≤ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can

Table A.1(Page 19 of 20)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

3. Trojan Fuel Debris Process Can Capsules and/or Trojan plant fuel assemblies classified as fuel debris, for which the original fuel assemblies meet the applicable criteria listed in Table A.2 and meet the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Initial Enrichment:	3.7% ^{235}U
c. Post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	
i. Fuel:	Cooling Time: ≥ 16 years Burnup: ≤ 42,000 MWD/MTU Decay Heat: ≤ 725 Watts Minimum Enrichment: ≥ 2.10 wt% ^{235}U
ii. Non-fuel hardware	BPRAs: Cooling Time ≥ 24 years TPDs: Cooling Time ≥ 11 years RCCAs: Cooling Time ≥ 9 years
d. Fuel assembly length:	≤ 169.3 inches (nominal design)
e. Fuel assembly width:	≤ 8.43 inches (nominal design)
f. Fuel Assembly Weight:	≤ 1,680 lbs, including non-fuel hardware and DFC or Failed Fuel Can

B. Quantity per MPC: Except for Trojan plant fuel, up to 24 PWR intact fuel assemblies. For Trojan plant fuel, up to four (4) damaged fuel assemblies, fuel assemblies classified as fuel debris, and/or Trojan Fuel Debris Process Can Capsules may be transported in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24EF fuel storage locations may be filled with Trojan plant intact fuel assemblies.

C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.

D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware or neutron sources. Trojan fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.

E. Trojan plant damaged fuel assemblies, fuel assemblies classified as fuel debris, and Fuel Debris Process Can Capsules must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan plant fuel.

F. Up to six (6) Sb-Be and/or Cf neutron sources may be transported in any fuel storage location.

Table A.1(Page 20 of 20)
Fuel Assembly Limits

VI. MPC MODEL: MPC-32

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies in array/classes 15x15D, E, F, and H and 17x17A, B, and C listed in Table A.2 and meeting the following specifications:

a. Cladding type:	Zircaloy (Zr)
b. Maximum Initial Enrichment:	As specified in Table A.2 for the applicable fuel assembly array/class.
c. Post-irradiation cooling time, maximum average burnup, maximum and minimum initial enrichment per assembly	An assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment as specified in Table A.8 or A.9, as applicable.
d. Minimum average burnup per assembly	Calculated value as a function of initial enrichment. See Table A.10
e. Decay heat per assembly	An assembly decay heat as specified in Table A.11.
f. Fuel assembly length:	≤ 176.8 inches (nominal design)
g. Fuel assembly width:	≤ 8.54 inches (nominal design)
h. Fuel Assembly Weight:	≤ 1,680 lbs

B. Quantity per MPC: Up to 32 PWR intact fuel assemblies.

C. Fuel assemblies shall not contain non-fuel hardware.

D. Damaged fuel assemblies and fuel debris are not authorized for loading into the MPC-32.

E. Trojan plant fuel is not permitted to be transported in the MPC-32.

Table A.2 (Page 1 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**14x14A**	**14x14B**	**14x14C**	**14x14D**	**14x14E**
Clad Material (Note 2)	Zr	Zr	Zr	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 407	≤ 407	≤ 425	≤ 400	≤ 206
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ^{235}U)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.0 (24) ≤ 5.0 (24E/EF)	≤ 5.0
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	N/A	N/A	N/A	N/A	N/A
No. of Fuel Rod Locations	179	179	176	180	173
Fuel Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.422	≥ 0.3415
Fuel Clad I.D. (in.)	≤ 0.3514	≤ 0.3734	≤ 0.3880	≤ 0.3890	≤ 0.3175
Fuel Pellet Dia. (in.)	≤ 0.3444	≤ 0.3659	≤ 0.3805	≤ 0.3835	≤ 0.3130
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 0.580	≤ 0.556	Note 6
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 144	≤ 102
No. of Guide and/or Instrument Tubes	17	17	5 (Note 4)	16	0
Guide/Instrument Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.038	≥ 0.0145	N/A

Table A.2 (Page 2 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**15x15A**	**15x15B**	**15x15C**	**15x15D**	**15x15E**	**15x15F**
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 464	≤ 464	≤ 464	≤ 475	≤ 475	≤ 475
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ^{235}U)	≤ 4.1 (24) ≤ 4.5 (24E/EF)	≤ 4.1 (24) ≤ 4.5 (24E/EF)	≤ 4.1 (24) ≤ 4.5 (24E/EF)	≤ 4.1 (24) ≤ 4.5 (24E/EF)	≤ 4.1 (24) ≤ 4.5 (24E/EF)	≤ 4.1 (24) ≤ 4.5 (24E/EF)
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	N/A	N/A	N/A	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	204	204	204	208	208	208
Fuel Clad O.D. (in.)	≥ 0.418	≥ 0.420	≥ 0.417	≥ 0.430	≥ 0.428	≥ 0.428
Fuel Clad I.D. (in.)	≤ 0.3660	≤ 0.3736	≤ 0.3640	≤ 0.3800	≤ 0.3790	≤ 0.3820
Fuel Pellet Dia. (in.)	≤ 0.3580	≤ 0.3671	≤ 0.3570	≤ 0.3735	≤ 0.3707	≤ 0.3742
Fuel Rod Pitch (in.)	≤ 0.550	≤ 0.563	≤ 0.563	≤ 0.568	≤ 0.568	≤ 0.568
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	21	21	17	17	17
Guide/Instrument Tube Thickness (in.)	≥ 0.0165	≥ 0.015	≥ 0.0165	≥ 0.0150	≥ 0.0140	≥ 0.0140

Table A.2 (Page 3 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	15x15G	15x15H	16x16A	17x17A	17x17B	17x17C
Clad Material (Note 2)	SS	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 420	≤ 475	≤ 443	≤ 467	≤ 467	≤ 474
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ^{235}U)	≤ 4.0 (24) ≤ 4.5 (24E/EF)	≤ 3.8 (24) ≤ 4.2 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.0 (24) ≤ 4.4 (24E/EF)	≤ 4.0 (24) ≤ 4.4 (24E/EF) (Note 7)	≤ 4.0 (24) ≤ 4.4 (24E/EF)
Initial Enrichment (MPC-32) (wt % ^{235}U) (Note 5)	N/A	≤ 5.0	N/A	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	204	208	236	264	264	264
Fuel Clad O.D. (in.)	≥ 0.422	≥ 0.414	≥ 0.382	≥ 0.360	≥ 0.372	≥ 0.377
Fuel Clad I.D. (in.)	≤ 0.3890	≤ 0.3700	≤ 0.3320	≤ 0.3150	≤ 0.3310	≤ 0.3330
Fuel Pellet Dia. (in.)	≤ 0.3825	≤ 0.3622	≤ 0.3255	≤ 0.3088	≤ 0.3232	≤ 0.3252
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.568	≤ 0.506	≤ 0.496	≤ 0.496	≤ 0.502
Active Fuel Length (in.)	≤ 144	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	17	5 (Note 4)	25	25	25
Guide/Instrument Tube Thickness (in.)	≥ 0.0145	≥ 0.0140	≥ 0.0400	≥ 0.016	≥ 0.014	≥ 0.020

Table A.2 (Page 4 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.

2. Zr. Designates cladding material made of Zirconium or Zirconium alloys.

3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each PWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with users' fuel records to account for manufacturer tolerances.

4. Each guide tube replaces four fuel rods.

5. Minimum burnup required per Table A.10.

6. This fuel assembly array/class includes only the Indian Point Unit 1 fuel assembly. This fuel assembly has two pitches in different sectors of the assembly. These pitches are 0.441 inches and 0.453 inches.

7. Trojan plant-specific fuel is governed by the limits specified for array/class 17x17B and will be transported in the custom-designed Trojan MPC-24E/EF canisters. The Trojan MPC-24E/EF design is authorized to store only Trojan plant fuel with a maximum initial enrichment of 3.7 wt.% ^{235}U.

Table A.3 (Page 1 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	6x6A	6x6B	6x6C	7x7A	7x7B	8x8A
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 110	≤ 110	≤ 110	≤ 100	≤ 195	≤ 120
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 2.7	≤ 2.7 for the UO_2 rods. See Note 4 for MOX rods	≤ 2.7	≤ 2.7	≤ 4.2	≤ 2.7
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 4.0	≤ 4.0	≤ 4.0	≤ 5.5	≤ 5.0	≤ 4.0
No. of Fuel Rod Locations	35 or 36	35 or 36 (up to 9 MOX rods)	36	49	49	63 or 64
Fuel Clad O.D. (in.)	≥ 0.5550	≥ 0.5625	≥ 0.5630	≥ 0.4860	≥ 0.5630	≥ 0.4120
Fuel Clad I.D. (in.)	≤ 0.5105	≤ 0.4945	≤ 0.4990	≤ 0.4204	≤ 0.4990	≤ 0.3620
Fuel Pellet Dia. (in.)	≤ 0.4980	≤ 0.4820	≤ 0.4880	≤ 0.4110	≤ 0.4910	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.710	≤ 0.710	≤ 0.740	≤ 0.631	≤ 0.738	≤ 0.523
Active Fuel Length (in.)	≤ 120	≤ 120	≤ 77.5	≤ 80	≤ 150	≤ 120
No. of Water Rods (Note 11)	1 or 0	1 or 0	0	0	0	1 or 0
Water Rod Thickness (in.)	≥ 0	≥ 0	N/A	N/A	N/A	≥ 0
Channel Thickness (in.)	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.120	≤ 0.100

Table A.3 (Page 2 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	8x8B	8x8C	8x8D	8x8E	8x8F	9x9A
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 185	≤ 185	≤ 185	≤ 185	≤ 185	≤ 177
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	63 or 64	62	60 or 61	59	64	74/66 (Note 5)
Fuel Clad O.D. (in.)	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930	≥ 0.4576	≥ 0.4400
Fuel Clad I.D. (in.)	≤ 0.4295	≤ 0.4250	≤ 0.4230	≤ 0.4250	≤ 0.3996	≤ 0.3840
Fuel Pellet Dia. (in.)	≤ 0.4195	≤ 0.4160	≤ 0.4140	≤ 0.4160	≤ 0.3913	≤ 0.3760
Fuel Rod Pitch (in.)	≤ 0.642	≤ 0.641	≤ 0.640	≤ 0.640	≤ 0.609	≤ 0.566
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 or 0	2	1 - 4 (Note 7)	5	N/A (Note 12)	2
Water Rod Thickness (in.)	≥ 0.034	> 0.00	> 0.00	≥ 0.034	≥ 0.0315	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.055	≤ 0.120

Table A.3 (Page 3 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	9x9B	9x9C	9x9D	9x9E (Note 13)	9x9F (Note 13)	9x9G
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.1	≤ 4.1	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	72	80	79	76	76	72
Fuel Clad O.D. (in.)	≥ 0.4330	≥ 0.4230	≥ 0.4240	≥ 0.4170	≥ 0.4430	≥ 0.4240
Fuel Clad I.D. (in.)	≤ 0.3810	≤ 0.3640	≤ 0.3640	≤ 0.3640	≤ 0.3860	≤ 0.3640
Fuel Pellet Dia. (in.)	≤ 0.3740	≤ 0.3565	≤ 0.3565	≤ 0.3530	≤ 0.3745	≤ 0.3565
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 (Note 6)	1	2	5	5	1 (Note 6)
Water Rod Thickness (in.)	> 0.00	≥ 0.020	≥ 0.0300	≥ 0.0120	≥ 0.0120	≥ 0.0320
Channel Thickness (in.)	≤ 0.120	≤ 0.100	≤ 0.100	≤ 0.120	≤ 0.120	≤ 0.120

Table A.3 (Page 4 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**10x10A**	**10x10B**	**10x10C**	**10x10D**	**10x10E**
Clad Material (Note 2)	Zr	Zr	Zr	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 186	≤ 186	≤ 186	≤ 125	≤ 125
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5
No. of Fuel Rod Locations	92/78 (Note 8)	91/83 (Note 9)	96	100	96
Fuel Clad O.D. (in.)	≥ 0.4040	≥ 0.3957	≥ 0.3780	≥ 0.3960	≥ 0.3940
Fuel Clad I.D. (in.)	≤ 0.3520	≤ 0.3480	≤ 0.3294	≤ 0.3560	≤ 0.3500
Fuel Pellet Dia. (in.)	≤ 0.3455	≤ 0.3420	≤ 0.3224	≤ 0.3500	≤ 0.3430
Fuel Rod Pitch (in.)	≤ 0.510	≤ 0.510	≤ 0.488	≤ 0.565	≤ 0.557
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 83	≤ 83
No. of Water Rods (Note 11)	2	1 (Note 6)	5 (Note 10)	0	4
Water Rod Thickness (in.)	≥ 0.0300	> 0.00	≥ 0.031	N/A	≥ 0.022
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.055	≤ 0.080	≤ 0.080

Table A.3 (Page 5 of 5)
BWR FUEL CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.

2. Zr designates cladding material made from Zirconium or Zirconium alloys.

3. Design initial uranium weight is the uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each BWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 1.5% for comparison with users' fuel records to account for manufacturer's tolerances.

4. $\leq$ 0.635 wt. % ^{235}U and $\leq$ 1.578 wt. % total fissile plutonium (^{239}Pu and ^{241}Pu), (wt. % of total fuel weight, i.e., UO_2 plus PuO_2).

5. This assembly class contains 74 total fuel rods; 66 full length rods and 8 partial length rods.

6. Square, replacing nine fuel rods.

7. Variable

8. This assembly class contains 92 total fuel rods; 78 full length rods and 14 partial length rods.

9. This assembly class contains 91 total fuel rods, 83 full length rods and 8 partial length rods.

10. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.

11. These rods may be sealed at both ends and contain Zr material in lieu of water.

12. This assembly is known as "QUAD+."It has four rectangular water cross segments dividing the assembly into four quadrants.

13. For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or 9x9F set of limits for clad O.D., clad I.D., and pellet diameter.

Table A.4

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH NON-ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	**Assembly Burnup (MWD/MTU)**	**Assembly Minimum Enrichment (wt. % U-235)**
≥ 10	≤ 24,500	≥ 2.3
≥ 12	≤ 29,500	≥ 2.6
≥ 14	≤ 34,500	≥ 2.9
≥ 15	≤ 39,500	≥ 3.2
≥ 19	≤ 44,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.5

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	**Assembly Burnup (MWD/MTU)**	**Assembly Minimum Enrichment (wt. % U-235)**
≥ 7	≤ 24,500	≥ 2.3
≥ 8	≤ 29,500	≥ 2.6
≥ 9~~10~~	≤ 34,500	≥ 2.9
≥ 12	≤ 39,500	≥ 3.2
≥ 15	≤ 44,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.6

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH STAINLESS STEEL CLAD (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 19	≤ 30,000	≥ 3.1
≥ 24	≤ 40,000	≥ 3.1

Note 1: Linear interpolation between points is permitted.

Table A.7

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-68 (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 8	≤ 24,500	≥ 2.1
≥ 9	≤ 29,500	≥ 2.4
≥ 11	≤ 34,500	≥ 2.6
≥ 14	≤ 39,500	≥ 2.9
≥ 19	≤ 44,500	≥ 3.0

Note 1: Linear interpolation between points is permitted.

Table A.8

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-32 PWR FUEL WITH ZIRCALOY CLAD AND
WITH NON-ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 12	≤ 24,500	≥ 2.3
≥ 14	≤ 29,500	≥ 2.6
≥ 16	≤ 34,500	≥ 2.9
≥ 19	≤ 39,500	≥ 3.2
≥ 20	≤ 42,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.9

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-32 PWR FUEL WITH ZIRCALOY CLAD AND
WITH ZIRCALOY IN-CORE GRID SPACERS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 10	≤ 24,500	≥ 2.3
≥ 11	≤ 29,500	≥ 2.6
≥ 12	≤ 34,500	≥ 2.9
≥ 14	≤ 39,500	≥ 3.2
≥ 18	≤ 44,500	≥ 3.4

Note 1: Linear interpolation between points is permitted.

Table A.10

FUEL ASSEMBLY MINIMUM BURNUP REQUIREMENTS FOR MPC-32

Fuel Assembly Array/Class	**Minimum Burnup (B) as a Function of Initial Enrichment** (Note 1) (GWD/MTU)
15x15D, E, F and H (Initial enrichment ≤ 4.0 wt. % ^{235}U)	$B \geq (1.1018)E^3 - (14.3434)E^2 + (71.3106)E - 89.1034$
15x15D, E, F and H (Initial enrichment > 4.0 and ≤ 5.0 wt. % ^{235}U)	$B \geq (1.1018)E^3 - (14.3434)E^2 + (81.3106)E - 129.1034$
17x17A, B, and C (Initial enrichment ≤ 4.0 wt. % ^{235}U)	$B \geq (0.4483)E^3 - (6.3861)E^2 + (42.401)E - 58.9255$
17x17A, B, and C (Initial enrichment > 4.0 and ≤ 5.0 wt. % ^{235}U)	$B \geq (0.4483)E^3 - (6.3861)E^2 + (52.401)E - 98.9255$

NOTES:

1. E = Initial enrichment from the fuel vendor's data sheet, i.e., for 4.05 wt.%, E = 4.05

Table A.11

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT

Post-irradiation Cooling Time (years)	Assembly Decay Heat (MPC-24/24E/24EF) (kW)	Assembly Decay Heat (MPC-32) (kW)	Assembly Decay Heat (MPC-68) (kW)
≥ 7	≤ 0.751	NP (Note 1)	NP
≥ 8	≤ 0.745	NP	≤ 0.249
≥ 9	≤ 0.739	NP	≤ 0.247
≥ 10	≤ 0.733	≤ 0.549	≤ 0.245
≥ 11	≤ 0.727	≤ 0.546	≤ 0.244
≥ 12	≤ 0.722	≤ 0.542	≤ 0.242
≥ 13	≤ 0.717	≤ 0.538	≤ 0.241
≥ 14	≤ 0.712	≤ 0.534	≤ 0.240
≥ 15	≤ 0.707	≤ 0.530	≤ 0.238
≥ 16	≤ 0.702	≤ 0.526	≤ 0.237
≥ 17	≤ 0.696	≤ 0.522	≤ 0.236
≥ 18	≤ 0.691	≤ 0.518	≤ 0.234
≥ 19	≤ 0.686	≤ 0.515	≤ 0.233
≥ 20	≤ 0.681	≤ 0.511	≤ 0.232

Note 1: “NP” means not permitted.

REFERENCE:

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 dated TBD.

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL DESCRIPTION: HI-STAR 100 OVERPACK		
PROJECT NO. 1020	DRAWING NO. 3913	SHEET 1	TOTAL SHEETS 8
P.O. NO. N/A	FILE PATH G:\DRAWINGS\1020\3913\		

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL
	DESCRIPTION: HI-STAR 100 OVERPACK ELEVATION VIEW
COMPANION DRAWINGS	SIZE: D · DRAWING NO.: 3913 · SHEET: 2 · REV: 0
	SCALE: NTS · FILE PATH: G:\DRAWINGS\1020\3913\

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL			
	DESCRIPTION: HI-STAR 100 OVERPACK DETAIL OF TOP FLANGE AT 0° & 180°			
COMPANION DRAWINGS	SIZE: D	DRAWING NO.: 3913	SHEET: 3	REV: 0
	SCALE: NTS	FILE PATH: C:\DRAWINGS\1020\3913\		

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL DESCRIPTION: HI-STAR 100 OVERPACK CLOSURE PLATE BOLT HOLE & BOLT
COMPANION DRAWINGS	SIZE: D · DRAWING NO.: 3913 · SHEET: 4 · REV: 0
	SCALE: NTS · FILE PATH: C:\DRAWINGS\1020\3913\

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN DRIVE WEST
MARLTON, NJ 08053

CLIENT: GENERAL

DESCRIPTION: HI-STAR 100 OVERPACK TOP PLAN VIEW "D" – "D"

COMPANION DRAWINGS

SIZE	DRAWING NO.	SHEET	REV
D	3913	5	0

SCALE: NTS | FILE PATH: G:\DRAWINGS\1020\3913\

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN DRIVE WEST
MARLTON, NJ 08053

CLIENT: GENERAL

DESCRIPTION: HI-STAR 100 OVERPACK MID-PLANE SECTION "E" - "E"

COMPANION DRAWINGS

SIZE	DRAWING NO.	SHEET	REV
D	3913	6	0

SCALE: NTS
FILE PATH: C:\DRAWINGS\1020\3913\

2 1

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL

HOLTEC CENTER
555 LINCOLN DRIVE WEST
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	HI-STAR 100 OVERPACK TEST, VENT AND DRAIN PORT DETAILS
COMPANION DRAWINGS	
SIZE	D
DRAWING NO.	3913
SHEET	7
REV	0
SCALE	NTS
FILE PATH.	G:\DRAWINGS\1020\3913\

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL			
	DESCRIPTION: HI-STAR 100 OVERPACK DETAIL "H"			
COMPANION DRAWINGS	SIZE: D	DRAWING NO.: 3913	SHEET: 8	REV: 0
	SCALE: NTS	FILE PATH: C:\DRAWINGS\1020\3913\		

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS COVER SHEET MUST BE MAINTAINED WITH THE LATEST REVISIONS OF THE DRAWING IDENTIFIED HEREIN.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT GENERAL		
	DESCRIPTION MPC ENCLOSURE VESSEL		
PROJECT NO 5014	DRAWING NO 3923	SHEET 1	TOTAL SHEETS 4
P.O. NO. N/A		FILE PATH G:\DRAWINGS\5014\3923	

2 1 A

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	MPC ENCLOSURE VESSEL
SIZE	D
DRAWING NO	3923
SHEET	2
REV	0
SCALE	NONE
FILE PATH	G:\DRAWINGS\5014\3923
COMPANION DRAWINGS	

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

A

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	MPC ENCLOSURE VESSEL ELEVATION DETAILS
SIZE	D
DRAWING NO.	3923
SHEET	3
REV	0
SCALE	NONE
FILE PATH	G:\DRAWINGS\5014\3923

COMPANION DRAWINGS

2

1

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL
	DESCRIPTION: MPC ENCLOSURE VESSEL LID DETAILS
COMPANION DRAWINGS	SIZE: D; DRAWING NO: 3923; SHEET: 4; REV: 0
	SCALE: NONE; FILE PATH: G:\DRAWINGS\5014\3923

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS COVER SHEET MUST BE MAINTAINED WITH THE LATEST REVISIONS OF THE DRAWING IDENTIFIED HEREIN.				
HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT GENERAL			
	DESCRIPTION MPC-24E/EF FUEL BASKET ASSEMBLY			
PROJECT NO. 1022	DRAWING NO. 3925		SHEET 1	TOTAL SHEETS 3
P.O. NO. N/A		FILE PATH G:\DRAWINGS\1022\3925		

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL			
	DESCRIPTION: MPC-24E/EF FUEL BASKET ARRANGEMENT			
COMPANION DRAWINGS: -	SIZE: D	DRAWING NO: 3925	SHEET: 2	REV: 0
	SCALE: NONE	FILE PATH: G:\DRAWINGS\1022\3925		

A

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	MPC-24E/EF FUEL BASKET LAYOUT AND WELD DETAILS
COMPANION DRAWINGS	-
SIZE	D
DRAWING NO	3925
SHEET	3
REV	0
SCALE	NONE
FILE PATH	G:\DRAWINGS\1022\3925

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS COVER SHEET MUST BE MAINTAINED WITH THE LATEST REVISIONS OF THE DRAWING IDENTIFIED HEREIN.

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HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL
	DESCRIPTION: MPC-24 FUEL BASKET ASSEMBLY
PROJECT NO: 1022	DRAWING NO: 3926 / SHEET: 1 / TOTAL SHEETS: 3
P.O. NO: N/A	FILE PATH: G:\DRAWINGS\1022\3926

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL
	DESCRIPTION: MPC-24 FUEL BASKET ARRANGEMENT
COMPANION DRAWINGS: -	SIZE: D; DRAWING NO: 3926; SHEET: 2; REV: 0
	SCALE: NONE; FILE PATH: G:\DRAWINGS\1022\3926

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2 1

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL DESCRIPTION: MPC-24 FUEL BASKET LAYOUT AND WELD DETAILS
COMPANION DRAWINGS: -	SIZE: D; DRAWING NO: 3926; SHEET: 3; REV: 0 SCALE: NONE; FILE PATH: G:\DRAWINGS\1022\3926

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS COVER SHEET MUST BE MAINTAINED WITH THE LATEST REVISIONS OF THE DRAWING IDENTIFIED HEREIN.

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HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL		
	DESCRIPTION: MPC-32 FUEL BASKET ASSEMBLY		
PROJECT NO: 1023	DRAWING NO: 3927	SHEET: 1	TOTAL SHEETS: 3
PO NO: N/A		FILE PATH: G:\DRAWINGS\1023\3927	

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL			
	DESCRIPTION: MPC-32 FUEL BASKET ARRANGEMENT			
COMPANION DRAWINGS	SIZE: D	DRAWING NO.: 3927	SHEET: 2	REV: 0
	SCALE: NONE	FILE PATH: G:\DRAWINGS\1023\3927		

A

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL		
	DESCRIPTION: MPC-32 FUEL BASKET LAYOUT AND WELD DETAILS		
COMPANION DRAWINGS:	SIZE: D	DRAWING NO.: 3927	SHEET: 3 / REV: 0
	SCALE: NONE	FILE PATH: G:\DRAWINGS\1023\3927	

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FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS COVER SHEET MUST BE MAINTAINED WITH THE LATEST REVISIONS OF THE DRAWING IDENTIFIED HEREIN.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN CENTER MARLTON, NJ 08053	CLIENT: GENERAL		
	DESCRIPTION: MPC-68/68F/68FF FUEL BASKET ASSEMBLY		
PROJECT NO. 1021	DRAWING NO. 3928	SHEET 1	TOTAL SHEETS 3
P.O. NO. N/A	FILE PATH G:\DRAWINGS\1021\3928		

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	MPC-68/68F/68FF FUEL BASKET
COMPANION DRAWINGS	
SIZE	D
DRAWING NO	3928
SHEET	2
REV	0
SCALE	NONE
FILE PATH	G:\DRAWINGS\1021\3928

A

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	MPC-68/68F/68FF FUEL BASKET LAYOUT AND WELD DETAILS
COMPANION DRAWINGS	
SIZE	D
DRAWING NO.	3928
SHEET	3
REV	0
SCALE	NONE
FILE PATH	G:\DRAWINGS\1021\3928

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING	
DESCRIPTION HI-STAR 100 IMPACT LIMITER CoC No. 9261, APPENDIX B		
CLIENT VARIOUS		
COMPANION DRAWINGS NONE		REV. 1
PROJECT No. 5014	DRAWING No.	
P.O. No. VARIOUS	C1765 SHT. 1 OF 7	

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING
DESCRIPTION HI-STAR 100 BOTTOM IMPACT LIMITER CoC No. 9261, APPENDIX B	
CLIENT VARIOUS	
COMPANION DRAWINGS NONE	REV. 1
PROJECT No.5014	DRAWING No.
P.O. No. VARIOUS	C1765 SHT. 2 OF 7

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING
DESCRIPTION HI-STAR 100 TOP IMPACT LIMITER CoC No. 9261, APPENDIX B	
CLIENT VARIOUS	
COMPANION DRAWINGS NONE	REV. 1
PROJECT No.5014	DRAWING No.
P.O. No. VARIOUS	C1765 SHT. 3 OF 7

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING	
DESCRIPTION HI-STAR 100 TOP IMPACT LIMITER CoC No.9261, APPENDIX B		
CLIENT VARIOUS		
COMPANION DRAWINGS NONE		REV. 1
PROJECT No.5014	DRAWING No.	
P.O. No. VARIOUS	C1765 SHT. 4 OF 7	

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING
DESCRIPTION HI-STAR 100 TOP IMPACT LIMITER DETAIL OF ITEM #6 CoC No. 9261, APPENDIX B	
CLIENT VARIOUS	
COMPANION DRAWINGS NONE	REV. 1
PROJECT No.5014	DRAWING No.
P.O. No. VARIOUS	C1765 SHT. 5 OF 7

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

HOLTEC INTERNATIONAL	EQUIPMENT DESIGN ANALYSIS CONSULTING
DESCRIPTION HI-STAR 100 IMPACT LIMITER HONEYCOMB DETAILS CoC No. 9261, APPENDIX B	
CLIENT VARIOUS	
COMPANION DRAWINGS NONE	REV. 1
PROJECT No.5014	DRAWING No.
P.O. No. VARIOUS	C1765 SHT. 6 OF 7

FIGURE WITHHELD AS SENSITIVE
UNCLASSIFIED INFORMATION

DATE	REV.	DESCRIPTION	PREP. BY	CHECKED BY	ENG.	QA
FEB 19-98	0	FOR APPROVAL	C.Y. 2-19-98			

REVISION

HOLTEC INTERNATIONAL

EQUIPMENT DESIGN
ANALYSIS
CONSULTING

DESCRIPTION
HI-STAR 100 BOTTOM IMPACT LIMITER
CoC No. 9261, APPENDIX B -

CLIENT
VARIOUS

COMPANION DRAWINGS
NONE

REV. 0

PROJECT No. 5014

DRAWING No.
C1765 SHT. 7 OF 7

P.O. No. VARIOUS

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL DESCRIPTION: HI-STAR 100 ASSEMBLY FOR TRANSPORT
PROJECT NO. 1020	DRAWING NO. 3930 — SHEET 1 — TOTAL SHEETS 2
P.O. NO. N/A	FILE PATH: C:\DRAWINGS\1020\3930R0

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

THE DRAWINGS MUST BE USED IN CONJUNCTION WITH THE APPLICABLE DESIGN DRAWING PACKAGE COVER SHEET WHICH CONTAINS THE APPROPRIATE REVIEWS AND APPROVALS.

HOLTEC INTERNATIONAL HOLTEC CENTER 555 LINCOLN DRIVE WEST MARLTON, NJ 08053	CLIENT: GENERAL			
	DESCRIPTION: HI-STAR 100 ASSEMBLY FOR TRANSPORT			
COMPANION DRAWINGS	SIZE: D	DRAWING NO.: 3930	SHEET: 2	REV: 0
	SCALE: NTS	FILE PATH: G:\DRAWINGS\1020\3930R0		

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2.U-7	Deleted in Rev. 10		2.W-21	Deleted in Rev. 10
2.U-8	Deleted in Rev. 10		2.W-22	Deleted in Rev. 10
2.U-9	Deleted in Rev. 10		2.W-23	Deleted in Rev. 10
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2.U-11	Deleted in Rev. 10		2.W-25	Deleted in Rev. 10
2.U-12	Deleted in Rev. 10		2.W-26	Deleted in Rev. 10
2.U-13	Deleted in Rev. 10		2.X-1	Deleted in Rev. 10
2.U-14	Deleted in Rev. 10		2.X-2	Deleted in Rev. 10
2.U-15	Deleted in Rev. 10		2.X-3	Deleted in Rev. 10
2.U-16	Deleted in Rev. 10		2.X-4	Deleted in Rev. 10
2.U-17	Deleted in Rev. 10		2.X-5	Deleted in Rev. 10
2.U-18	Deleted in Rev. 10		2.X-6	Deleted in Rev. 10
2.U-19	Deleted in Rev. 10		2.X-7	Deleted in Rev. 10
2.U-20	Deleted in Rev. 10		2.X-8	Deleted in Rev. 10
2.U-21	Deleted in Rev. 10		2.X-9	Deleted in Rev. 10
2.U-22	Deleted in Rev. 10		2.X-10	Deleted in Rev. 10
2.U-23	Deleted in Rev. 10		2.X-11	Deleted in Rev. 10
2.U-24	Deleted in Rev. 10		2.X-12	Deleted in Rev. 10
2.U-25	Deleted in Rev. 10		2.X-13	Deleted in Rev. 10
2.V-1	Deleted in Rev. 10		2.X-14	Deleted in Rev. 10

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2.AA-1	Deleted in Rev. 10		2.AA-51	Deleted in Rev. 10
2.AA-2	Deleted in Rev. 10		2.AA-52	Deleted in Rev. 10
2.AA-3	Deleted in Rev. 10		2.AA-53	Deleted in Rev. 10
2.AA-4	Deleted in Rev. 10		2.AA-54	Deleted in Rev. 10
2.AA-5	Deleted in Rev. 10		2.AA-55	Deleted in Rev. 10
2.AA-6	Deleted in Rev. 10		2.AA-56	Deleted in Rev. 10
2.AA-7	Deleted in Rev. 10		2.AA-57	Deleted in Rev. 10
2.AA-8	Deleted in Rev. 10		2.AA-58	Deleted in Rev. 10
2.AA-9	Deleted in Rev. 10		2.AA-59	Deleted in Rev. 10
2.AA-10	Deleted in Rev. 10		2.AA-60	Deleted in Rev. 10
2.AA-11	Deleted in Rev. 10		2.AA-61	Deleted in Rev. 10
2.AA-12	Deleted in Rev. 10		2.AA-62	Deleted in Rev. 10
2.AA-13	Deleted in Rev. 10		2.AA-63	Deleted in Rev. 10
2.AA-14	Deleted in Rev. 10		2.AA-64	Deleted in Rev. 10
2.AA-14	Deleted in Rev. 10		2.AA-65	Deleted in Rev. 10
2.AA-15	Deleted in Rev. 10		2.AA-66	Deleted in Rev. 10
2.AA-16	Deleted in Rev. 10		2.AA-67	Deleted in Rev. 10
2.AA-17	Deleted in Rev. 10		2.AA-68	Deleted in Rev. 10
2.AA-18	Deleted in Rev. 10		2.AA-69	Deleted in Rev. 10
2.AA-19	Deleted in Rev. 10		2.AA-70	Deleted in Rev. 10
2.AA-20	Deleted in Rev. 10		2.AB-1	Deleted in Rev. 10
2.AA-21	Deleted in Rev. 10		2.AB-2	Deleted in Rev. 10
2.AA-22	Deleted in Rev. 10		2.AB-3	Deleted in Rev. 10
2.AA-23	Deleted in Rev. 10		2.AB-4	Deleted in Rev. 10
2.AA-24	Deleted in Rev. 10		2.AB-5	Deleted in Rev. 10
2.AA-25	Deleted in Rev. 10		2.AB-6	Deleted in Rev. 10
2.AA-26	Deleted in Rev. 10		2.AB-7	Deleted in Rev. 10
2.AA-27	Deleted in Rev. 10		2.AB-8	Deleted in Rev. 10
2.AA-28	Deleted in Rev. 10		2.AB-9	Deleted in Rev. 10
2.AA-29	Deleted in Rev. 10		2.AB-10	Deleted in Rev. 10
2.AA-30	Deleted in Rev. 10		2.AC-1	Deleted in Rev. 10
2.AA-31	Deleted in Rev. 10		2.AC-2	Deleted in Rev. 10
2.AA-32	Deleted in Rev. 10		2.AC-3	Deleted in Rev. 10
2.AA-33	Deleted in Rev. 10		2.AC-4	Deleted in Rev. 10
2.AA-34	Deleted in Rev. 10		2.AC-5	Deleted in Rev. 10
2.AA-35	Deleted in Rev. 10		2.AC-6	Deleted in Rev. 10
2.AA-36	Deleted in Rev. 10		2.AC-7	Deleted in Rev. 10
2.AA-37	Deleted in Rev. 10		2.AC-8	Deleted in Rev. 10
2.AA-38	Deleted in Rev. 10		2.AC-9	Deleted in Rev. 10
2.AA-39	Deleted in Rev. 10		2.AC-10	Deleted in Rev. 10
2.AA-40	Deleted in Rev. 10		2.AC-11	Deleted in Rev. 10
2.AA-41	Deleted in Rev. 10		2.AC-12	Deleted in Rev. 10
2.AA-42	Deleted in Rev. 10		2.AC-13	Deleted in Rev. 10
2.AA-43	Deleted in Rev. 10		2.AC-14	Deleted in Rev. 10
2.AA-44	Deleted in Rev. 10		2.AC-15	Deleted in Rev. 10
2.AA-45	Deleted in Rev. 10		2.AC-16	Deleted in Rev. 10
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2.AC-22	Deleted in Rev. 10		2.AC-73	Deleted in Rev. 10
2.AC-23	Deleted in Rev. 10		2.AC-74	Deleted in Rev. 10
2.AC-24	Deleted in Rev. 10		2.AC-75	Deleted in Rev. 10
2.AC-25	Deleted in Rev. 10		2.AC-76	Deleted in Rev. 10
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2.AC-28	Deleted in Rev. 10		2.AC-79	Deleted in Rev. 10
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2.AC-30	Deleted in Rev. 10		2.AC-81	Deleted in Rev. 10
2.AC-31	Deleted in Rev. 10		2.AC-82	Deleted in Rev. 10
2.AC-32	Deleted in Rev. 10		2.AC-83	Deleted in Rev. 10
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2.AC-40	Deleted in Rev. 10		2.AC-91	Deleted in Rev. 10
2.AC-41	Deleted in Rev. 10		2.AC-92	Deleted in Rev. 10
2.AC-42	Deleted in Rev. 10		2.AC-93	Deleted in Rev. 10
2.AC-43	Deleted in Rev. 10		2.AC-94	Deleted in Rev. 10
2.AC-44	Deleted in Rev. 10		2.AC-95	Deleted in Rev. 10
2.AC-45	Deleted in Rev. 10		2.AC-96	Deleted in Rev. 10
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2.AC-49	Deleted in Rev. 10		2.AC-100	Deleted in Rev. 10
2.AC-50	Deleted in Rev. 10		2.AC-101	Deleted in Rev. 10
2.AC-51	Deleted in Rev. 10		2.AC-102	Deleted in Rev. 10
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2.AC-67	Deleted in Rev. 10		2.AC-118	Deleted in Rev. 10
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2.AC-175	Deleted in Rev. 10		2.AC-226	Deleted in Rev. 10
2.AC-176	Deleted in Rev. 10		2.AC-227	Deleted in Rev. 10
2.AC-177	Deleted in Rev. 10		2.AC-228	Deleted in Rev. 10
2.AC-178	Deleted in Rev. 10		2.AC-229	Deleted in Rev. 10
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2.AC-184	Deleted in Rev. 10		2.AC-235	Deleted in Rev. 10
2.AC-185	Deleted in Rev. 10		2.AC-236	Deleted in Rev. 10
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2.AC-187	Deleted in Rev. 10		2.AC-238	Deleted in Rev. 10
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2.AC-195	Deleted in Rev. 10		2.AC-246	Deleted in Rev. 10
2.AC-196	Deleted in Rev. 10		2.AC-247	Deleted in Rev. 10
2.AC-197	Deleted in Rev. 10		2.AC-248	Deleted in Rev. 10
2.AC-198	Deleted in Rev. 10		2.AC-249	Deleted in Rev. 10
2.AC-199	Deleted in Rev. 10		2.AC-250	Deleted in Rev. 10
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2.AC-204	Deleted in Rev. 10		2.AC-255	Deleted in Rev. 10
2.AC-205	Deleted in Rev. 10		2.AC-256	Deleted in Rev. 10
2.AC-206	Deleted in Rev. 10		2.AC-257	Deleted in Rev. 10
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2.AC-210	Deleted in Rev. 10		2.AC-261	Deleted in Rev. 10
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2.AC-212	Deleted in Rev. 10		2.AC-263	Deleted in Rev. 10
2.AC-213	Deleted in Rev. 10		2.AC-264	Deleted in Rev. 10
2.AC-214	Deleted in Rev. 10		2.AC-265	Deleted in Rev. 10
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2.AC-216	Deleted in Rev. 10		2.AC-267	Deleted in Rev. 10
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2.AC-218	Deleted in Rev. 10		2.AC-269	Deleted in Rev. 10
2.AC-219	Deleted in Rev. 10		2.AC-270	Deleted in Rev. 10
2.AC-220	Deleted in Rev. 10		2.AC-271	Deleted in Rev. 10
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2.AC-278	Deleted in Rev. 10		2.AC-329	Deleted in Rev. 10
2.AC-279	Deleted in Rev. 10		2.AC-330	Deleted in Rev. 10
2.AC-280	Deleted in Rev. 10		2.AC-331	Deleted in Rev. 10
2.AC-281	Deleted in Rev. 10		2.AC-332	Deleted in Rev. 10
2.AC-282	Deleted in Rev. 10		2.AC-333	Deleted in Rev. 10
2.AC-283	Deleted in Rev. 10		2.AC-334	Deleted in Rev. 10
2.AC-284	Deleted in Rev. 10		2.AC-335	Deleted in Rev. 10
2.AC-285	Deleted in Rev. 10		2.AC-336	Deleted in Rev. 10
2.AC-286	Deleted in Rev. 10		2.AC-337	Deleted in Rev. 10
2.AC-287	Deleted in Rev. 10		2.AC-338	Deleted in Rev. 10
2.AC-288	Deleted in Rev. 10		2.AC-339	Deleted in Rev. 10
2.AC-289	Deleted in Rev. 10		2.AC-340	Deleted in Rev. 10
2.AC-290	Deleted in Rev. 10		2.AC-341	Deleted in Rev. 10
2.AC-291	Deleted in Rev. 10		2.AC-342	Deleted in Rev. 10
2.AC-292	Deleted in Rev. 10		2.AC-343	Deleted in Rev. 10
2.AC-293	Deleted in Rev. 10		2.AC-344	Deleted in Rev. 10
2.AC-294	Deleted in Rev. 10		2.AC-345	Deleted in Rev. 10
2.AC-295	Deleted in Rev. 10		2.AC-346	Deleted in Rev. 10
2.AC-296	Deleted in Rev. 10		2.AC-347	Deleted in Rev. 10
2.AC-297	Deleted in Rev. 10		2.AC-348	Deleted in Rev. 10
2.AC-298	Deleted in Rev. 10		2.AC-349	Deleted in Rev. 10
2.AC-299	Deleted in Rev. 10		2.AC-350	Deleted in Rev. 10
2.AC-300	Deleted in Rev. 10		2.AC-351	Deleted in Rev. 10
2.AC-301	Deleted in Rev. 10		2.AC-352	Deleted in Rev. 10
2.AC-302	Deleted in Rev. 10		2.AC-353	Deleted in Rev. 10
2.AC-303	Deleted in Rev. 10		2.AC-354	Deleted in Rev. 10
2.AC-304	Deleted in Rev. 10		2.AC-355	Deleted in Rev. 10
2.AC-305	Deleted in Rev. 10		2.AC-356	Deleted in Rev. 10
2.AC-306	Deleted in Rev. 10		2.AC-357	Deleted in Rev. 10
2.AC-307	Deleted in Rev. 10		2.AC-358	Deleted in Rev. 10
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2.AC-309	Deleted in Rev. 10		2.AC-360	Deleted in Rev. 10
2.AC-310	Deleted in Rev. 10		2.AC-361	Deleted in Rev. 10
2.AC-311	Deleted in Rev. 10		2.AC-362	Deleted in Rev. 10
2.AC-312	Deleted in Rev. 10		2.AC-363	Deleted in Rev. 10
2.AC-313	Deleted in Rev. 10		2.AC-364	Deleted in Rev. 10
2.AC-314	Deleted in Rev. 10		2.AC-365	Deleted in Rev. 10
2.AC-315	Deleted in Rev. 10		2.AC-366	Deleted in Rev. 10
2.AC-316	Deleted in Rev. 10		2.AC-367	Deleted in Rev. 10
2.AC-317	Deleted in Rev. 10		2.AC-368	Deleted in Rev. 10
2.AC-318	Deleted in Rev. 10		2.AC-369	Deleted in Rev. 10
2.AC-319	Deleted in Rev. 10		2.AC-370	Deleted in Rev. 10
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2.AC-321	Deleted in Rev. 10		2.AC-372	Deleted in Rev. 10
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2.AC-380	Deleted in Rev. 10		2.AE-3	Deleted in Rev. 10
2.AC-381	Deleted in Rev. 10		2.AE-4	Deleted in Rev. 10
2.AC-382	Deleted in Rev. 10		2.AE-5	Deleted in Rev. 10
2.AC-383	Deleted in Rev. 10		2.AE-6	Deleted in Rev. 10
2.AC-384	Deleted in Rev. 10		2.AE-7	Deleted in Rev. 10
2.AC-385	Deleted in Rev. 10		2.AE-8	Deleted in Rev. 10
2.AC-386	Deleted in Rev. 10		2.AE-9	Deleted in Rev. 10
2.AC-387	Deleted in Rev. 10		2.AE-10	Deleted in Rev. 10
2.AC-388	Deleted in Rev. 10		2.AE-11	Deleted in Rev. 10
2.AC-389	Deleted in Rev. 10		2.AE-12	Deleted in Rev. 10
2.AC-390	Deleted in Rev. 10		2.AE-13	Deleted in Rev. 10
2.AC-391	Deleted in Rev. 10		2.AE-14	Deleted in Rev. 10
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2.AC-393	Deleted in Rev. 10		2.AE-16	Deleted in Rev. 10
2.AC-394	Deleted in Rev. 10		2.AE-17	Deleted in Rev. 10
2.AC-395	Deleted in Rev. 10		2.AE-18	Deleted in Rev. 10
2.AC-396	Deleted in Rev. 10		2.AE-19	Deleted in Rev. 10
2.AC-397	Deleted in Rev. 10		2.AE-20	Deleted in Rev. 10
2.AC-398	Deleted in Rev. 10		2.AE-21	Deleted in Rev. 10
2.AC-399	Deleted in Rev. 10		2.AE-22	Deleted in Rev. 10
2.AC-400	Deleted in Rev. 10		2.AE-23	Deleted in Rev. 10
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2.AD-5	Deleted in Rev. 10		2.AE-28	Deleted in Rev. 10
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2.AD-18	Deleted in Rev. 10		2.AE-41	Deleted in Rev. 10
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2.AD-21	Deleted in Rev. 10		2.AE-44	Deleted in Rev. 10
2.AD-22	Deleted in Rev. 10		2.AE-45	Deleted in Rev. 10
2.AD-23	Deleted in Rev. 10		2.AE-46	Deleted in Rev. 10
2.AD-24	Deleted in Rev. 10		2.AE-47	Deleted in Rev. 10
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2.AE-54	Deleted in Rev. 10		2.AE-105	Deleted in Rev. 10
2.AE-55	Deleted in Rev. 10		2.AE-106	Deleted in Rev. 10
2.AE-56	Deleted in Rev. 10		2.AE-107	Deleted in Rev. 10
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