HOLTEC INTERNATIONAL

Holtec Center, 555 Lincoln Drive West, Marlton, NJ 08053
Telephone (856) 797-0900
Fax (856) 797-0909

February 5, 2010

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

Reference: USNRC Docket No. 71-9261 (HI-STAR 100)
USNRC Docket No. 72-27 (Humboldt Bay ISFSI FSAR)
Holtec Project 5014

Subject: Submittal of License Amendment Request 9261-8 to HI-STAR 100 Certificate of Compliance 71-9261

Holtec International herewith submits License Amendment Request (LAR) 9261-8 proposing certain changes to the HI-STAR 100 System 10 CFR 71 Certificate of Compliance (CoC) Number 9261, Revision 7 and its supporting Safety Analysis Report (SAR).

The main focus of this LAR is to update licensing drawings with various proposed design changes and one-time manufacturing deviations (most of which have been previously implemented in as-manufactured equipment in accordance with 10CFR72 as applicable) for both generic and Humboldt Bay specific licensed equipment. There are two proposed changes that are considered significant, namely 1) the incorporation of Metamic as an approved neutron absorber material option to Boral for all currently approved generic MPC models and 2) the redesign of the AL-STAR impact limiter non-backbone components (i.e. crush material only).

The baseline documents for this LAR are the currently approved CoC Amendment 7 and SAR Revision 13 which incorporated the NRC approved changes from Amendment 7.

A complete and updated SAR (Revision 14) is provided with this LAR. Only changed sections, and figures since Revision 13 are marked with Revision 14 in the footer. To facilitate the staff's review, a summary of changes proposed in this amendment request is provided in Attachment 1. This summary document lists the proposed changes to the CoC and SAR along with the reasons and justifications for the changes. Additionally, a detailed list of licensing drawing changes is provided in Attachment 2.

NMSS01
NMSS

HOLTEC INTERNATIONAL

Holtec Center, 555 Lincoln Drive West, Marlton, NJ 08053

Telephone (856) 797-0900

Fax (856) 797-0909

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Document ID 5014696.doc

The following attachments are provided:

Attachment 1: Summary of Proposed Changes.
Attachment 2: Licensing Drawing Changes
Attachment 3: Proposed CoC Changes. All text changes are marked by vertical bars in the right margin, additions are in italics and deletions in strikeout.
Attachment 4: SAR Revision 14 (Proprietary). All text changes are marked by vertical bars in the right margin.
Attachment 5: Affidavit pursuant to 10 CFR 2.390

We appreciate the staff's timely review and attention to this application.

Sincerely,

for Tammy Morin

Tammy Morin
Licensing Manager, Holtec Technical Services
Holtec International

cc: Mr. Eric Benner, NRC
Mr. Douglas Weaver, NRC
Holtec Groups 1, 2 and 4 (w/o attachments)
HUG Main and Licensing Committees (w/o attachments)

AFFIDAVIT PURSUANT TO 10 CFR 2.390

I, Luis E. Hinojosa, being duly sworn, depose and state as follows:

(1) I have reviewed the information described in paragraph (2) which is sought to be withheld, and am authorized to apply for its withholding.

(2) The information sought to be withheld is information provided in Attachment 4 to Holtec letter Document ID 5014696. This Attachment contains Holtec Proprietary information.

(3) In making this application for withholding of proprietary information of which it is the owner, Holtec International relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

AFFIDAVIT PURSUANT TO 10 CFR 2.390

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by Holtec's competitors without license from Holtec International constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

c. Information which reveals cost or price information, production, capacities, budget levels, or commercial strategies of Holtec International, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future Holtec International customer-funded development plans and programs of potential commercial value to Holtec International;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs 4.a, 4.b and 4.d, above.

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have

AFFIDAVIT PURSUANT TO 10 CFR 2.390

been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within Holtec International is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his designee), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside Holtec International are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed descriptions of analytical approaches and methodologies not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed by Holtec International. A substantial effort has been expended by Holtec International to develop this information. Release of this information would improve a competitor's position because it would enable Holtec's competitor to copy our technology and offer it for sale in competition with our company, causing us financial injury.

AFFIDAVIT PURSUANT TO 10 CFR 2.390

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to Holtec International's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of Holtec International's comprehensive spent fuel storage technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology, and includes development of the expertise to determine and apply the appropriate evaluation process.

The research, development, engineering, and analytical costs comprise a substantial investment of time and money by Holtec International.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

Holtec International's competitive advantage will be lost if its competitors are able to use the results of the Holtec International experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to Holtec International would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive Holtec International of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

AFFIDAVIT PURSUANT TO 10 CFR 2.390

STATE OF NEW JERSEY)
) ss:
COUNTY OF BURLINGTON)

Mr. Luis E. Hinojosa, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at Marlton, New Jersey, this 5th day of February, 2010.

Luis Hinojosa

Luis E. Hinojosa
Holtec International

Subscribed and sworn before me this 5th day of February, 2010.

Maria C. Massi

MARIA C. MASSI
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires April 25, 2010

Document 5014696
Attachment 1
February 5, 2010

SUMMARY OF PROPOSED CHANGES (LAR 9261-8)

PROPOSED CHANGES TO CERTIFICATE OF COMPLIANCE

Proposed Change No. 1.

Throughout CoC Amendment numbers, SAR Revisions, effective dates, and miscellaneous items have been changed to TBD where applicable.

Reason for Change
Upon approval of this amendment request these items will need to be updated.

Proposed Change No. 2.

Drawing Revisions have been updated in Section 5(a)(3).

Reason for Change
Licensing drawings for the HI-STAR 100 equipment have been revised to incorporate design and/or editorial changes. These drawing changes and justifications for the changes are described in more detail in Attachment 2 of this letter. Where necessary the SAR has been updated to include evaluation of these changes.

PROPOSED CHANGES TO SAFETY ANALYSIS REPORT

Proposed Change No. 3.

Changes were made to the SAR and the Licensing Drawing to modify the design of the impact limiter for the HI-STAR 100 (AL-STAR). Specifically:

- Drawing shows new arrangement of crush material in the impact limiter (this change is not applicable to HI-STAR HB Impact Limiters).
- Discussion in SAR Section 2.3.1.5 has been modified and Table 2.3.7 has been added to reflect the revised minimum crush strengths for the HI-STAR 100 Impact Limiters. The minimum crush strength values for HB impact limiters remain unchanged but are also reflected in Table 2.3.7.
- Appendix 2.C has been added to include an LS-DYNA evaluation of the modified HI-STAR 100 impact limiter in accordance with previously approved USNRC methodology and approach (namely HI-STAR 60 Docket 71-9336 and HI-STAR 180 Docket 71-9325).
- References for thermal properties for the impact limiter materials are updated. Properties of solid Aluminum are used during fire to maximize heat input and properties of air are used during normal transport and post-fire cooldown to minimize heat dissipation. This update is editorial.

Reason for Change
Using impact limiter sections made of materials with uniform crush strength removes complexity from the design and also allows for more flexibility during fabrication resulting in enhanced product quality.

Justification for Change
The required technical justifications and acceptance criteria are provided in the SAR.

Proposed Change No. 4.

Changes were made to the SAR and the Licensing Drawings to add Metamic as a neutron absorber. Specifically:

- Drawings list Metamic as acceptable neutron absorber, and specify the minimum B-10 loading (g/cm^2).
- The minimum Metamic B-10 loading (g/cm^2) for the MPC-24/24E/24EF, MPC-32, and MPC-68 models has been added to Table 1.2.3 (consistent with the drawings).
- Criticality evaluation of Metamic has been added to Chapter 6.
- Acceptance criteria for Metamic has been added to Section 8.1.

Reason for Change
Metamic is an advanced neutron absorber material that is already approved by the NRC for use in storage per Amendment #2 to CoC 1014, for transport in HI-STAR 60 (USNRC Docket 71-9336) and in this license for the Humboldt Bay specific equipment.

Justification for Change
The required technical justifications and acceptance criteria are provided in the SAR.

Proposed Change No. 5.

Changes were made to the generic MPC basket drawings to permit panels with a reduced panel width over a limited length of the panel.

Reason for Change
Manufacturing flexibility.

Justification for Change
Criticality evaluations provided in Chapter 6, Section 6.4.13, show that the proposed changes have a negligible effect on the reactivity of the system and are therefore acceptable. Other analyses of the HI-STAR system are unaffected by this change.

Proposed Change No. 6.

Additional clarification on exhausting or purging the space under the MPC lid during MPC lid to MPC shell welding and cutting is provided.

- Sections 7.1 and 7.2 have been modified to recommend purging during welding and cutting.
- Section 1.2.1.4.1 has been modified accordingly.
- Section 2.4.4 has been modified accordingly.

Reason for Change

Clarification to procedure steps to mitigate hydrogen burn/ignition during welding/cutting of the MPC lid to shell weld.

Justification for Change

Holtec has recommended in the HI-STORM storage FSAR (HI-2002444) to purge the space under the MPC lid with inert gas during welding and cutting to mitigate the accumulation of combustible gases. This recommendation is added to the transport SAR operations chapter for consistency. The option for exhausting remains in the SAR since it remains a valid alternative.

Proposed Change No. 7.

Optional basket supports and optional fuel spacers were added to the design of the MPC EV. These options are shown in more detail on the licensing drawings and are discussed in SAR Section 2.6.1.3.1.

Reason for Change

Fabrication flexibility for enhanced product quality.

Justification for Change

The evaluations summarized in the SAR Table 2.6.8 show the safety factors for the optional design of the basket supports are above 1.0 under normal conditions. SAR Table 2.7.4 shows the safety factors for the optional design of the basket supports are above 1.0 under accident conditions.

The optional fuel spacer design, using I-beam construction, is stronger than the tubing construction; therefore the safety factors for the tubing design bound the I-beam design.

Proposed Change No. 8.

The lifting evaluation of the Damaged Fuel Container (DFC) for Humboldt Bay is removed from Appendix 2.B (Table 2.B.1) and a revised evaluation is added to Section 2.I.5.4.

Reason for Change

The DFC for Humboldt Bay is specifically designed for use at Humboldt Bay and is not the same as the DFC for Dresden. The lifting of the loaded DFC for Humboldt Bay is performed with a special tool that engages the slots on the top ring of the DFC (slots only accessible with DFC lid removed). Therefore the safety evaluation has been updated to support the actual operation/method implemented to lift the DFC for Humboldt Bay.

Justification for Change

The safety evaluation and safety factor for lifting the loaded Humboldt Bay DFC is provided in 2.I.5.4. The safety factor is greater than 1.0.

Attachment 2
Holtec Letter 5014696
February 5, 2010

Detailed Changes to Licensing Drawings

Changes have been made to some of the licensing drawings in Section 1.4 of the SAR. Only the latest revision of the drawing is provided in the SAR even if there was more than one revision since the last approval. This appendix details all changes made to the drawings from one revision to the next, and provides justifications for all changes. Changes are categorized as **Editorial** (No change to design); **Minor** (Analysis in the SAR not affected); or **SAR Change** (drawing changes either resulted from or in a change to the HI-STAR SAR Revision 13 and are in Revision 14).

DRAWING 3913 HI-STAR 100 OVERPACK

No Proposed Changes

DRAWING 3923 MPC ENCLOSURE VESSEL

Revision 16 - Approved for Transport in CoC 9261 Revision 7

Revision 17 changes (ECOs 1021-94, 1022-73, 1023-51):
[1] SHEET 1; ADD NOTE 18 TO READ, "DIFFERENCES BETWEEN THE GENERIC MPC ENCLOSURE VESSEL AND THE IP1 MPC ENCLOSURE VESSEL ARE SPECIFICALLY NOTED (FOR PART 72 USE ONLY)"
[2] SHEET 3; ADD TO END OF NOTE 1, "IP1 MPC DIMENSION IS 156 15/16" (MAX.)."
[3] SHEET 3; ADD TO END OF NOTE 2, "IP1 MPC DIMENSION IS 144 15/16" (MAX.)."

Justification:
Editorial; There is no affect on transport license. Results from the approval of the shortened MPC enclosure vessel for Indian Point 1 under Holtec's dry storage CoC 72-1014 Amendment 4.

Revision 18 changes (ECOs 1021-96, 1022-75, 1023-54):
Licensing Drawing 3923, Revision 17:
[1] Sheet 1: Note 18: Delete note and replace with the text "Deleted."
[2] Sheet 3: Note 1: Delete Sentence beginning "IP1 MPC Dimension..."
[3] Sheet 3: Note 2: Delete Sentence beginning "IP1 MPC Dimension..."

Justification:
Editorial; There is no affect on transport license. These references to Indian Point 1 (IP1) specific dimensions are removed from the licensing drawing because the Indian Point design is not part of CoC 72-1014 Amendment 5.

Revision 19 changes (ECOs 1021-95, 1022-74, 1023-52):
[1] Sheet 5: Lower PWR fuel spacer assembly: Sector D7: Remove all around weld symbol from weld. Add 1" weld length to weld symbol and add "ON FOUR SIDES. OMIT CORNER RADIUS" to weld callout.

[2] Sheet 5: Lower PWR fuel spacer assembly: Sector C7: Add "TYP.(1" MIN. WELD LENGTH)" to the weld symbol.
[3] Sheet 5: Upper PWR fuel spacer assembly: Sector B7: Remove the all around weld symbol from weld. Add 1" weld length to weld symbol and add "FOUR PLACES" to the weld symbol. Remove the leader branch showing weld between the top plate and the bolt and add a separate 1/8" fillet weld between the top plate and the bolt to read "VT ALTERNATING HEX FACES (1/2" MIN. WELD LENGTH)".
[4] Sheet 5: Upper PWR fuel spacer assembly: Sector AB-7: Remove the all around weld symbol from weld. Add 1" weld length to weld symbol and add "FOUR PLACES" to the weld symbol.
[5] Sheet 5: Lower BWR fuel spacer assembly: Sector D3: Remove all around weld symbol from weld. Add 1" weld length to weld symbol and add "ON FOUR SIDES. OMIT CORNER RADIUS" to Weld.
[6] Sheet 5: Lower BWR fuel spacer assembly: Sector C3: Remove all around weld symbol from weld. Add "TYP.(1" MIN. WELD LENGTH)" to the weld symbol.
[7] Sheet 5: Upper BWR fuel spacer assembly: Sector B3: Remove the all around weld symbol from weld. Add 1" weld length to weld symbol and add "FOUR PLACES" to the weld symbol. Remove the leader branch showing weld between the top plate and the bolt and add a separate 1/8" fillet weld between the top plate and the bolt to read "VT ALTERNATING HEX FACES (1/2" MIN. WELD LENGTH)".
[8] Sheet 5: Add Note 3 reference to the Lower PWR Fuel Spacer Assembly caption. Add Note 3 to read "THE USE OF LOWER FUEL SPACER IS OPTIONAL FOR MPC-32. A LONGER UPPER FUEL SPACER MAY BE USED TO COMPENSATE FOR THE LENGTH AND TO ELIMINATE THE USE OF A LOWER FUEL SPACER".

Justification:
Minor; [1-7] The weld lengths and size for above described welds are reduced to minimize distortion. For the units certified for transportation, the governing load condition for the fuel spacers is the 60g vertical end drop. The fuel spacer welds must be capable of resisting the amplified self weight of the upper fuel spacer, which is bolted to the underside of MPC lid. The proposed weld lengths and size (four 1/8" x 1" long fillet welds) have a total capacity of 9,875 lb (= 4 in x 0.125 in x 0.7071 x 27,930 psi) under Hypothetical Accident Conditions. Therefore, the maximum weight of an upper fuel spacer that can be supported by the four welds under a 60g impact deceleration is 163 lb (= 9,875 lb / 60). Since the maximum weight of an upper fuel spacer is less than 100 lb, the welds have sufficient capacity to withstand the 60g impact deceleration. Since the lower fuel spacers rest freely on the MPC baseplate, the lower fuel spacer welds do not experience any significant tensile load during a top end drop. The compression loads on the lower fuel spacer are resisted by metal-to-metal contact between the upper plate, the spacer column, and the lower plate, as opposed to the fillet welds. Therefore, reducing the weld lengths and size will not have an adverse impact on the structural integrity of MPC units.
[8] Removal of the lower fuel spacers will be compensated (as appropriate) by longer upper fuel spacers. This reduces the number of components to be verified and simplifies the fuel loading operation resulting in potential reduction of dose (ALARA).

Revision 20 changes (ECOs 1021-99, 1022-78, 1023-57):
Sheet 4, Note 1, add the following text at the end of the note: "The bottom piece may be made either from stainless steel or carbon steel. For a carbon steel piece, all surfaces that may come in contact with spent fuel pool water shall be coated or covered with stainless steel."

Justification:
SAR Change; The bottom section of the MPC lid is used only for shielding purposes. The top portion of the lid which is welded to the MPC shell is part of the MPC enclosure vessel. SAR subsections 2.5.1.3, 2.6.1.3.1.2, and 5.3.1 have been updated to address the dual lid construction.

Revision 21 changes (ECO 5014-164):
Sheet 1, Revision Log, Rev 19 row: Add ECO-1022-74 Rev. 0 and ECO-1021-95 Rev. 0 to the "Summary of Changes/Affected ECOs" column.

Justification:
Editorial; Fixed Drawing Revision Log inconsistency

Revision 22 changes (ECOs 1021-100, 1022-79, 1023-58):
Add a sheet to show the OPTIONAL new design of lower PWR fuel spacer assembly and lower BWR fuel spacer assembly with the following details:
[1] In LOWER PWR FUEL SPACER ASSEMBLY include Lower Fuel Spacer Support I-Beam.
[2] In LOWER PWR FUEL SPACER ASSEMBLY include Lower Fuel Spacer Support Top Plate.
[3] In LOWER PWR FUEL SPACER ASSEMBLY, include assembly view with the updated I-beam Lower fuel spacer support and lower fuel spacer top plate.
[4] In LOWER BWR FUEL SPACER ASSEMBLY include Lower Fuel Spacer Support I-Beam with notch.
[5] In LOWER BWR FUEL SPACER ASSEMBLY include Lower Fuel Spacer Support Top Plate.
[6] In LOWER BWR FUEL SPACER ASSEMBLY, include assembly view with the updated I-beam Lower fuel spacer

Justification:
Minor; This design provides an optional design for ease of fabrication. The length of the fuel spacers do not change, therefore there is no effect on criticality. The space occupied by the optional new fuel spacers in the MPC is similar to the space occupied by the older fuel spacers without any effect on the thermal analysis. The clearance provided on the support beam serves as a substitute for the mouse holes in the older design. This allows free flow of the helium into the fuel assembly without any hindrance. Therefore it has no effect on thermal analysis. The optional fuel spacers have larger sectional areas and moments of inertia than the original design. Therefore, the original design is bounding and the optional design is structurally safe. Discussion is added to SAR Section 2.6.1.3.1.3.

Revision 23 changes (ECOs 1021-101):
Optional Lower BWR fuel spacer assembly: Added see Note 1 on this sheet. Added a new Note 1 to say, "The optional lower BWR fuel spacer design shall not be used in MPC cell locations to be loaded with Dresden Unit 1 fuel ".

Justification:
Editorial; Clarification on optional fuel spacer design was required.

Revision 24 changes (ECOs 1021-102, 1022-80, 1023-59):
Add new sheet 9 to detail MPC S/N 1021-173 lid lift holes per Supplier Manufacturing Deviation Report (SMDR) 1629.

Justification:
SAR change; The licensing drawing is updated to reflect the repaired lid however, the repair does not reduce the structural safety margins for lifting the MPC below the acceptable margins since the threaded plugs have a greater capacity against failure than the actual lifting holes.

Revision 25 changes (ECOs 1021-104, 1022-82, 1023-62):
[1] Sheet 5, Zone D6, Change Lower PWR Fuel Spacer Upper Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[2] Sheet 5, Zone C6, Change Lower PWR Fuel Spacer Lower Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[3] Sheet 5, Zone D2, Change Lower BWR Fuel Spacer Upper Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[4] Sheet 5, Zone C2, Change Lower BWR Fuel Spacer Lower Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[5] Sheet 5, Zone B5, Change Upper PWR Fuel Spacer Upper Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[6] Sheet 5, Zone B2, Change Upper BWR Fuel Spacer Upper Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.
[7] Sheet 5, Zone A6, Change Upper PWR Fuel Spacer Lower Plate thickness from 3/4"THK (Min.) to 3/4" THK.
[8] Sheet 8, Zone D7, Change Optional Lower BWR Fuel Spacer Top Plate thickness from 1/4"THK (Max.) to 3/8" THK OR 1/4" THK.
[9] Sheet 8, Zone D2, Change Optional Lower PWR Fuel Spacer Top Plate thickness from 3/8"THK (Max.) to 3/8" THK OR 1/4" THK.

Justification:
Minor; The change was made to provide an upper and lower bound value for the thickness of the plates. Per Note 15 on the drawing, the tolerances for thickness of ASME code MPC Enclosure vessel material are specified in ASME Section II and hence are not required to be specified on the drawing. Also, the thickness dimension provided on the drawing for upper plate and the lower plate on the upper and lower PWR/BWR fuel spacer assembly is not a critical value since they are not credited for any load in the structural analysis of the fuel spacers.

DRAWING 3925 MPC-24E/EF FUEL BASKET ASSEMBLY

Revision 5 - Approved for Transport in CoC 9261 Revision 7

Revision 6 changes (ECO 1022-68):

a. Sheet 2, Note 1 and 2: Specified 155-7/8" as a minimum for the length of the neutron absorber.
b. Sheet 2, Basket Elevation View: Added a dimension for the radius of the mouseholes. The dimension shall be typical for the top and bottom of the basket and the tolerance shall be +/- 1/2".
c. Sheet 3, Coordinate D3: Removed "Nom." from the 10.85 +/- .25 dimension.
d. Sheet 4, Wide and Thin Shim: Replaced the tolerance on the height with "Nom".

Justification:

a. **Minor**; Ensures alignment of the active fuel region with the neutron absorber region during fabrication as assumed in the criticality analysis.
b. **Editorial**; this dimension was inadvertently omitted from previous drawing revisions.
c. **Editorial**; this dimension is inspected and verified during the fabrication process.
d. **Editorial**; the heights of the shims are shown in the licensing drawings for information and are appropriately labeled Nom.

Revision 7 changes (ECO 1022-67):

a. Sheet 1, Note 11: Addition of "Both Boral and Metamic are approved for use as a neutron absorber"
b. Sheet 1, Note 11: Replaced "Boral" with "neutron absorber" in three instances.
c. Sheet 2: Addition of Note 7 "Metamic to be 0.106" (Nom.) THK. X 7 ½" Wide MIN. x 155 7/8" MIN. (156" Nom.) Lg. The minimum Metamic ^{10}B loading is 0.0310 g/cm^2 with a minimum B_4C loading 31.5% and maximum 33%. Metamic is not required to be passivated. Sheathing 0.06" (Nom.) THK."
d. Sheet 2: Addition of Note 8 "Metamic to be 0.106" (Nom.) THK. X 6 ¼" Wide MIN. x 155 7/8" MIN. (156" Nom.) Lg. The minimum Metamic ^{10}B loading is 0.0310 g/cm^2 with a minimum B_4C loading 31.5% and maximum 33%. Metamic is not required to be passivated. Sheathing 0.06" (Nom.) THK."
e. Sheet 2, Coordinates C8, B8, and A3: Replaced three instances of "Boral" with "neutron absorber"
f. Sheet 3, Note 4: Replaced two instances of "Boral" with "neutron absorber"
g. Sheet 3, Coordinate C7: Replaced two instances of "Boral" with "neutron absorber" in the Minimum Weld Length dimensions.
h. Sheet 1, Note 19: "Neutron absorber panels may be a single piece or two pieces as long as the total length indicated is maintained and the gap between the panels is maintained at less than ¼"."
i. Sheet 1, Note 20: "Neutron absorber panels may have a reduction in width of up to 1/32" over a length of no more than 12" provided the average width of the panel is no less than the minimum specified."

Justification:

a. thru g. **SAR Change**; the drawing is changed where necessary so that either Boral or Metamic may be used as a neutron absorber. See Attachment 1, Proposed Change No. 4

h. & i. **SAR Change**; the change provides flexibility during manufacturing. Criticality analysis shows this is acceptable (see Attachment 1, Proposed Change No. 5). Note that Note 19 on Sheet 1 is deleted from revision 9 of the licensing drawing since it is not needed (see below).

Revision 8 changes (ECO 1022-76):
[1] Sheet 3: Sector C7: Delete the MINIMUM WELD LENGTH table. Change the Weld note to read MIN. WELD LENGTH REQUIRED FOR EACH WELD AT TOP & BOTTOM SHEATHING TO CELL WALL IS 3-3/4".
[2] Sheet 3: Detail F: Add "OR GROOVE" to the weld symbol.

Justification:
Minor; [1] Weld length table was deleted and weld note was revised because the weld length requirement was not driven by any calculation. However, a calculation for minimum sheathing panel weld length considering bounding weights of the MPC sheathing panels during the design basis 60g drop was performed (See Attachment: Supplement #53 of HI-2012787) and it was determined that to hold the neutron absorber in position the required minimum weld length would be 3.735" for MPC-24. Therefore, the minimum required weld length per the calculation is 3-3/4" which is the nearest rounding fraction to 3.735".
[2] Groove weld is added as an option to allow flexibility in welding process. Since a groove weld is a stronger weld compared to a fillet weld there is no adverse impact on the structural function of the unit.

Revision 9 changes (ECO 1022-81):
Sheet 1, General Notes: Delete Note 19.

Justification:
Editorial; Note 19 allowed for neutron absorber panels to be made up of two panels with a maximum gap between panels of 1/4". The 2-piece panel option is removed from the design. No MPC canisters have been built utilizing this option, therefore there is no effect on previously built units.

DRAWING 3926 MPC-24 FUEL BASKET ASSEMBLY

Revision 5 - Approved for Transport in CoC 9261 Revision 7

Revision 6 changes (ECO 1022-58):

a. Sheet 2, Coordinate C8: Deleted "Boral" and added "& Note 4"
b. Sheet 2, Coordinate B8: Deleted "Boral" and added "& Note 5"
c. Sheet 3, Coordinate C7: Replaced "Boral" with "neutron absorber"
d. Sheet 1, General Note 10: Addition of "Both Boral and Metamic are approved for use as a neutron absorber"; Replaced "Boral" with "neutron absorber" in two instances.
e. Sheet 2: Addition of note 4: "Metamic to be 0.106" (Nom.) THK. X 7 ½" Wide MIN. x 155 7/8" MIN. (156" Nom.) Lg. The minimum Metamic ^{10}B loading is 0.0310 g/cm^2 with a minimum B_4C loading 31.5% and maximum 33%. Metamic is not required to be passivated. Sheathing 0.06" (Nom.) THK."
f. Sheet 2: Addition of note 5: "Metamic to be 0.106" (Nom.) THK. X 6 ¼" Wide MIN. x 155 7/8" MIN. (156" Nom.) Lg. The minimum Metamic ^{10}B loading is 0.0310 g/cm^2 with a minimum B_4C loading 31.5% and maximum 33%. Metamic is not required to be passivated. Sheathing 0.06" (Nom.) THK."
g. Sheet 3, Note 2: Replaced two instances of "Boral" with "neutron absorber"

Justification:

a. - g. **SAR Change**; the drawing is changed where necessary so that either Boral or Metamic may be used as a neutron absorber. See Attachment 1, Proposed Change No. 4.

Revision 7 changes (ECO 1022-59):

a. Sheet 2, Note 4 & 5: Change thickness callout from 0.075" to 0.077".
b. Sheet1, Note 10: Replace the word Boral and with neutron absorber in the statement "Boral damage of up to…".

Justification:

a. & b. **SAR Change**; the drawing is changed where necessary so that either Boral or Metamic may be used as a neutron absorber. See Attachment 1, Proposed Change No. 4.

Revision 8 changes (ECO 1022-68):

a. Sheet 2, Note 1 and 2: Specifying a minimum length for the neutron absorber of 155 7/8 inches
b. Sheet 4, Wide and Thin Shim: Replaced the tolerance on the height with "Nom".

Justification:

a. **Minor**; ensures alignment of the active fuel region with the neutron absorber region during fabrication as assumed in the criticality analysis.
b. **Editorial**; the heights of the shims are shown in the licensing drawings for information and are appropriately labeled Nom.

Revision 9 changes (ECO 1022-67):

a. Sheet 1, Note 19: "Neutron absorber panels may be a single piece or two pieces as long as the total length indicated is maintained and the gap between the panels is maintained at less than ¼"."
b. Sheet 1, Note 20: "Neutron absorber panels may have a reduction in width of up to 1/32" over a length of no more than 12" provided the average width of the panel is no less than the minimum specified."

Justification:

a. & b. **SAR Change**; the change provides flexibility during manufacturing. Criticality analysis shows this is acceptable (see Attachment 1, Proposed Change No. 5). Note that Note 19 on Sheet 1 is deleted from revision 11 of the licensing drawing since it is not needed (see below).

Revision 10 changes (ECO 1022-76):

[1] Sheet 3: Sector C7: Delete the MINIMUM WELD LENGTH table. Change the Weld note to read MIN. WELD LENGTH REQUIRED FOR EACH WELD AT TOP & BOTTOM SHEATHING TO CELL WALL IS 3-3/4".
[2] Sheet 3: Detail F: Add "OR GROOVE" to the weld symbol.

Justification:

Minor; [1] Weld length table was deleted and weld note was revised because the weld length requirement was not driven by any calculation. However, a calculation for minimum sheathing panel weld length considering bounding weights of the MPC sheathing panels during the design basis 60g drop was performed (See Attachment: Supplement #53 of HI-2012787) and it was determined that to hold the neutron absorber in position the required minimum weld length would be 3.735" for MPC-24. Therefore, the minimum required weld length per the calculation is 3-3/4" which is the nearest rounding fraction to 3.735".
[2] Groove weld is added as an option to allow flexibility in welding process. Since a groove weld is a stronger weld compared to a fillet weld there is no adverse impact on the structural function of the unit.

Revision 11 changes (ECO 1022-81):

Sheet 1, General Notes: Delete Note 19.

Justification:

Editorial; Note 19 allowed for neutron absorber panels to be made up of two panels with a maximum gap between panels of 1/4". The 2-piece panel option is removed from the design. No MPC canisters have been built utilizing this option, therefore there is no effect on previously built units.

DRAWING 3927 MPC-32 FUEL BASKET ASSEMBLY

Revision 6 Approved for Transport in CoC 9261 Revision 7.

Revision 7 changes (ECO 1023-33):

a. Sheet 1: Add sheet 5 and change title on sheet 4 under package contents.
b. Sheet 2, cross sectional view of MPC-32: Replace v-channel angled supports with basket support plates.
c. Sheet 4: Label page "standard construction".
d. Sheet 4, detail d,e: Revise to show basket supports that consist of two parallel plates welded onto the mpc inner shell. Fillet welds connecting the plates to the mpc shell shall be full length and have 1/8" dimension. Shim and support block are positioned in between plates and welded in place. Fillet welds shall be full length, 5/32" dimension, and are located between inside edge of shim and outside edge of plates. Show that VT is required for fillet welds. Tack weld is located between inside edge of plates and block support to read " optional quantity, size, and weld location for support block to be determined by fabricator". Show item details for basket plate support (a), (b), (c) and shim. Basket support plate (c) dimensions are 1/4" thk x 3 5/8" nom x 168 1/2" nom. Basket support plate (b) dimensions are 1/4" thk x 4" nom x 168 1/2" nom. Basket support plate (a) dimensions are 1/4" thk x 5" nom x 168 1/2" nom. Shim dimensions are as reqd thk x 1" nom x 168 1/2" nom. Move v-channel angled supports to sheet 5 and label "optional construction." Change label of detail e to detail g and 5/32 weld location to be between c-channel and shim. Move angle support (b), angle aupport (a), and shim assembly to sheet 5.
e. Sheet 4: Change inner shell to basket support plate (a) shim dimension from 5.2" to 5.4". Change inner shell to basket support plate(c) shim from 3.6" to 3.9".

Justification:

a. thru d. **Minor**; These changes are designed to update the current licensing drawing in order to incorporate an additional basket support design. The original design is maintained. The additional design provides the same level of basket support as the original design as discussed in SAR Section 2.6.1.3.1.1.

e. **Minor**; This change is due to the change in geometry of the fuel basket supports. In previous drawing revisions there exists a 1/4" clearance between the fuel basket and shim. By making this change, the governing dimension between the shim and fuel basket in drawing 3753 remains the same.

Revision 8 changes (ECO 1023-31):

a. Sheet 2, C8: Delete "Boral". Add "Note 3".
b. Sheet 2, Notes: Add Note 3 to read "Metamic may be used as an alternative to Boral following final NRC approval of CoC 1014 Amendment #2. Metamic to be 0.101" (Nom) THK X 7 1/2" WIDE MIN X 155 7/8" MIN (156" Nom) LG. The minimum Metamic ^{10}B loading is 0.0310 g/cm^2, with a minimum B_4C loading of 31.5% and maximum of 33%. Metamic is not required to be passivated. Sheathing 0.035" THK".
c. Sheet 3, D3: Replace "Boral" with "Neutron absorber" (2 places).
d. Sheet 1, General Note 10: Replace "Boral" with "Neutron absorber".

Justification:

a. thru d. See justification for ECO 1023-43 (a. thru c). below

Revision 9 changes (ECO 1023-32):

a. Sheet 2, Note 3: Change thickness call out on Metamic to 0.106"
b. Sheet 1, Note 10: replace "Boral" with "neutron absorber"

Justification:

a. & b. See justification for ECO 1023-43 (a. thru c.) below

Revision 10 changes (ECO 1023-45):

a. Sheet 2, Note 1: Specified a minimum length for the neutron absorber

Justification:

a. **Minor**; ensures alignment of the active fuel region with the neutron absorber region as assumed in the criticality analysis during fabrication.

Revision 11 changes (ECO 1023-46):

a. Sheet 4, Detail D & E: For the 1/8" fillet weld between the support plates and the MPC shell, specified a 1-8 stitch pattern.
b. Sheet 4, Detail D & E: Indicated that the support block is optional

Justification:

a. **Minor**; this change is made to be consistent with the MPC-68 design, which specifies a 1-8" stitch pattern for the weld between the MPC shell and the fuel basket support plates.
b. **Editorial**; these changes are made to show how the fuel basket supports are actually assembled and to keep the drawing consistent with the delivered product. Use of the blocks (Item 29) is currently optional and is determined by the fabricator. Because the fabricator elects not to utilize the blocks, they are deleted. The associated tack welds are also deleted.

Revision 12 changes (ECO 1023-43):

a. Sheet 1, Note 10: Add to beginning "Both Boral and Metamic are approved for use as neutron absorbers"
b. Sheet 2, Note 3: Delete the words "Metamic may be used as an alternative to Boral following final NRC approval of CoC 1014 Amendment #2."
c. Sheet 2, Basket Elevation View, Coordinate A3: Change "Boral" to "neutron absorber"
d. Sheet 1, Note 18: "Neutron absorber panels may be a single piece or two pieces as long as the total length indicated is maintained and the gap between the panels is maintained at less than ¼"."
e. Sheet 1, Note 19: "Neutron absorber panels may have a reduction in width of up to 1/32" over a length of no more than 12" provided the average width of the panel is no less than the minimum specified."

Justification:

a. thru c. **SAR Change**; this justification encompasses all of the changes that were made to the drawings to reflect the NRC approval of the use of Metamic as a neutron absorber in Amendment #2 to CoC 1014. Non-specific references to Boral were changed to "neutron absorber" and additional notes were added to specify dimensions for Metamic. See Attachment 1, Proposed Change No. 4.

d. & e. **SAR Change**; the change provides flexibility during manufacturing. Criticality analysis shows this is acceptable (see Attachment 1, Proposed Change No. 5). Note that Note 18 on Sheet 1 is deleted from revision 16 of the licensing drawing since it is not needed (see below).

Revision 13 changes (ECO 1023-50):

[1] SHEET 1; ADD GENERAL NOTE 20 TO READ, "DIFFERENCES BETWEEN THE GENERIC MPC-32 AND THE IP1 MPC-32 ARE SPECIFICALLY NOTED (FOR PART 72 USE ONLY"
[2] SHEET 2; BASKET ELEVATION VIEW, UNDER DIMENSION MARKED 176 1/2" +/- 1/4" ADD, "(SEE NOTE 4)"
[3] SHEET 2; NOTE 1, ADD TO END OF NOTE, "THE LENGTH OF THE BORAL FOR THE IP1 BASKET IS 136" (NOM.) (135 7/8" MIN.)"
[4] SHEET 2; NOTE 3, ADD TO END OF NOTE, "THE LENGTH OF THE METAMIC FOR THE IP1 BASKET IS 136" (NOM.) (135 7/8" MIN.)"
[5] SHEET 2; ADD NOTE 4 TO READ, "THE IP1 BASKET DIMENSION IS 143 1/8" +/- 1/4"."
[6] SHEET 4; ADD NOTE 2 TO READ, "THE IP1 BASKET SUPPORT DIMENSION IS 135 1/8" (NOM.)"
[7] SHEET 4; TO BASKET SUPPORT PLATE A, B, AND C AND THE SHIM LENGTH DIMENSION (4 PLACES) ADD, "(SEE NOTE 2)"
[8] SHEET 5; TO ANGLE SUPPORT A AND B AND THE SHIM ASSEMBLY (4 PLACES) ADD, "(SEE NOTE 2)"
[9] SHEET 5; ADD NOTE 2 TO READ, "THE IP1 BASKET SUPPORT DIMENSION IS 135 1/8" (NOM.)"

Justification:

Editorial; There is no affect on the transport license. Theses changes were implemented on the drawing upon approval of Amendment #4 to Certificate Compliance 72-1014 which added the Indian Point 1 equipment to the HI-STORM 100 storage system.

Revision 14 changes (ECO 1023-54):

[1] Sheet 1: Note 20: Delete note and replace with the text "Deleted."
[2] Sheet 2: Basket Elevation View: Delete ""(See Note 4)" from the height dimension.
[3] Sheet 2: Note 1: Delete sentence beginning - "The length of the Boral for the IP1 Basket is..."
[4] Sheet 2: Note 3: Delete sentence beginning - "The length of Metamic for the IP1 Basket is..."
[5] Sheet 2: Note 4: Delete note and replace with the text "Deleted."
[6] Sheet 4: Note 2: Delete note and replace with the text "Deleted."

[7] Sheet 4: Basket Support Plate (C): Delete "(See Note 2)" from the dimension.
[8] Sheet 4: Basket Support Plate (B): Delete "(See Note 2)" from the dimension.
[9] Sheet 4: Basket Support Plate (A): Delete "(See Note 2)" from the dimension.
[10] Sheet 4: Shim: Delete "(See Note 2)" from the dimension.
[11] Sheet 5: Angle Support (B): Delete "(See Note 2)" from the dimension.
[12] Sheet 5: Angle Support (A): Delete "(See Note 2)" from the dimension.
[13] Sheet 5: Shim Assembly: Delete "(See Note 2)" from both the dimensions.
[14] Sheet 5: Note 2: Delete note and replace with the text "Deleted."

Justification:
Editorial; There is no affect on transport license. These references to Indian Point 1 (IP1) specific dimensions are removed from the licensing drawing because the Indian Point design is not part of CoC 72-1014 Amendment 5.

Revision 15 changes (ECO 1023-55):
Sheet 3: Sector D3: Change the Weld note to read MINIMUM WELD LENGTH REQUIRED FOR EACH WELD AT TOP AND BOTTOM SHEATHING TO CELL WALL IS 4-13/16".

Justification:
Minor; The Weld was revised because 6.5" weld length requirement was not driven by any calculation. However, a calculation for minimum sheathing panel weld length considering bounding weights of the MPC sheathing panels during the design basis 60g drop was performed (See Attachment: Supplement #53 of HI-2012787) and it was determined that to hold the neutron absorber in position the required minimum weld length would be 4.76" for MPC-32. Therefore, the minimum required weld length per the calculation is 4-13/16" which is the nearest rounding fraction to 4.76".

Revision 16 changes (ECO 1023-60):
Sheet 1, General Notes: Delete Note 18.

Justification:
Editorial; Note 18 allowed for neutron absorber panels to be made up of two panels with a maximum gap between panels of 1/4". The 2-piece panel option is removed from the design. No MPC canisters have been built utilizing this option; therefore there is no effect on previously built units.

DRAWING 3928 MPC-68/68F/68FF FUEL BASKET

Revision 5 - Approved for Transport in CoC 9261 Revision 7

Revision 6 changes (ECO 1021-64):

a. Sheet 2, plan view: Replace v-channel angled supports with parallel flat plate supports.
b. Sheet 4: Change "cross sectional view of MPC-68 basket support structure (new design)" to "cross sectional view of MPC-68 basket support structure (standard construction)".
c. Sheet 4, detail c: Revise to show plate basket support that consists of two parallel plates welded onto the MPC inner shell. Fillet welds shall be intermittent (1-8), 1/8 dimension, and are located between MPC inner shell and outside edge of plates. Shim assembly and block support are positioned in between plates and welded in place. Fillet welds shall be full length, 5/32 dimension, and are located between inside edge of shim assembly and outside edge of flat plates. Show that VT is required for the fillet welds. Tack weld is located between inside edge of plates and block support to read "optional quantity and weld location for support block to be determined by fabricator".
d. Sheet 4: Move angle basket support and detail c to right side of vertical dividing line. Change "detail c (typ of 8)" to "detail c (typ of 8) (optional design)".
e. Sheet 4: Change "cross sectional view of mpc-68 basket support structure (old design)" to "cross sectional view of MPC-68 basket support structure (optional construction)".
f. Sheet 4, note 4: Change "basket support-to-basket support dimensions are common to the new and old designs" to "basket support-to-basket support dimensions are common to the standard construction and optional construction".

Justification:

a. thru f. **Minor**; These changes are designed to update the current licensing drawing in order to incorporate an additional basket support design. The original design is maintained. The additional design provides the same level of basket support as the original design.

Revision 7 changes (ECO 1021-62):

a. Sheet 2, B8: Delete "Boral". Add "and Note 6".
b. Sheet 2, Notes: Add Note 6 to read, "Metamic may be used as an alternative to Boral following final NRC approval of CoC 1014 Amendment #2. Metamic to be 0.101" (Nom) THK X 4.75 wide MIN X 155 7/8" MIN (156" Nom) LG. For MPC-68 the minimum Metamic B10 loading is 0.0310 g/cm^2 with a minimum B_4C loading of 31.5% and maximum OF 33%. Metamic is not required to be passivated".
c. Sheet 3, D2: Replace "Boral" With "neutron absorber".
d. Sheet 3, C2: Replace "Boral" with "neutron absorber".
e. Sheet 1, General Note 10: Replace "Boral" with "neutron absorber".

Justification:

a. thru e. See justification for ECO 1021-78 (a. thru c.) below.

Revision 8 changes (ECO 1021-63):

c. Sheet 2, Note 6: Change thickness call out on Metamic to 0.106"
d. Sheet 1, Note 10: replace "Boral" with "neutron absorber"

Justification:

a. & b. See justification for ECO 1021-78 (a. thru c.) below.

Revision 9 changes (ECO 1021-80):

a. Sheet 2, Note 1: Specified a minimum length for the neutron absorber
b. Sheet 4, Wide and Thin Shim: Replaced the tolerance on the height with "Nom".

Justification:

a. **Minor**; ensures alignment of the active fuel region with the neutron absorber region as assumed in the criticality analysis during fabrication.
b. **Editorial**; the heights of the shims are shown in the licensing drawings for information and are appropriately labeled Nom.

Revision 10 changes (ECO 1021-78):

a. Sheet 1, Note 10: Add to beginning "Both Boral and Metamic are approved for use as neutron absorbers"
b. Sheet 2, Note 6: Delete the words "Metamic may be used as an alternative to Boral following final NRC approval of CoC 1014 Amendment #2."; Add to end "Sheathing 0.075" (NOM.) THK."
c. Sheet 2, Basket Elevation View, Coordinate A3: Change "Boral" to "neutron absorber"
d. Sheet 1, Note 18: "Neutron absorber panels may be a single piece or two pieces as long as the total length indicated is maintained and the gap between the panels is maintained at less than ¼"."
e. Sheet 1, Note 19: "Neutron absorber panels may have a reduction in width of up to 1/32" over a length of no more than 12" provided the average width of the panel is no less than the minimum specified."

Justification:

a. thru c. **SAR Change**; this justification encompasses all of the changes that were made to the drawings to reflect the use of Metamic as a neutron absorber. Non-specific references to Boral were changed to "neutron absorber" and additional notes were added to specify dimensions for Metamic. See Attachment 1, Proposed Change No. 4.

d. & e. **Minor**; this change provides flexibility during manufacturing. Criticality analysis shows this is acceptable (see Attachment 1, Proposed Change No. 5). Note that Note 18 on Sheet 1 is deleted from revision 14 of the licensing drawing since it is not needed (see below).

Revision 11 changes (ECO 1021-89):
Sheet 4, Detail Shim-to-Shim or Support-to-Support Weld: Restored the weld size to 1/16" from 1/8".

Justification:
Editorial; The weld size was inadvertently increased to 1/8" between previous drawing revisions (Revisions 5 and 6), even though the applicable ECO did not create that change. The weld size was never intended to be increased and is being restored back to 1/16".

Revision 12 changes (ECO 1021-97):
[1] Sheet 2: Sector D4: Change the Weld note to read MINIMUM WELD LENGTH REQUIRED FOR EACH WELD AT TOP AND BOTTOM SHEATHING TO CELL WALL IS 3-5/16".
[2] Sheet 3: Sector D4: Change dimensions 13.73 to 13.23, 39.69 to 39.19, 52.67 to 52.17 and 65.65 to 65.15.

Justification:
[1] Minor; The revised weld length of 3-5/16" is acceptable since none of the calculations are effected by this change. However, a calculation for minimum sheathing panel weld length, considering bounding weights of the MPC sheathing panels during the design basis 60g drop was performed (See Attachment: Supplement #53 of HI-2012787). It was determined that to hold the neutron absorber in position the required minimum weld length would be 3.297" for MPC-68. Therefore, the minimum required weld length per the calculation is 3-5/16" which is the nearest rounding fraction to 3.297".
[2] Editorial; The forced dimensions in SolidWorks model are changed to actual (true/realistic) solid model dimensions.

Revision 13 changes (ECO 1021-102):
Sheet 2, Notes: Add new note 7 to read, "MPC-68 Serial #1021-172 includes a one-time deviation to a cell panel. The cell panel includes a 1 5/16" diameter hole located 3" from the bottom of the basket, which will have a negligible impact on the design basis analyses (SMDR-1021-1623)."

Justification:
Minor; During welding of this basket the forward motion of the welding machine stopped, but the arc and weld wire continued. A hole measuring 1-1/4" x 3/4" located 3" from the bottom of the basket along with a quantity of solidified metal on both sides of the hole was located between Cell 11 and Cell 12, welds 18.11.4 and 18.12.3 respectively. The defect in the cell plate was eliminated by drilling a 1-5/16" maximum diameter hole over the damaged area. The 1-5/16" diameter hole is equal in size to the handling holes on the fuel basket near the top of the basket. These small holes produce local stress concentrations, which are not analyzed in the structural analysis of the fuel basket since there is no secondary stress limit under Level D conditions per Subsection NG of the ASME Code; therefore, there is no significant effect on the structural integrity of the basket. The hole will be away from the high-source zone and will be too small to have any noticeable effect on the thermal or shielding performance of the basket. The hole will not penetrate any Metamic neutron absorber panels and therefore will have a negligible effect on criticality.

Revision 14 changes (ECO 1021-103):
Sheet 1, General Notes: Delete Note 18.

Justification:
Editorial; Note 18 allowed for neutron absorber panels to be made up of two panels with a maximum gap between panels of 1/4". The 2-piece panel option is removed from the design. No MPC canisters have been built utilizing this option; therefore there is no effect on previously built units.

DRAWING 3930 HI-STAR 100 ASSEMBLY FOR TRANSPORT

No Proposed Changes

DRAWING 5014-C1765 HI-STAR IMPACT LIMITER

Sheet 1 of 7 (E.I.D. 4420) Rev. 4 - Approved for Transport in CoC 9261 Revision 7

Revision 5 changes (ECO 5014-176):
[1] BOM - Change material description from ALUMINUM HONEYCOMB to ALUMINUM CRUSH MATERIAL. Items 1, 13, 23, and 27.
[2] BOM Change description from 1/8 THK. To 11 GA. Items 3, 4, 5, 19, 24, 25, and 26.
[3] Note 1 - Change note to read REQUIRED CRUSH PROPERTIES AND ORIENTATION OF PRINCIPAL CRUSH AXES FOR ALUMINUM CRUSH MATERIAL IS DEFINED IN SAR TABLE 2.3.7. THE CRUSH STRENGTH AND ORIENTATION OF PRINCIPAL CRUSH AXES LISTED IN THE TABLE ARE HEREBY INCORPORATED BY REFERENCE INTO THE COC.
[4] Note 8 - Delete table and change note to read WELD JOINT CONFIGURATIONS SHOWN ARE REPRESENTATIVE. ALTERNATE WELD JOINT CONFIGURATIONS WITH EQUAL OR GREATER STRENGTH MAY BE SUBSTITUTED.
[5] Note 6 - Relocated the percent sign for B4C to before NOM.
[6] Deleted path in the filename listed on the sheet

Justification:
[1] **Editorial;** Changed to a more generic reference to allow impact material choices from a variety of sources.
[2] **Minor;** Plate material is not readily available as 1/8 inch thick. 11 Gauge is 0.120 inch thick.
[3,4] **SAR change;** Crush material properties are being moved to a table in the SAR to allow for use of a generic drawing and customization of material properties to different cask loads. See Attachment 1 Proposed Change 3.
[6] **Editorial**

Sheet 2 of 7 (E.I.D. 4421) Rev. 3 – Approved for Transport in CoC 9261 Revision 7

Revision 4 changes (ECO 5014-176):
[1] Note 2- Change ALUMINUM HONEYCOMB to ALUMINUM CRUSH MATERIAL.
[2] Deleted path in the filename listed on the sheet

Justification:
[1] **Editorial;** Changed to a more generic reference to allow impact material choices from a variety of sources.
[2] **Editorial**

Sheet 3 of 7 (E.I.D. 4798) Rev. 4 – Approved for Transport in CoC 9261 Revision 7

Revision 5 changes (ECO 5014-176):
[1] Delete Notes 3 and 4.
[2] Section A-A- Change all TYPE 5 material callouts to TYPE 2, 6 places.
[3] Deleted path in the filename listed on the sheet

Justification:
[1] **SAR change;** Crush material properties are being moved to a table in the SAR to allow for use of a generic drawing and customization of material properties to different cask loads. See Attachment 1 Proposed Change 3
[2] **SAR Change;** Type 5 material is eliminated by analysis. Single Type 2 material will be used. See Attachment 1 Proposed Change 3
[3] **Editorial**

Sheet 4 of 7 (E.I.D. 4422) Rev. 4 – Approved for Transport in CoC 9261 Revision 7

Revision 5 changes (ECO 5014-176):
[1] Section B-B- Change all ALUMINUM SECTION TYPE 2 and 5 to ALUMINUM SECTION TYPE 2. 2 places.
[2] Note 2- Change ALUMINUM HONEYCOMB to ALUMINUM CRUSH MATERIAL.
[3] Deleted path in the filename listed on the sheet

Justification:
[1] **SAR Change;** Type 5 material is eliminated by analysis. Single Type 2 material will be used. See Attachment 1 Proposed Change 3.
[2] **Editorial;** Changed to a more generic reference to allow impact material choices from a variety of sources.
[3] **Editorial**

Sheet 6 of 7 (E.I.D. 5372) Rev. 3 – Approved for Transport in CoC 9261 Revision 7

Revision 4 changes (ECO 5014-176)

[1] Section Type 1- Delete crush strength and core type information. Identify outer section as ZONE A and inner section as ZONE B, 2 places.
[2] Section Type 2- Delete crush strength and core type information.
[3] Section Type 3- Delete crush strength and core type information.
[4] Section Type 4- Delete crush strength and core type information. Identify the top section as ZONE A and the bottom section as ZONE B. Delete Detail A. Add T2 crush orientation symbol in radial direction.
[5] Delete Section Type 5 information.
[6] Note 2- Delete Note
[7] Note 3- Change note to read PRECRUSH REQUIRED ONLY FOR CRUSH MATERIALS HAVING A HIGH INITIAL PEAK FORCE. MATERIALS WHICH EXHIBIT NO SIGNIFICANT INCREASE IN INITIAL CRUSH STRENGTH DO NOT REQUIRE PRECRUSH. FOR CRUSH MATERIALS EXHIBITING A SIGNIFICANT INITIAL CRUSH STRENGTH, PRECRUSH IS ONLY REQUIRED WHERE INDICATED.
[8] Note 4- Change note to read SEPTUMS ARE REQUIRED BETWEEN CRUSH ZONES WHERE THE CRUSH STRENGTH IS DIFFERENT BETWEEN ZONES. NO SEPTUM IS REQUIRED BETWEEN CRUSH MATERIALS HAVING THE SAME NOMINAL CRUSH STRENGTH.
[9] Note 5 - Delete Note.
[10] Deleted path in the filename listed on the sheet

Justification:
[1,2,3,4,6,7,8,9] **SAR change;** Crush material properties are being moved to a table in the SAR to allow for use of a generic drawing and customization of material properties to different cask loads. See Attachment 1 Proposed Change 3.
[5] **SAR Change;** Type 5 material is eliminated by analysis. Single Type 2 material will be used. See Attachment 1 Proposed Change 3.
[10] **Editorial**

DRAWING 4082 HI-STAR HB OVERPACK

Revision 3 - Approved for Transport in CoC 9261 Revision 7

Revision 4 changes (ECO 1125-15):
Sheet 5: View D-D: Replace the cut out configuration of the rim of the top flange near trunion by machined flat surfaces.

Justification:
Minor; Change implemented for the ease of machining. The structural integrity of the top flange is actually improved, since there is a smaller reduction in material in the area around the trunnions. Therefore, the existing structural qualification of the top flange remains bounding. There is no adverse impact in operation.

Revision 5 changes (ECO 1125-20):

Sheet 2: Detail A and Detail B: Add "WHERE POSSIBLE" on the 3/8" all around weld between the fourth intermediate shell and the top flange.

Justification:
Minor; Per ECO-1125-15 a design change was made to machine the flats around the HI-STAR lifting trunnions. Because of this design change the weld that is applied between Item 11 and 19 is no longer an all around weld. The change in the 3/8" weld callout is a clarification made to improve the understanding of the design intent for the 4th intermediate shell to top flange welds on the drawing. There is no change to the fabricated weld length or size; therefore the welds remain as analyzed.

Revision 6 changes (ECO 1125-28):
[1] Sheet 2, Elevation View: Add "See Note 3" to the impact limiter alignment hole callout.
[2] Sheet 2, Notes: Add new note 3 to read, "HI-STAR HB Serial #1020-08 includes a one-time deviation to an impact limiter alignment hole, which will have a negligible impact on the design basis analyses (SMDR-1125-1586)."
[3] Sheet 2, Elevation View: Add "See Note 4" to the impact limiter attachment hole callout.
[4] Sheet 2, Notes: Add new note 4 to read, "HI-STAR HB Serial #1020-010 includes a one-time deviation to an impact limiter attachment hole, which will have a negligible impact on the design basis analyses (SMDR-1125-1684)."
[5] Sheet 3, Top Flange Detail: Add "See Note 1" to the closure bolt hole callout.
[6] Sheet 3: Add note 1 to read, "HI-STAR HB Serial #1020-012 includes a one-time deviation to useable thread length on closure lid bolt holes. The deviation will have negligible impact on the design basis analyses. See SMDR-1125-1783 for evaluation."
[7] Sheet 4, Section F-F: Add "See Note 1, Sht 3" to the closure bolt hole callout.
[8] Sheet 7, Closure Plate Test Port Detail: Add "See Note 1".
[9] Sheet 7, Add note 1 to read, "HI-STAR HB Serial #1020-09 and #1020-011 include a one-time deviation to the closure plate test port, which will have a negligible impact on the design basis analyses. See SMDR-1125-1746."

Justification:
[1,2] Minor; HI-STAR HB Serial #1020-08: The structural integrity of the impact limiter alignment hole remains unchanged since the threaded plug will actually have a greater capacity against failure than the actual hole. The plug has been fabricated from the same material as the bottom forging and the threaded plug has a larger diameter and equivalent depth as the impact limiter alignment hole. Also, the ¼" groove weld between the plug and the bottom forging is sufficiently sized to withstand any torque that may be experienced during impact limiter installation. Stresses in the bottom forging due to reduced local thickness after repairing the alignment hole remain negligibly small under the design pressure load.

[3,4] Minor; HI-STAR HB Serial #1020-010: The structural integrity of the impact limiter attachment hole remains unchanged since the threaded plug will actually have a greater capacity against failure than the actual hole. The plug has been fabricated from the same material as the bottom forging and the threaded plug has a larger diameter and equivalent depth as the impact limiter attachment hole. Also, the ¼" groove weld between the plug and the bottom forging is sufficiently sized to withstand any torque that may be experienced during installation of the impact limiter.

Stresses in the bottom forging due to reduced local thickness after repairing the damaged hole remain negligibly small under the design pressure load.

[5,6] SAR Change; See SAR Section 2.I.6.1.1. HI-STAR HB Serial #1020-012: The preload force associated with the 49 bolts in the undamaged hole locations that are presently torqued to 2,000 ft-lb +250/-0 ft-lb is sufficient to maintain compression on the seals during normal operation of the HI-STAR HB system and to minimize the potential for gross unloading of all bolts during a hypothetical accident. Also, the lengths of thread engagement and thread diameters at hole locations #20, #30, #37, #51 and #52 are sufficient to meet ASME Section III, Subsection NB stress limits under the maximum proposed torque load of 750 ft-lb. Hence, with a bolt torque of 750 ft-lb applied, the thread engagement and thread diameter at hole locations #20, #30, #37, #51, and #52 have been confirmed to meet ASME Code stress limits. Therefore, the safety margin on the threaded connection and the required preload for the seals remain adequate.

[7,8,9] Minor; HI-STAR HB Serial #1020-09 and #1020-011: The total amount of stainless steel weld metal to be applied is approximately 3/8 inch in depth over a hole diameter of ½ inch, which is more than sufficient to provide the necessary structural rigidity. While the extension of the stainless steel overlay material replaces the forging material, SA350-LF3, the total depth of material is more than sufficient to compress the mechanical seal.

DRAWING 4103 HI-STAR HB FUEL BASKET

Revision 5 - Approved for Transport in CoC 9261 Revision 7

Revision 6 changes (ECO 1125-28):
[1] Sheet 2, Plan View: Add "See Note 3" to the 5/16" thk basket support callout.
[2] Sheet 2, Notes: Add note 3 to read, "MPC HB Serial #1021-127 includes a one-time deviation to the basket supports adjacent to cells 77 and 80. An additional stainless steel shim is added to the supports, which will have a negligible impact on the design basis analyses (SMDR-1125-1694)."
[3] Sheet 2, Plan View: Add "See Note 4" to the top and bottom sheathing to cell wall weld callout.
[4] Sheet 2, Notes: Add note 4 to read, "MPC HB Serial #1021-124, -125, -126, -127, and -128 do not include full length top and bottom sheathing to cell wall welds. The as-built weld length is sufficient to withstand all design basis loads. See SMDR-1125-1743.

Justification:
[1,2,3] Minor; MPC HB Serial #1021-127: The additional shims will be under compression only, since they will be sandwiched between the basket supports and the basket itself. The 1/8" stitch fillet weld is sufficient to keep the shim attached to the basket support during all postulated events. The purpose of adding the shims is to maintain the maximum distance between the basket support and the basket. Therefore, this repair is meant to make the MPC adhere to the inputs used in the structural analyses and thus does not deviate from them.
[4] Minor; MPC HB Serial #1021-124, -125, 126, -127, and -128: The sheathing welds function to keep the neutron absorber in the proper position on the cell panel during all normal, off-normal, and accident events. The bounding HI-STAR storage event is to apply a 60g deceleration load vertically and horizontally to the sheathing and to the confined neutron absorber. Therefore, the deviation to

the minimum top and bottom sheathing weld length must be adequate to support the 60g deceleration load. Calculations have been performed (HI-2033035, Supplement 4) to determine the minimum length of the top and bottom weld required to withstand a 60g deceleration. This length is 2.093". The actual minimum amount of weld on the subject MPCs meets or exceeds this amount. Therefore, the structural analysis is not impacted and the neutron absorber remains in the proper location under all loading conditions.

DRAWING 4113 DAMAGED FUEL CONTAINER HB

Revision 1 - Approved for Transport in CoC 9261 Revision 7

Revision 2 changes:
Corrected the DFC bolt material and length.

Justification:
Editorial; The bolt material was inadvertently specified as a Class 2 material. It should have been the default Class 1. Also, the bolt length was given as 2". The correct length is 1.75", to ensure that the bolt will not impact the MPC lid before the rim of the DFC lid during a top-end drop.

NRC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE		PAGES
9261	TBD~~7~~	71-9261	USA/9261/B(U)F-96	1	OF	7

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, NJ 08053

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

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 ~~12~~TBD, dated TBD.

4. CONDITIONS

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

5.

(a) Packaging

(1) Model No.: HI-STAR 100 System

(2) Description

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

Multi-Purpose Canister

There are seven Multi-Purpose Canister (MPC) models designated as the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, MPC-68F, and the MPC-HB. All MPCs are designed to have identical exterior dimensions, except 1) MPC-24E/EFs custom-designed for the Trojan plant, which are approximately nine inches shorter than the generic Holtec MPC design; and 2) MPC-HBs custom-designed for the Humboldt Bay plant, which are approximately 6.3 feet

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

shorter than the generic Holtec MPC designs. The two digits after the MPC designate the number of reactor fuel assemblies for which the respective MPCs are designed. The MPC-24 series is designed to contain up to 24 Pressurized Water Reactor (PWR) fuel assemblies; the MPC-32 is designed to contain up to 32 intact PWR assemblies; and the MPC-68 and MPC-68F are designed to contain up to 68 Boiling Water Reactor (BWR) fuel assemblies. The MPC-HB is designed to contain up to 80 Humboldt Bay BWR fuel assemblies.

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 outer diameter of the Humboldt Bay MPCs is the same as the generic MPC, but the height is approximately 6.3 feet shorter than the generic MPC design. The Humboldt Bay MPCs are transported in a shorter version of the HI-STAR overpack, designated as the HI-STAR HB. The fuel basket designs vary based on the MPC model.

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 ~~12, as supplemented~~TBD:

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

(a) HI-STAR 100 Overpack	Drawing 3913, Sheets 1-9, Rev. 9
(b) MPC Enclosure Vessel	Drawing 3923, Sheets 1-5, Rev. 25~~16~~
(c) MPC-24E/EF Fuel Basket	Drawing 3925, Sheets 1-4, Rev. 9~~5~~
(d) MPC-24 Fuel Basket Assembly	Drawing 3926, Sheets 1-4, Rev. 11~~5~~
(e) MPC-68/68F/68FF Fuel Basket	Drawing 3928, Sheets 1-4, Rev. 14~~5~~
(f) HI-STAR 100 Impact Limiter	Drawing C1765, Sheet 1, Rev. 5~~4~~; Sheet 2, Rev. 4~~3~~; Sheet 3, Rev. 5~~4~~, Sheet 4, Rev. 5~~4~~; Sheet 5, Rev. 2; Sheet 6, Rev. 4~~3~~; and Sheet 7, Rev. 1
(g) HI-STAR 100 Assembly for Transport	Drawing 3930, Sheets 1-3, Rev. 2
(h) Trojan MPC-24E/EF Spacer Ring	Drawing 4111, Sheets 1-2, Rev. 0
(i) Damaged Fuel Container for Trojan Plant SNF	Drawing 4119, Sheet 1-4, Rev. 1
(j) Spacer for Trojan Failed Fuel Can	Drawing 4122, Sheets 1-2, Rev. 0
(k) Failed Fuel Can for Trojan	SNC Drawings PFFC-001, Rev. 8 and PFFC-002, Sheets 1 and 2, Rev. 7
(l) MPC-32 Fuel Basket Assembly	Drawing 3927, Sheets 1-4, Rev. 16~~6~~
(m) HI-STAR HB Overpack	Drawing 4082, Sheets 1-7, Rev. 6~~3~~
(n) MPC-HB Enclosure Vessel	Drawing 4102, Sheets 1-4, Rev. 1
(o) MPC-HB Fuel Basket	Drawing 4103, Sheets 1-3, Rev. 6~~5~~
(p) Damaged Fuel Container HB	Drawing 4113, Sheets 1-2, Rev. 2~~1~~

5.(b) Contents

(1) Type, Form, and Quantity of Material

(a) Fuel assemblies meeting the specifications and quantities provided in Appendix A to this Certificate of Compliance and meeting the requirements provided in Conditions 5.b(1)(b) through 5.b(1)(i) below are authorized for transportation.

5.(b)(1) Type, Form, and Quantity of Material (continued)

(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, missing structural components such as grid spacers, whose structural integrity has been impaired such that geometric rearrangement of fuel or gross failure of the cladding is expected based on engineering evaluations, or that cannot be handled by normal means. Fuel assemblies that cannot be handled by normal means due to fuel cladding damage are considered FUEL DEBRIS.

Damaged Fuel Containers (or Canisters) (DFCs) are specially designed fuel containers for damaged fuel assemblies or fuel debris that permit gaseous and liquid media to escape while minimizing dispersal of gross particulates.

The DFC designs authorized for use in the HI-STAR 100 are shown in Figures 1.2.10, 1.2.11, and 1.I.1 of the HI-STAR 100 System SAR, Rev. ~~12, as supplemented~~TBD.

Fuel Debris is ruptured fuel rods, severed rods, loose fuel pellets, and fuel assemblies with known or suspected defects which cannot be handled by normal means due to fuel cladding damage, including containers and structures supporting these parts. 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). Trojan fuel assemblies not loaded into DFCs or FFCs are classified as intact assemblies.

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 (BPRA), Thimble Plug Devices (TPDs), and Rod Cluster Control Assemblies (RCCAs).

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

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

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

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

Rev. 8 and PFFC-002, Rev. 7.

Trojan Fuel Debris Process Cans are Trojan plant-specific canisters containing fuel debris (metal fragments) and were used to process organic media removed from the Trojan plant spent fuel pool during cleanup operations in preparation for spent fuel pool decommissioning. Trojan Fuel Debris Process Cans are loaded into Trojan Fuel Debris Process Can Capsules or directly into Trojan Failed Fuel Cans. The Trojan Fuel Debris Process Can is depicted in Figure 1.2.10B of the HI-STAR100 System SAR, Rev. ~~12, as supplemented~~TBD.

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. ~~12, as supplemented~~TBD.

Undamaged Fuel Assemblies are fuel assemblies where all the exterior rods in the assembly are visually inspected and shown to be intact. The interior rods of the assembly are in place; however, the cladding of these rods is of unknown condition. This definition only applies to Humboldt Bay fuel assembly array/class 6x6D and 7x7C.

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

(c) For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the more restrictive of the decay heat limits for the stainless steel clad fuel assemblies or the applicable ZR clad fuel assemblies.

(d) For MPCs partially loaded with damaged fuel assemblies or fuel debris, all remaining ZR clad intact fuel assemblies in the MPC shall meet the more

5.(b)(1)~~(b)~~ Type, Form, and Quantity of Material (continued)~~— Definitions (continued)~~

restrictive of the decay heat limits for the damaged fuel assemblies or the intact fuel assemblies.

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

(f) PWR non-fuel hardware and neutron sources are not authorized for transportation except as specifically provided for in Appendix A to this CoC.

(g) BWR stainless-steel channels and control blades are not authorized for transportation.

(h) For spent fuel assemblies to be loaded into MPC-32s, core average soluble boron, assembly average specific power, and assembly average moderator temperature in which the fuel assemblies were irradiated, shall be determined according to Section 1.2.3.7.1 of the SAR, and the values shall be compared against the limits specified in Part VI of Table A.1 in Appendix A of this Certificate of Compliance.

(i) For spent fuel assemblies to be loaded into MPC-32s, the reactor records on spent fuel assemblies average burnup shall be confirmed through physical burnup measurements as described in Section 1.2.3.7.2 of the SAR.

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

6. 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 provisions provided in Chapter 7 of the HI-STAR SAR.

(b) All acceptance tests and maintenance shall be performed in accordance with detailed written procedures. Procedures for acceptance testing and maintenance shall be developed and shall include the provisions provided in Chapter 8 of the HI-STAR SAR.

7. The maximum gross weight of the package as presented for shipment shall not exceed 282,000 pounds, except for the HI-STAR HB, where the gross weight shall not exceed

187,200 pounds.

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

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

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

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

12. Revision No. ~~6~~7 of this certificate may be used until ~~May 31, 2010~~TBD.

13. Expiration Date: March 31, 2014

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 ~~12~~TBD, dated ~~October 9, 2006~~TBD.

~~Holtec International supplements dated June 29, July 27, August 3, September 27, October 5, and December 18, 2007; January 9, March 19, and September 30, 2008; and February 27, 2009.~~

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

~~Eric J. Benner~~TBD, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: TBD

APPENDIX A

CERTIFICATE OF COMPLIANCE NO. 9261, REVISION ~~7~~TBD

MODEL NO. HI-STAR 100 SYSTEM

INDEX TO APPENDIX A

Page:	Table:	Description:
Page A-1 to A-23	Table A.1	Fuel Assembly Limits
Page A-1		MPC-24: Uranium oxide, PWR intact fuel assemblies listed in Table A.2.
A-2		MPC-68: Uranium oxide, BWR intact fuel assemblies listed in Table A.3 with or without Zircaloy channels.
A-3		MPC-68: 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.
A-4		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-5		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.
A-6		MPC-68: Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters
A-7		MPC-68F: 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.
A-8		MPC-68F: 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.
A-9		MPC-68F: 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.

INDEX TO APPENDIX A

INDEX TO APPENDIX A

Table A.1 (Page 1 of 23)
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:	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:	
i. ZR Clad:	≤833 Watts
ii. SS Clad:	≤488 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

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 23)
Fuel Assembly Limits.

II. MPC MODEL: MPC-68

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies listed in Table A.3, except assembly classes 6x6D and 7x7C, with or without Zircaloy channels, and meeting the following specifications:

a. Cladding type:	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 ≥ 1.45 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:	
i. ZR Clad:	≤272 Watts, except for array/class 8X8F fuel assemblies, which shall have a decay heat ≤183.5 Watts.
a. SS Clad:	≤83 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 23)
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:	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 ≥ 1.45 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 containers

Table A.1 (Page 4 of 23)
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:	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 ≥ 18 years, an average burnup ≤ 30,000 MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods.
e. Fuel assembly length:	≤ 135.0 inches (nominal design)
f. Fuel assembly width:	≤ 4.70 inches (nominal design)
g. Fuel assembly weight:	≤ 400 lbs, including channels

Table A.1 (Page 5 of 23)
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 damaged 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:	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.
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 containers.

Table A.1 (Page 6 of 23)
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 1 Thoria Rod Canisters (as shown in Figure 1.2.11A of the HI-STAR 100 System SAR, Revision ~~12~~TBD) and meeting the following specifications:

a. Cladding type:	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 source material shall be in a water rod location.

Table A.1 (Page 7 of 23)
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:	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 $\geq$ 1.45 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 23)
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:	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 ≥ 1.45 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 containers

Table A.1 (Page 9 of 23)
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:	ZR
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for the applicable original fuel assembly array/class.
c. Initial maximum rod enrichment:	As specified in Table A.3 for the applicable original 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 ≥ 1.45 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 containers

Table A.1 (Page 10 of 23)
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:	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 23)
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:	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 containers

Table A.1 (Page 12 of 23)
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:	ZR
b. Maximum planar-average initial enrichment:	As specified in Table A.3 for original fuel assembly array/class 6x6B.
c. Initial maximum rod enrichment:	As specified in Table A.3 for original 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 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 containers

Table A.1 (Page 13 of 23)
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 the HI-STAR 100 System SAR, Revision ~~12~~TBD) and meeting the following specifications:

a. Cladding Type:	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:	≤ 18
d. Decay heat per Thoria Rod Canister:	≤ 115 Watts
e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister:	A fuel post-irradiation cooling time ≥ 18 years and an average burnup ≤ 16,000 MWD/MTIHM.
f. Initial heavy metal weight:	≤ 27 kg/canister
g. Fuel cladding O.D.:	≥ 0.412 inches
h. Fuel cladding I.D.:	≤ 0.362 inches
i. Fuel pellet O.D.:	≤ 0.358 inches
j. Active fuel length:	≤ 111 inches
k. Canister weight:	≤ 550 lbs, including fuel

Table A.1 (Page 14 of 23)
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 23)
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:	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, 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.
iii. Trojan plant fuel	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.8.
iv Trojan plant non-fuel hardware and neutron sources	Post-irradiation cooling time, and average burnup as specified in Table A.9
d. Decay heat per assembly	
i. ZR Clad:	Except for Trojan plant fuel, decay heat ≤ 833 Watts. Trojan plant fuel decay heat: ≤ 725 Watts
ii. SS Clad:	≤ 488 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, including non-fuel hardware and neutron sources

Table A.1 (Page 16 of 23)
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:	ZR
b. Maximum initial enrichment:	3.7% ^{235}U
c. Fuel assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly	An assembly post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8 Decay Heat: ≤ 725 Watts
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 DFC or Failed Fuel Can

B. Quantity per MPC: Up to 24 PWR intact fuel assemblies. For Trojan plant fuel only, 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 or neutron sources. Trojan intact 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. One (1) Trojan plant Sb-Be and /or up to two (2) Cf neutron sources in a Trojan plant intact fuel assembly (one source per fuel assembly) may be transported in any one MPC. Each fuel assembly neutron source may be transported in any fuel storage location.

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

H. Trojan plant non-fuel hardware and neutron sources may not be transported in the same fuel storage location as a damaged fuel assembly.

Table A.1 (Page 17 of 23)
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:	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, 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.
iii Trojan plant fuel:	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.8.
iv Trojan plant non-fuel hardware and neutron sources:	Post-irradiation cooling time, and average burnup as specified in Table A.9.
d. Decay heat per assembly:	
a. ZR Clad:	Except for Trojan plant fuel, decay heat ≤ 833 Watts. Trojan plant fuel decay heat: ≤ 725 Watts.
b. SS Clad:	≤ 488 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, including non-fuel hardware and neutron sources.

Table A.1 (Page 18 of 23)
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:	ZR
b. Maximum initial enrichment:	3.7% ^{235}U
c. Fuel assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8. Decay Heat: ≤ 725 Watts
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 DFC or Failed Fuel Can.

Table A.1 (Page 19 of 23)
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:	ZR
b. Maximum initial enrichment:	3.7% ^{235}U
c. Fuel debris post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly:	Post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8. Decay Heat: ≤ 725 Watts
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 DFC or Failed Fuel Can.

B. Quantity per MPC: Up to 24 PWR intact fuel assemblies. For Trojan plant fuel only, up to four (4) damaged fuel assemblies, fuel assemblies classified as fuel debris, and/or Trojan Fuel Debris Process Can Capsules may be stored 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 intact 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. One (1) Trojan plant Sb-Be and /or up to two (2) Cf neutron sources in a Trojan plant intact fuel assembly (one source per fuel assembly) may be transported in any one MPC. Each fuel assembly neutron source may be transported in any fuel storage location.

G. Trojan plant non-fuel hardware and neutron sources may not be transported in the same fuel storage location as a damaged fuel assembly.

Table A.1 (Page 20 of 23)
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:	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, and minimum initial enrichment per assembly:	An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.10 or A.11, as applicable.
d. Minimum average burnup per assembly: (Assembly Burnup shall be confirmed per Subsection 1.2.3.7.2 of the SAR, which is hereby included by reference)	Calculated value as a function of initial enrichment. See Table A.12.
e. Decay heat per assembly:	≤ 625 Watts
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

i. Operating parameters during irradiation of the assembly (Assembly operating parameters shall be determined per Subsection 1.2.3.7.1 of the SAR, which is hereby included by reference)

Core ave. soluble boron concentration:	≤ 1,000 ppmb
Assembly ave. moderator temperature:	≤ 601 K for array/classes 15x15D, E, F, and H ≤ 610 K for array/classes 17x17A, B, and C
Assembly ave. specific power:	≤ 47.36 kW/kg-U for array/classes 15x15D, E, F, and H ≤ 61.61 kW/kg-U for array/classes 17x17A, B, and C

Table A.1 (Page 21 of 23)
Fuel Assembly Limits

VI. MP C MODEL: MPC-32 (continued)

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 transport in MPC-32.

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

Table A.1 (Page 22 of 23)
Fuel Assembly Limits

VII. MPC MODEL: MPC-HB

A. Allowable Contents

1. Uranium oxide, INTACT and/or UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS, with or without channels, meeting the criteria specified in Table A.3 for fuel assembly array/class 6x6D or 7x7C and the following specifications:

a. Cladding type:	ZR
b. Maximum planar-average 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 ≥ 29 years, an average burnup ≤ 23,000 MWD/MTU, and a minimum initial enrichment ≥ 2.09 wt% ^{235}U.
e. Fuel assembly length:	≤ 96.91 inches (nominal design)
f. Fuel assembly width:	≤ 4.70 inches (nominal design)
g. Fuel assembly weight:	≤ 400 lbs, including channels and DFC
h. Decay heat per assembly:	≤ 50 W
h. Decay heat per MPC:	≤ 2000 W

Table A.1 (Page 23 of 23)
Fuel Assembly Limits

VII. MPC MODEL: MPC-HB (continued)

B. Quantity per MPC-HB: Up to 80 fuel assemblies

C. Damaged fuel assemblies and fuel debris must be stored in a damaged fuel container. Allowable Loading Configurations: Up to 28 damaged fuel assemblies/fuel debris, in damaged fuel containers, may be placed into the peripheral fuel storage locations as shown in SAR Figure 6.I.3, or up to 40 damaged fuel assemblies/fuel debris, in damaged fuel containers, can be placed in a checkerboard pattern as shown in SAR Figure 6.I.4. The remaining fuel locations may be filled with intact and/or undamaged fuel assemblies meeting the above applicable specifications, or with intact and/or undamaged fuel assemblies placed in damaged fuel containers.

NOTE 1: The total quantity of damaged fuel or fuel debris permitted in a single damaged fuel container is limited to the equivalent weight and special nuclear material quantity of one intact assembly.

NOTE 2: Fuel debris includes material in the form of loose debris consisting of zirconium clad pellets, stainless steel clad pellets, unclad pellets, or rod segments up to a maximum of one equivalent fuel assembly. A maximum of 1.5 kg of stainless steel clad is allowed per cask.

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	Zr
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
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 Tubes	17	17	5 (Note 4)	16	0
Guide 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	(Note 5)	(Note 5)	(Note 5)
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.)	≥ 0.015	≥ 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	(Note 5)	N/A	(Note 5)	(Note 5)	(Note 5)
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 and maximum initial enrichment as specified in Table A.12.

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 transport only Trojan plant fuel with a maximum initial enrichment of 3.7 wt.% ^{235}U.

Table A.3 (Page 1 of 6)
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 6)
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 6)
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	≤ 4.0	≤ 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 Rods	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 6)
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	≤ 5.0
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 6)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**6x6D**	**7x7C**
Clad Material (Note 2)	Zr	Zr
Design Initial U (kg/assy.)(Note 3)	≤ 78	≤ 78
Maximum planar-average initial enrichment (wt.% ^{235}U)	≤ 2.6	≤ 2.6
Initial Maximum Rod Enrichment (wt.% ^{235} U)	≤ 4.0 (Note 14)	≤ 4.0
No. of Fuel Rod Locations	36	49
Fuel Clad O.D. (in.)	≥ 0.5585	≥ 0.486
Fuel Clad I.D. (in.)	≤ 0.505	≤ 0.426
Fuel Pellet Dia. (in.)	≤ 0.488	≤ 0.411
Fuel Rod Pitch (in.)	≤ 0.740	≤ 0.631
Active Fuel Length (in.)	≤ 80	≤ 80
No. of Water Rods (Note 11)	0	0
Water Rod Thickness (in.)	N/A	N/A
Channel Thickness (in.)	≤ 0.060	≤ 0.060

Table A.3 (Page 6 of 6)
BWR 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 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+" and 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.

14. Only two assemblies may contain one rod each with an initial maximum enrichment up to 5.5 wt%.

Table A.4

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND INITIAL ENRICHMENT
MPC-24/24E/24/EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH NON-ZIRCALOY IN-CORE GRID SPACERS

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Initial Enrichment (wt. % U-235)
≥ 9	≤ 24,500	≥ 2.3
≥ 11	≤ 29,500	≥ 2.6
≥ 13	≤ 34,500	≥ 2.9
≥ 15	≤ 39,500	≥ 3.2
≥ 18	≤ 44,500	≥ 3.4

Table A.5

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND INITIAL ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH ZIRCALOY IN-CORE GRID SPACERS

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Initial Enrichment (wt. % U-235)
≥ 6	≤ 24,500	≥ 2.3
≥ 7	≤ 29,500	≥ 2.6
≥ 9	≤ 34,500	≥ 2.9
≥ 11	≤ 39,500	≥ 3.2
≥ 14	≤ 44,500	≥ 3.4

Table A.6

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND INITIAL ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH STAINLESS STEEL CLAD

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

Table A.7

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND INITIAL ENRICHMENT
MPC-68

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Initial Enrichment (wt. % U-235)
≥ 5	≤ 10,000	≥ 0.7
≥ 7	≤ 20,000	≥ 1.35
≥ 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

Table A.8

TROJAN PLANT FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND INITIAL ENRICHMENT LIMITS (Note 1)

Post-irradiation Cooling Time (years)	**Assembly Burnup (MWD/MTU)**	**Assembly Initial Enrichment (wt.% ^{235}U)**
≥16	≤42,000	≥3.09
≥16	≤37,500	≥2.6
≥16	≤30,000	≥2.1

NOTES:

1. Each fuel assembly must only meet one set of limits (i.e., one row)

Table A.9

TROJAN PLANT NON-FUEL HARDWARE AND NEUTRON SOURCES COOLING AND BURNUP LIMITS

Type of Hardware or Neutron Source	**Burnup (MWD/MTU)**	**Post-irradiation Cooling Time (Years)**
BPRAs	≤15,998	≥24
TPDs	≤118,674	≥11
RCCAs	≤125,515	≥9
Cf neutron source	≤15,998	≥24
Sb-Be neutron source with 4 source rods, 16 burnable poison rods, and 4 thimble plug rods	≤45,361	≥19
Sb-Be neutron source with 4 source rods, 20 thimble plug rods	≤88,547	≥9

Table A.10

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

Post-irradiation cooling time (years)	Assembly burnup (MWD/MTU)	Assembly Initial 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

Table A.11

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

Post-irradiation cooling time (years)	Assembly burnup (MWD/MTU)	Assembly Initial Enrichment (wt.% U-235)
≥8	≤24,500	≥2.3
≥9	≤29,500	≥2.6
≥12	≤34,500	≥2.9
≥14	≤39,500	≥3.2
≥19	≤44,500	≥3.4

Table A.12

FUEL ASSEMBLY MAXIMUM ENRICHMENT AND MINIMUM BURNUP REQUIREMENTS FOR TRANSPORTATION IN MPC-32

Fuel Assembly Array/Class	**Configuration (Note 2)**	**Maximum Enrichment (wt.% U-235)**	**Minimum Burnup (B) as a Function of Initial Enrichment (E) (Note 1) (GWD/MTU)**
15x15D, E, F, H	A	4.65	B = (1.6733)*E^3-(18.72)*E^2+(80.5967)*E-88.3
	B	4.38	B = (2.175)*E^3-(23.355)*E^2+(94.77)*E-99.95
	C	4.48	B = (1.9517)*E^3-(21.45)*E^2+(89.1783)*E-94.6
	D	4.45	B = (1.93)*E^3-(21.095)*E^2+(87.785)*E-93.06
17x17A,B,C	A	4.49	B = (1.08)*E^3-(12.25)*E^2+(60.13)*E-70.86
	B	4.04	B = (1.1)*E^3-(11.56)*E^2+(56.6)*E-62.59
	C	4.28	B = (1.36)*E^3-(14.83)*E^2+(67.27)*E-72.93
	D	4.16	B = (1.4917)*E^3-(16.26)*E^2+(72.9883)*E-79.7

NOTES:

1. E = Initial enrichment (e.g., for 4.05 wt.%, E = 4.05).
2. See Table A.13.
3. Fuel Assemblies must be cooled 5 years or more.

Table A.13

LO ADING CONFIGURATIONS FOR THE MPC-32

CONFIGURATION	ASSEMBLY SPECIFICATIONS
A	$ Assemblies that have not been located in any cycle under a control rod bank that was permitted to be inserted during full power operation (per plant operating procedures); or $ Assemblies that have been located under a control rod bank that was permitted to be inserted during full power operation (per plant operating procedures), but where it can be demonstrated, based on operating records, that the insertion never exceeded 8 inches from the top of the active length during full power operation.
B	$ Of the 32 assemblies in a basket, up to 8 assemblies can be from core locations where they were located under a control rod bank, that was permitted to be inserted more than 8 inches during full power operation. There is no limit on the duration (in terms of burnup) under this bank. $ The remaining assemblies in the basket must satisfy the same conditions as specified for configuration A.
C	$ Of the 32 assemblies in a basket, up to 8 assemblies can be from core locations where they were located under a control rod bank, that was permitted to be inserted more than 8 inches during full power operation. Location under such a control rod bank is limited to 20 GWD/MTU of the assembly. $ The remaining assemblies in the basket must satisfy the same conditions as specified for configuration A.
D	$ Of the 32 assemblies in a basket, up to 8 assemblies can be from core locations where they were located under a control rod bank, that was permitted to be inserted more than 8 inches during full power operation. Location under such a control rod bank is limited to 30 GWD/MTU of the assembly. $ The remaining assemblies in the basket must satisfy the same conditions as specified for configuration A.

Appendix A - Certificate of Compliance 9261, Revision TBD~~7~~

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 ~~12~~TBD, dated ~~October 6, 2006~~TBD~~, as supplemented~~.