HOLTEC INTERNATIONAL

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BY OVERNIGHT MAIL

August 17, 2001

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: USNRC Docket No. 72-1014, TAC L23344
HI-STORM 100 Certificate of Compliance 1014
HI-STORM License Amendment Request 1014-1, Revision 2, Supplement 1

References:
1. Holtec Project 5014
2. Holtec Letter, B. Gutherman, to the NRC Document Control Desk, dated July 3, 2001.
3. NRC Letter, C. Jackson to B. Gutherman, dated August 3, 2001
4. Holtec Letter, B. Gutherman, to the NRC Document Control Desk, dated August 13, 2001.

Dear Sir:

As committed in our Reference 4 letter, enclosed herewith are the documents comprising Supplement 1 to License Amendment Request (LAR) 1014-1, Revision 2. Please insert and replace pages in the LAR notebooks in accordance with the enclosed instructions. As discussed previously with the SFPO Project Manager, also included in Supplement 1 are a small number of minor changes to the LAR package that correct inconsequential discrepancies that had remained undetected until this time. These additional changes are listed in a table included in the FSAR List of Effective Pages (LOEP) entitled "Additional LAR Changes."

To facilitate the staff's ongoing review of the HI-STORM 100S drawings, we have a provided a comprehensive list of all changes made to the 100S overpack design in a table included in the LOEP. These changes, identified as necessary during the manufacturing of the first HI-STORM overpacks, were subject to the 10 CFR 72.48 process because of the extensive amount of design information in our licensing package drawings. The §72.48 evaluation, presently undergoing a formal adoption within our system, has determined that all but one of the changes could be implemented without prior NRC approval. The rotation of the overpack lid by 45 degrees for the storage configuration was determined be one change that required NRC approval (in the form of a change to the technical specifications) prior to implementation.

NMSS01 Public

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U. S. Nuclear Regulatory Commission
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Document ID: 5014433

Once again, we thank the SFPO for their timely acceptance review of LAR 1014-1, Revision 2. We look forward to the draft CoC and SER in accordance with the previously published review schedule to ensure our clients, who are relying on the changes in this LAR, can meet their spent fuel loading schedules.

Sincerely,

Brian Gutherman, P.E.
Licensing Manager

Approval:

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

Discipline Concurrence*	
Structural Mechanics Dr. A.I. Soler:	Thermal/Hydraulics Dr. Indresh Rampall:
Shielding Evaluation Dr. Everett Redmond II: for ER II	Civil/Structures Mr. Ray Kellar:
Operations Mr. Stephen Agace:	

* All Holtec QA-validated submittals on safety significant projects require relevant technical discipline concurrence.

cc: Mr. Christopher Jackson, USNRC (w/10 sets of enclosures)
emcc: HUG Group N (w/o encl.)
Holtec Group1 (w/o encl.)
Holtec International Florida Operations (w/o encl.)
UST&D, Inc. (Mr. Robert L. Moscardini) (w/0 encl.)

Document ID: 5014433

Enclosures: Insert pages for LAR 1014-1, Rev. 2 and instructions

INSTRUCTIONS FOR LAR 1014-1, REV. 2, SUPPLEMENT 1

The following instructions apply to LAR 1014-1, Revision 2, contained in a two-volume set of blue three-ring binders dated July, 2001. Insertion pages are enclosed with Holtec letter to the NRC number 5014433.

1. CoC Markup (Tab # 3):

   a. Remove pages 1 through 4 of the Certificate of Compliance and replace with the five enclosed replacement pages.

   b. Remove page 2-1/2-2 of CoC Appendix B and replace with the enclosed page 2-1/2-2.

   c. Remove page 3-9/3-10 of CoC Appendix B and replace with the enclosed page 3-9/3-10.

2. Revised CoC (Tab # 4)

   a. Remove pages 1 through 4 of the Certificate of Compliance and replace with the five enclosed replacement pages.

   b. Remove page 2-1/2-2 of CoC Appendix B and replace with the enclosed page 2-1/2-2.

   c. Remove page 3-9/3-10 of CoC Appendix B and replace with the enclosed replacement page 3-9/3-10.

3. Drawings (Tab # 5)

   Remove Sheets 1, 5, and 6 (all Rev. 0) of drawing 3669 and replace with the enclosed Sheets 1, 5, and 6 (all Rev. 1) of drawing 3669.

4. Proposed FSAR Changes (Tab # 6)

   a. LOEP Tab: Insert the enclosed table entitle "Additional LAR Changes" as the first table behind the LOEP tab.

   b. List of Effective Pages (LOEP) Tab: Remove the single page table "Summary of Significant Changes to HI-STORM 100S From LAR 1014-1, Revision 1 to Revision 2" and replace with the enclosed 18-page table "HI-STORM 100S Changes (LAR 1014-1 Revision 1 to Revision 2)" (ehind the table inserted in item 'a' above)

   c. LOEP Tab: Replace the existing LOEP in its entirety with the enclosed version.

   d. Remove page 1.0-3/1.0-4, Rev. 1.B and replace with enclosed page 1.0-3/1.0-4, Rev. 1C/1B.

e. Remove pages 1.0-7 through 1.0-9, Rev. 1B and replace with enclosed pages 1.0-7 through 1.0-9, Rev. 1B/1C.

f. Insert Figures 2.1.1, 2.1.2, 2.1.2A, 2.1.2B, and 2.1.2C at the end of FSAR Section 2.1.

g. Remove pages 2.A-1 through 2.A-4, Rev. 1B and replace with enclosed 2.A-1 through 2.A-5, Rev. 1B/1C. **Do not remove Figure 2.A.1.**

h. Remove page 3.3-9/10, Rev. 1B and replace with enclosed page 3.3-9/10, Rev. 1B/1C.

i. Remove Appendix 3.D, Rev. 1 in its entirety and replace with enclosed Appendix 3.D, Rev. 1C.

j. Remove pages 5.1-11 through 5.1-16, Rev. 1B and replace with enclosed pages 5.1-11 through 5.1-16, Rev. 1B/1C.

k. Remove pages 5.3-3 through 5.3-6, Rev. 1B and replace with enclosed pages 5.3-3 through 5.3-6, Rev. 1C.

l. Remove pages 8.0-1 trough 8.0-4, Rev. 1 and replace with enclosed pages 8.0-1 through 8.0-4, Rev. 1C/1.

m. Remove pages 8.1-1 through 8.1-6, Rev. 1B and replace with enclosed pages 8.1-1 through 8.1-6, Rev. 1B/1C.

n. Remove page 8.1-13/14, Rev. 1B and replace with enclosed page 8.1-13/14, Rev. 1B/1C.

o. Remove page 8.1-17/18, Rev. 1B and replace with enclosed page 8.1-17/18, Rev. 1B/1C.

p. Remove Sections 10.1 and 10.3, Rev. 1B in their entirety and replace with enclosed Sections 10.1 and 10.3, Rev. 1C[1]

q. Remove Section 10.2, Rev. 1. There are no proposed changes to this FSAR section.

[1] Note that nearly all of the dose data in Table 10.3.1.a/b through Table 10.3.3.a/b are revised based on changes to the fuel contents in this amendment request. For clarity, the old data in the tables is not shown in strikeout format.

CERTIFICATE OF COMPLIANCE
FOR SPENT FUEL STORAGE CASKS

The U.S. Nuclear Regulatory Commission is issuing this Certificate of Compliance pursuant to Title 10 of the Code of Federal Regulations, Part 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR Part 72). This certificate is issued in accordance with 10 CFR 72.238, certifying that the storage design and contents described below meet the applicable safety standards set forth in 10 CFR Part 72, Subpart L, and on the basis of the Final Safety Analysis Report (FSAR) of the cask design. This certificate is conditional upon fulfilling the requirements of 10 CFR Part 72, as applicable, and the conditions specified below.

Certificate No.	Effective Date	Expiration Date	Docket Number	Amendment No.	Amendment Date	Package Identification No.
1014	05/31/00	06/01/20	72-1014	0		USA/72-1014

Issued To: (Name/Address)

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

Safety Analysis Report Title

Holtec International Inc., Final Safety Analysis Report for the HI-STORM 100 Cask System
Docket No. 72-1014

CONDITIONS

This certificate is conditioned upon fulfilling the requirements of 10 CFR Part 72, as applicable, the attached Appendix A (Technical Specifications) and Appendix B – (Approved Contents and Design Features), and the conditions specified below:

1. CASK

   a. Model No.: HI-STORM 100 Cask System

   The HI-STORM 100 Cask System (the cask) consists of the following components: (1) interchangeable multi-purpose canisters (MPCs), which contain the fuel; (2) a storage overpack (HI-STORM 100), which contains the MPC during storage; and (3) a transfer cask (HI-TRAC), which contains the MPC during loading, unloading and transfer operations. The cask stores up to ~~24~~ 32 pressurized water reactor (PWR), fuel assemblies or 68 boiling water reactor (BWR) fuel assemblies.

   b. Description

   The HI-STORM 100 Cask System is certified as described in the Topical Safety Analysis Report (SAR) and in NRC's Safety Evaluation Report (SER) accompanying the Certificate of Compliance. The cask comprises three discrete components: the MPCs, the HI-TRAC transfer cask, and the HI-STORM 100 storage overpack.

1. b. Description (continued)

The MPC is the confinement system for the stored fuel. It is a welded, cylindrical canister with a honeycombed fuel basket, a baseplate, a lid, a closure ring, and the canister shell. It is made entirely of stainless steel except for the neutron absorbers and aluminum heat conduction elements. The canister shell, baseplate, lid, vent and drain port cover plates, and closure ring are the main confinement boundary components. The honeycombed basket, which is equipped with Boral neutron absorbers, provides criticality control.

There are seven types of MPCs: the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, MPC-68F, and MPC-68FF. The MPC-24 and MPC-32 hold up to 24 and 32 PWR fuel assemblies, respectively, that must be intact. The MPC-24E holds up to 24 PWR fuel assemblies, up to four of which may be classified as damaged fuel assemblies. The MPC-24EF holds up to 24 PWR fuel assemblies, up to four of which may be classified as damaged fuel assemblies or in the form of fuel debris. The MPC-68 holds up to 68 BWR fuel assemblies that may be intact or damaged (i.e., with known or suspected cladding defects greater than hairline cracks or pinholes). The number of damaged fuel assemblies is limited to sixteen unless they are Dresden Unit 1 or Humboldt Bay fuel assemblies. The MPC-68F holds up to 68 Dresden Unit 1 or Humboldt Bay BWR fuel assemblies that may be intact, damaged, or in the form of fuel debris (i.e., with known or suspected defects such as ruptured fuel rods, severed fuel rods, and loose fuel pellets). The MPC-68FF holds up to 68 BWR fuel assemblies, up to sixteen of which may be classified as damaged fuel or fuel debris. The maximum number of fuel assemblies in the form a fuel debris is eight. All fuel to be stored in the HI-STORM 100 System must comply with the limits specified in Appendix B to this CoC. All seven MPC models have the same external dimensions.~~There are three types of MPCs: the MPC-24, the MPC-68, and the MPC-68F. The MPC-24 holds up to 24 PWR fuel assemblies that must be intact. The MPC-68 holds up to 68 BWR fuel assemblies that may be intact or damaged (i.e., with known or suspected cladding defects greater than hairline cracks or pinholes). The MPC-68F holds up to 68 BWR fuel assemblies that may be intact, damaged, or in the form of fuel debris (i.e., with known or suspected defects such as ruptured fuel rods, severed fuel rods, and loose fuel pellets). All three MPCs have the same external dimensions.~~

The HI-TRAC transfer cask provides shielding and structural protection of the MPC during loading, unloading, and movement of the MPC from the spent fuel pool to the storage overpack. The transfer cask is a multi-walled (carbon steel/lead/carbon steel) cylindrical vessel with a water jacket attached to the exterior. Two types of HI-TRAC transfer casks are available: the 125 ton-HI-TRAC and the 100 ton HI-TRAC. The weight designation is the maximum weight of a loaded transfer cask during any loading, unloading or transfer operation. Both transfer cask types have identical cavity diameters. The 125 ton HI-TRAC transfer cask has thicker lead and water shielding and larger outer dimensions that the 100 ton HI-TRAC transfer cask.

The HI-STORM 100 storage overpack provides shielding and structural protection of the MPC during storage. The overpack is a heavy-walled steel and concrete, cylindrical vessel. Its side wall consists of plain *(un-reinforced)* concrete that is enclosed between inner and outer carbon steel shells. The overpack has four air inlets at the bottom and four air outlets at the top to allow air to circulate naturally through the cavity to cool the MPC inside. The inner shell has channels attached to its interior surface to guide the MPC during insertion and removal, provide a flexible medium to absorb impact loads, and allow cooling air to circulate through the overpack. A loaded MPC is stored within the HI-STORM 100 storage overpack in a vertical orientation.

2. OPERATING PROCEDURES

Written operating procedures shall be prepared for cask handling, loading, movement, surveillance, and maintenance. The user's site-specific written operating procedures shall be consistent with the technical basis described in Chapter 8 of the SAR.

3. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Written cask acceptance tests and maintenance program shall be prepared consistent with the technical basis described in Chapter 9 of the SAR.

4. QUALITY ASSURANCE

Activities in the areas of design, purchase, fabrication, assembly, inspection, testing, operation, maintenance, repair, modification of structures, systems and components, and decommissioning that are important to safety shall be conducted in accordance with a Commission-approved quality assurance program which satisfies the applicable requirements of 10 CFR Part 72, Subpart G, and which is established, maintained, and executed with regard to the cask system.

5. HEAVY LOADS REQUIREMENTS

Each lift of an MPC, a HI-TRAC transfer cask, or a HI-STORM 100 overpack must be made in accordance to the existing heavy loads requirements and procedures of the licensed facility at which the lift is made. A plant-specific safety review (under 10 CFR 50.59 or 10 CRF 72.48, if applicable) is required to show operational compliance with existing plant specific heavy loads requirements. Lifting operations outside of structures governed by 10 CFR Part 50 must be in accordance with Section 3.5 of Appendix B to this certificate.

6. APPROVED CONTENTS

Contents of the HI-STORM 100 Cask System must meet the fuel specifications given in Appendix B to this certificate.

7. DESIGN FEATURES

Features or characteristics for the site, cask, or ancillary equipment must be in accordance with Appendix B to this certificate.

8. CHANGES TO THE CERTIFICATE OF COMPLIANCE

The holder of this certificate who desires to make changes to the certificate, which includes Appendix A (Technical Specifications) and Appendix B (Approved Contents and Design Features), shall submit an application for amendment of the certificate.

9. SPECIAL REQUIREMENTS FOR FIRST SYSTEMS IN PLACE

The heat transfer characteristics of the cask system will be recorded by temperature measurements for the first HI-STORM SFSC Systems (MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, MPC-68F and MPC-68FF) placed into service with a heat load equal to or greater than 10 kW. An analysis shall be performed that demonstrates the temperature measurements validate the analytic methods and predicted thermal behavior described in Chapter 4 of the SAR.

Validation tests shall be performed for each subsequent cask system that has a heat load that exceeds a previously validated heat load by more than 2 kW (e.g., if the initial test was conducted at 10 kW, then no additional testing is needed until the heat load exceeds 12 kW). No additional testing is required for a system after it has been tested at a heat load equal to or greater than 16 kW.

Letter reports summarizing the results of each validation test shall be submitted to the NRC in accordance with 10 CFR 72.4. Cask users may satisfy these requirements by referencing validation test reports submitted to the NRC by other cask users.

10. PRE-OPERATIONAL TESTING AND TRAINING EXERCISE

A dry run training exercise of the loading, closure, handling, unloading, and transfer of the HI-STORM 100 Cask System shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The training exercise shall not be conducted with spent fuel in the MPC. The dry run may be performed in an alternate step sequence from the actual procedures, but all steps must be performed. The dry run shall include, but is not limited to the following:

a. *Moving the MPC and the TRANSFER CASK into the spent fuel pool.*

b. *Preparation of the HI-STORM 100 Cask System for fuel loading.*

c. *Selection and verification of specific fuel assemblies to ensure type conformance.*

d. *Loading specific assemblies and placing assemblies into the MPC (using a dummy fuel assembly), including appropriate independent verification.*

e. *Remote installation of the MPC lid and removal of the MPC and TRANSFER CASK from the spent fuel pool.*

10. PRE-OPERATIONAL TESTING AND TRAINING EXERCISE (continued)

f. MPC welding, NDE inspections, hydrostatic testing, draining, vacuum drying, helium backfilling, and leakage testing. (A mockup may be used for this dry-run exercise.)

g. TRANSFER CASK upending/downending on the horizontal transfer trailer or other transfer device, as applicable to the site's cask handling arrangement.

h. Transfer of the MPC from the TRANSFER CASK to the OVERPACK.

i. Placement of the HI-STORM 100 SFSC System at the ISFSI.

j. HI-STORM 100 Cask System unloading, including cooling fuel assemblies, flooding MPC cavity, removing MPC lid welds. (A mockup may be used for this dry-run exercise.)

~~9.~~ *11.* AUTHORIZATION

The HI-STORM 100 Cask System, which is authorized by this certificate, is hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to 10 CFR 72.210, subject to the conditions specified by 10 CFR 72.212, and the attached Appendix A and Appendix B.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

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

Attachments:

1. Appendix A
2. Appendix B

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel To Be Stored In The HI-STORM 100 SFSC System

a. INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, ~~and~~ FUEL DEBRIS, *and NON-FUEL HARDWARE* meeting the limits specified in Table 2.1-1 *and other referenced tables* may be stored in the HI-STORM 100 SFSC System.

b. For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the decay heat generation limit for the stainless steel clad fuel assemblies.

c. For MPCs partially loaded with DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, all remaining Zircaloy *(or other alloy of zirconium)* clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the DAMAGED FUEL ASSEMBLIES. *This requirement applies only to uniform fuel loading.*

d. For ~~MPC-68's~~ *MPCs* partially loaded with array/class 6x6A, 6x6B, 6x6C, *7x7A,* or 8x8A fuel assemblies, all remaining Zircaloy *(or other alloy of zirconium)* clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the 6x6A, 6x6B, 6x6C, *7x7A* and 8x8A fuel assemblies.

e. All BWR fuel assemblies may be stored with or without Zircaloy (or other alloy of zirconium) channels with the exception of array/class 10x10D and 10x10E fuel assemblies, which may be stored with or without Zircaloy or stainless steel channels.

(continued)

2.0 Approved Contents ~~(continued)~~

2.1 Fuel Specifications and Loading Conditions (cont'd)

2.1.2 ~~Preferential~~ *Uniform* Fuel Loading

Preferential fuel loading shall be used *during uniform loading (i.e., any authorized fuel assembly in any fuel storage location)* whenever fuel assemblies with significantly different post-irradiation cooling times (≥ 1 year) are to be loaded in the same MPC. Fuel assemblies with the longest post-irradiation cooling times shall be loaded into fuel storage locations at the periphery of the basket. Fuel assemblies with shorter post-irradiation cooling times shall be placed toward the center of the basket. *Regionalized fuel loading as described in Technical Specification 2.1.3 below meets the intent of preferential fuel loading.*

2.1.3 Regionalized Fuel Loading

Users may choose to store fuel using regionalized loading in lieu of uniform loading to allow higher heat emitting fuel assemblies to be stored than would otherwise be able to be stored using uniform loading. Regionalized loading is limited to those fuel assemblies with Zircaloy (or other alloy of zirconium) cladding. Figures 2.1-1 through 2.1-4 define the regions for the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, and MPC-68FF models, respectively[1]. Fuel assembly burnup, decay heat, and cooling time limits for regionalized loading are specified in Tables 2.1-6 and 2.1-7. Fuel assemblies used in regionalized loading shall meet all other applicable limits specified in Tables 2.1-1 through 2.1-3.

2.2 Violations

If any Fuel Specifications or Loading Conditions of 2.1 are violated, the following actions shall be completed:

2.2.1 The affected fuel assemblies shall be placed in a safe condition.

2.2.2 Within 24 hours, notify the NRC Operations Center.

2.2.3 Within 30 days, submit a special report which describes the cause of the violation, and actions taken to restore compliance and prevent recurrence.

[1] *These figures are only intended to distinguish the fuel loading regions. Other details of the basket design are illustrative and may not reflect the actual basket design details. The design drawings should be consulted for basket design details.*

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

b. For those ISFSI sites with design basis seismic acceleration values higher than those allowed for free-standing casks, the HI-STORM 100 System shall be anchored to the ISFSI pad. The site seismic characteristics and the anchorage system shall meet the following requirements:

i. The site acceleration response spectra at the top of the ISFSI pad shall have ZPAs that meet the following inequalities:

$$G_H \leq 2.12$$

AND

$$G_V \leq 1.5$$

Where:

G_H is the vectorial sum of the two horizontal ZPAs at a three-dimensional seismic site (and the horizontal ZPA at a two-dimensional site) and G_V is the vertical ZPA.

ii. Each HI-STORM 100 dry storage cask shall be anchored with twenty-eight (28), 2-inch diameter studs and compatible nuts of material suitable for the expected ISFSI environment. The studs shall meet the following requirements:

Yield Strength at Ambient Temperature: $\geq$ 80 ksi

Ultimate Strength at Ambient Temperature: $\geq$ 125 ksi

Initial Tensile Pre-Stress: $\geq$ 55 ksi AND $\leq$ 65 ksi

NOTE: The above anchorage specifications are required for the seismic spectra defined in item 3.4.3.b.i. Users may use fewer studs or those of different diameter to account for site-specific seismic spectra less severe than those specified above. The embedment design shall comply with Appendix B of ACI-349-97. A later edition of this Code may be used, provided a written reconciliation is performed.

iii. Embedment Concrete Compressive Strength: $\geq$ 4,000 psi at 28 days

(continued)

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

4. The analyzed flood condition of 15 fps water velocity and a height of 125 feet of water (full submergence of the loaded cask) are not exceeded.

5. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the on-site transporter fuel tank will contain no more than 50 gallons of diesel fuel while handling a loaded OVERPACK or TRANSFER CASK.

6. a. *For free-standing casks, the ISFSI pad shall be verified by analysis to limit cask deceleration during design basis drop and non-mechanistic tip-over events to ≤ 45 g's at the top of the MPC fuel basket. Analyses shall be performed using methodologies consistent with those described in the HI-STORM 100 FSAR. A lift height above the ISFSI pad is not required to be established if the cask is lifted with a device designed in accordance with ANSI N14.6 and having redundant drop protection features.* ~~In addition to the requirements of 10CFR72.212(b)(2)(ii), the cask storage pads and foundation shall include the following characteristics as applicable to the drop and tipover analyses.~~

   b. *For anchored casks, the ISFSI pad shall be designed to meet the embedment requirements of the anchorage design. A cask tip-over event for an anchored cask is not credible. The ISFSI pad shall be verified by analysis to limit cask deceleration during a design basis drop event to ≤ 45 g's at the top of the MPC fuel basket, except as provided for in this paragraph below. Analyses shall be performed using methodologies consistent with those described in the HI-STORM 100 FSAR. A lift height above the ISFSI pad is not required to be established if the cask is lifted with a device design in accordance with ANSI N14.6 and having redundant drop protection features.*

~~a. Concrete Thickness: ≤ 36 inches~~

~~b. Concrete Compressive Strength: ≤ 4,200 psi at 28 days~~

~~c. Reinforcement top and bottom (both directions):~~

~~Reinforcement area and spacing determined by analysis~~

~~Reinforcement shall be 60 ksi yield strength ASTM Material~~

CERTIFICATE OF COMPLIANCE FOR SPENT FUEL STORAGE CASKS

The U.S. Nuclear Regulatory Commission is issuing this Certificate of Compliance pursuant to Title 10 of the Code of Federal Regulations, Part 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR Part 72). This certificate is issued in accordance with 10 CFR 72.238, certifying that the storage design and contents described below meet the applicable safety standards set forth in 10 CFR Part 72, Subpart L, and on the basis of the Final Safety Analysis Report (FSAR) of the cask design. This certificate is conditional upon fulfilling the requirements of 10 CFR Part 72, as applicable, and the conditions specified below.

Certificate No.	Effective Date	Expiration Date	Docket Number	Amendment No.	Amendment Date	Package Identification No.
1014	05/31/00	06/01/20	72-1014	0		USA/72-1014

Issued To: (Name/Address)

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

Safety Analysis Report Title

Holtec International Inc., Final Safety Analysis Report for the HI-STORM 100 Cask System
Docket No. 72-1014

CONDITIONS

This certificate is conditioned upon fulfilling the requirements of 10 CFR Part 72, as applicable, the attached Appendix A (Technical Specifications) and Appendix B – (Approved Contents and Design Features), and the conditions specified below:

1. CASK

a. Model No.: HI-STORM 100 Cask System

The HI-STORM 100 Cask System (the cask) consists of the following components: (1) interchangeable multi-purpose canisters (MPCs), which contain the fuel; (2) a storage overpack (HI-STORM 100), which contains the MPC during storage; and (3) a transfer cask (HI-TRAC), which contains the MPC during loading, unloading and transfer operations. The cask stores up to *32* pressurized water reactor (PWR), fuel assemblies or 68 boiling water reactor (BWR) fuel assemblies.

b. Description

The HI-STORM 100 Cask System is certified as described in the Topical Safety Analysis Report (SAR) and in NRC's Safety Evaluation Report (SER) accompanying the Certificate of Compliance. The cask comprises three discrete components: the MPCs, the HI-TRAC transfer cask, and the HI-STORM 100 storage overpack.

1. b. Description (continued)

The MPC is the confinement system for the stored fuel. It is a welded, cylindrical canister with a honeycombed fuel basket, a baseplate, a lid, a closure ring, and the canister shell. It is made entirely of stainless steel except for the neutron absorbers and aluminum heat conduction elements. The canister shell, baseplate, lid, vent and drain port cover plates, and closure ring are the main confinement boundary components. The honeycombed basket, which is equipped with Boral neutron absorbers, provides criticality control.

There are seven types of MPCs: the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, MPC-68F, and MPC-68FF. The MPC-24 and MPC-32 hold up to 24 and 32 PWR fuel assemblies, respectively, that must be intact. The MPC-24E holds up to 24 PWR fuel assemblies, up to four of which may be classified as damaged fuel assemblies. The MPC-24EF holds up to 24 PWR fuel assemblies, up to four of which may be classified as damaged fuel assemblies or in the form of fuel debris. The MPC-68 holds up to 68 BWR fuel assemblies that may be intact or damaged (i.e., with known or suspected cladding defects greater than hairline cracks or pinholes). The number of damaged fuel assemblies is limited to sixteen unless they are Dresden Unit 1 or Humboldt Bay fuel assemblies. The MPC-68F holds up to 68 Dresden Unit 1 or Humboldt Bay BWR fuel assemblies that may be intact, damaged, or in the form of fuel debris (i.e., with known or suspected defects such as ruptured fuel rods, severed fuel rods, and loose fuel pellets). The MPC-68FF holds up to 68 BWR fuel assemblies, up to sixteen of which may be classified as damaged fuel or fuel debris. The maximum number of fuel assemblies in the form a fuel debris is eight. All fuel to be stored in the HI-STORM 100 System must comply with the limits specified in Appendix B to this CoC. All seven MPC models have the same external dimensions.

The HI-TRAC transfer cask provides shielding and structural protection of the MPC during loading, unloading, and movement of the MPC from the spent fuel pool to the storage overpack. The transfer cask is a multi-walled (carbon steel/lead/carbon steel) cylindrical vessel with a water jacket attached to the exterior. Two types of HI-TRAC transfer casks are available: the 125 ton-HI-TRAC and the 100 ton HI-TRAC. The weight designation is the maximum weight of a loaded transfer cask during any loading, unloading or transfer operation. Both transfer cask types have identical cavity diameters. The 125 ton HI-TRAC transfer cask has thicker lead and water shielding and larger outer dimensions that the 100 ton HI-TRAC transfer cask.

The HI-STORM 100 storage overpack provides shielding and structural protection of the MPC during storage. The overpack is a heavy-walled steel and concrete, cylindrical vessel. Its side wall consists of plain *(un-reinforced)* concrete that is enclosed between inner and outer carbon steel shells. The overpack has four air inlets at the bottom and four air outlets at the top to allow air to circulate naturally through the cavity to cool the MPC inside. The inner shell has channels attached to its interior surface to guide the MPC during insertion and removal, provide a flexible medium to absorb impact loads, and allow cooling air to circulate through the overpack. A loaded MPC is stored within the HI-STORM 100 storage overpack in a vertical orientation.

2. OPERATING PROCEDURES

Written operating procedures shall be prepared for cask handling, loading, movement, surveillance, and maintenance. The user's site-specific written operating procedures shall be consistent with the technical basis described in Chapter 8 of the SAR.

3. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Written cask acceptance tests and maintenance program shall be prepared consistent with the technical basis described in Chapter 9 of the SAR.

4. QUALITY ASSURANCE

Activities in the areas of design, purchase, fabrication, assembly, inspection, testing, operation, maintenance, repair, modification of structures, systems and components, and decommissioning that are important to safety shall be conducted in accordance with a Commission-approved quality assurance program which satisfies the applicable requirements of 10 CFR Part 72, Subpart G, and which is established, maintained, and executed with regard to the cask system.

5. HEAVY LOADS REQUIREMENTS

Each lift of an MPC, a HI-TRAC transfer cask, or a HI-STORM 100 overpack must be made in accordance to the existing heavy loads requirements and procedures of the licensed facility at which the lift is made. A plant-specific safety review (under 10 CFR 50.59 or 10 CRF 72.48, if applicable) is required to show operational compliance with existing plant specific heavy loads requirements. Lifting operations outside of structures governed by 10 CFR Part 50 must be in accordance with Section 3.5 of Appendix B to this certificate.

6. APPROVED CONTENTS

Contents of the HI-STORM 100 Cask System must meet the fuel specifications given in Appendix B to this certificate.

7. DESIGN FEATURES

Features or characteristics for the site, cask, or ancillary equipment must be in accordance with Appendix B to this certificate.

8. CHANGES TO THE CERTIFICATE OF COMPLIANCE

The holder of this certificate who desires to make changes to the certificate, which includes Appendix A (Technical Specifications) and Appendix B (Approved Contents and Design Features), shall submit an application for amendment of the certificate.

9. *SPECIAL REQUIREMENTS FOR FIRST SYSTEMS IN PLACE*

The heat transfer characteristics of the cask system will be recorded by temperature measurements for the first HI-STORM SFSC Systems (MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, MPC-68F and MPC-68FF) placed into service with a heat load equal to or greater than 10 kW. An analysis shall be performed that demonstrates the temperature measurements validate the analytic methods and predicted thermal behavior described in Chapter 4 of the SAR.

Validation tests shall be performed for each subsequent cask system that has a heat load that exceeds a previously validated heat load by more than 2 kW (e.g., if the initial test was conducted at 10 kW, then no additional testing is needed until the heat load exceeds 12 kW). No additional testing is required for a system after it has been tested at a heat load equal to or greater than 16 kW.

Letter reports summarizing the results of each validation test shall be submitted to the NRC in accordance with 10 CFR 72.4. Cask users may satisfy these requirements by referencing validation test reports submitted to the NRC by other cask users.

10. *PRE-OPERATIONAL TESTING AND TRAINING EXERCISE*

A dry run training exercise of the loading, closure, handling, unloading, and transfer of the HI-STORM 100 Cask System shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The training exercise shall not be conducted with spent fuel in the MPC. The dry run may be performed in an alternate step sequence from the actual procedures, but all steps must be performed. The dry run shall include, but is not limited to the following:

a. *Moving the MPC and the TRANSFER CASK into the spent fuel pool.*

b. *Preparation of the HI-STORM 100 Cask System for fuel loading.*

c. *Selection and verification of specific fuel assemblies to ensure type conformance.*

d. *Loading specific assemblies and placing assemblies into the MPC (using a dummy fuel assembly), including appropriate independent verification.*

e. *Remote installation of the MPC lid and removal of the MPC and TRANSFER CASK from the spent fuel pool.*

f. *MPC welding, NDE inspections, hydrostatic testing, draining, vacuum drying, helium backfilling, and leakage testing. (A mockup may be used for this dry-run exercise.)*

g. *TRANSFER CASK upending/downending on the horizontal transfer trailer or other transfer device, as applicable to the site's cask handling arrangement.*

h. *Transfer of the MPC from the TRANSFER CASK to the OVERPACK.*

i. *Placement of the HI-STORM 100 SFSC System at the ISFSI.*

10. PRE-OPERATIONAL TESTING AND TRAINING EXERCISE (continued)

j. HI-STORM 100 Cask System unloading, including cooling fuel assemblies, flooding MPC cavity, removing MPC lid welds. (A mockup may be used for this dry-run exercise.)

11. AUTHORIZATION

The HI-STORM 100 Cask System, which is authorized by this certificate, is hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to 10 CFR 72.210, subject to the conditions specified by 10 CFR 72.212, and the attached Appendix A and Appendix B.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

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

Attachments:

1. Appendix A
2. Appendix B

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel To Be Stored In The HI-STORM 100 SFSC System

a. INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, FUEL DEBRIS, and NON-FUEL HARDWARE meeting the limits specified in Table 2.1-1 and other referenced tables may be stored in the HI-STORM 100 SFSC System.

b. For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the decay heat generation limit for the stainless steel clad fuel assemblies.

c. For MPCs partially loaded with DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, all remaining Zircaloy (or other alloy of zirconium) clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the DAMAGED FUEL ASSEMBLIES. This requirement applies only to uniform fuel loading.

d. For MPCs partially loaded with array/class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A fuel assemblies, all remaining Zircaloy (or other alloy of zirconium) clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the 6x6A, 6x6B, 6x6C, *7x7A* and 8x8A fuel assemblies.

e. All BWR fuel assemblies may be stored with or without Zircaloy (or other alloy of zirconium) channels with the exception of array/class 10x10D and 10x10E fuel assemblies, which may be stored with or without Zircaloy or stainless steel channels.

(continued)

2.0 Approved Contents ~~(continued)~~

2.1 Fuel Specifications and Loading Conditions (cont'd)

2.1.2 Uniform Fuel Loading

Preferential fuel loading shall be used during uniform loading (i.e., any authorized fuel assembly in any fuel storage location) whenever fuel assemblies with significantly different post-irradiation cooling times ($\geq$ 1 year) are to be loaded in the same MPC. Fuel assemblies with the longest post-irradiation cooling times shall be loaded into fuel storage locations at the periphery of the basket. Fuel assemblies with shorter post-irradiation cooling times shall be placed toward the center of the basket. Regionalized fuel loading as described in Technical Specification 2.1.3 below meets the intent of preferential fuel loading.

2.1.3 Regionalized Fuel Loading

Users may choose to store fuel using regionalized loading in lieu of uniform loading to allow higher heat emitting fuel assemblies to be stored than would otherwise be able to be stored using uniform loading. Regionalized loading is limited to those fuel assemblies with Zircaloy (or other alloy of zirconium) cladding. Figures 2.1-1 through 2.1-4 define the regions for the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68, and MPC-68FF models, respectively[1]. Fuel assembly burnup, decay heat, and cooling time limits for regionalized loading are specified in Tables 2.1-6 and 2.1-7. Fuel assemblies used in regionalized loading shall meet all other applicable limits specified in Tables 2.1-1 through 2.1-3.

2.2 Violations

If any Fuel Specifications or Loading Conditions of 2.1 are violated, the following actions shall be completed:

2.2.1 The affected fuel assemblies shall be placed in a safe condition.

2.2.2 Within 24 hours, notify the NRC Operations Center.

2.2.3 Within 30 days, submit a special report which describes the cause of the violation, and actions taken to restore compliance and prevent recurrence.

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[1] These figures are only intended to distinguish the fuel loading regions. Other details of the basket design are illustrative and may not reflect the actual basket design details. The design drawings should be consulted for basket design details.

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

b. For those ISFSI sites with design basis seismic acceleration values higher than those allowed for free-standing casks, the HI-STORM 100 System shall be anchored to the ISFSI pad. The site seismic characteristics and the anchorage system shall meet the following requirements:

i. The site acceleration response spectra at the top of the ISFSI pad shall have ZPAs that meet the following inequalities:

$$G_H \leq 2.12$$

AND

$$G_V \leq 1.5$$

Where:

G_H is the vectorial sum of the two horizontal ZPAs at a three-dimensional seismic site (or the horizontal ZPA at a two-dimensional site) and G_V is the vertical ZPA.

ii. Each HI-STORM 100 dry storage cask shall be anchored with twenty-eight (28), 2-inch diameter studs and compatible nuts of material suitable for the expected ISFSI environment. The studs shall meet the following requirements:

Yield Strength at Ambient Temperature: $\geq$ 80 ksi

Ultimate Strength at Ambient Temperature: $\geq$ 125 ksi

Initial Tensile Pre-Stress: $\geq$ 55 ksi AND $\leq$ 65 ksi

NOTE: The above anchorage specifications are required for the seismic spectra defined in item 3.4.3.b.i. Users may use fewer studs or those of different diameter to account for site-specific seismic spectra less severe than those specified above. The embedment design shall comply with Appendix B of ACI-349-97. A later edition of this Code may be used, provided a written reconciliation is performed.

iii. Embedment Concrete Compressive Strength: $\geq$ 4,000 psi at 28 days

(continued)

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

4. The analyzed flood condition of 15 fps water velocity and a height of 125 feet of water (full submergence of the loaded cask) are not exceeded.

5. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the on-site transporter fuel tank will contain no more than 50 gallons of diesel fuel while handling a loaded OVERPACK or TRANSFER CASK.

6. a. For free-standing casks, the ISFSI pad shall be verified by analysis to limit cask deceleration during design basis drop and non-mechanistic tip-over events to $\leq$ 45 g's at the top of the MPC fuel basket. Analyses shall be performed using methodologies consistent with those described in the HI-STORM 100 FSAR. A lift height above the ISFSI pad is not required to be established if the cask is lifted with a device designed in accordance with ANSI N14.6 and having redundant drop protection features.

   b. For anchored casks, the ISFSI pad shall be designed to meet the embedment requirements of the anchorage design. A cask tip-over event for an anchored cask is not credible. The ISFSI pad shall be verified by analysis to limit cask deceleration during a design basis drop event to $\leq$ 45 g's at the top of the MPC fuel basket, except as provided for in this paragraph below. Analyses shall be performed using methodologies consistent with those described in the HI-STORM 100 FSAR. A lift height above the ISFSI pad is not required to be established if the cask is lifted with a device design in accordance with ANSI N14.6 and having redundant drop protection features.

(continued)

LICENSING DRAWING PACKAGE COVER SHEET

CLIENT: GENERAL

PROJECT NO. 1024 | P.O. NO. N/A

DRAWING PACKAGE I.D. 3669 | TOTAL SHEETS 11

DESIGN DRAWING PACKAGE CONTENTS:

SHEET	DESCRIPTION	REVISION
1	COVER SHEET	1
2	ASSEMBLY DRAWING , NOTES AND BILL OF MATERIALS	0
3	OVERALL DIMENSIONS	0
4	INNER SHELL ASSEMBLY	0
5	OVERPACK BODY INNER SHELL PART DETAILS	1
6	OVERPACK BODY ASSEMBLY	1
7	PEDESTAL ASSEMBLY	0
8	LID ASSEMBLY	0
9	LID STUD AND NUT	0
10	VENT SCREEN ASSEMBLIES	0
11	GAMMA SHIELD CROSS PLATES (INLET & OUTLET)	0

REVISION LOG

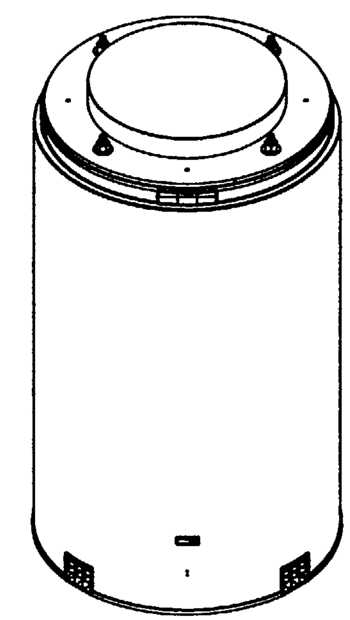
IT IS MANDATORY AT EACH REVISION TO COMPLETE THE REVIEW & APPROVAL LOG STORED IN HOLTEC'S DIRECTORY BY ALL RELEVANT TECHNICAL DISCIPLINES. EACH ATTACHED DRAWING SHEET CONTAINS ANNOTATED TRIANGLES INDICATING THE REVISION TO THE DRAWING.

REV	AFFECTED DRAWINGS	AFFECTED ECOs	PREP. BY	VIR# †
0	INITIAL ISSUE	1024-20, R1	David Butler 06/22/01	666818
1	REVISED WELD CALLOUTS	1024-32	David Butler 08/14/01	364273

† THE VALIDATION IDENTIFICATION RECORD (VIR) NUMBER IS A COMPUTER GENERATED RANDOM NUMBER WHICH CONFIRMS THAT ALL APPROPRIATE REVIEWS OF THIS DRAWING ARE DOCUMENTED IN COMPANY'S NETWORK.

GENERAL NOTE:

1. CHANGES TO THIS DRAWING AFFECT DESIGN DRAWING 3443.



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

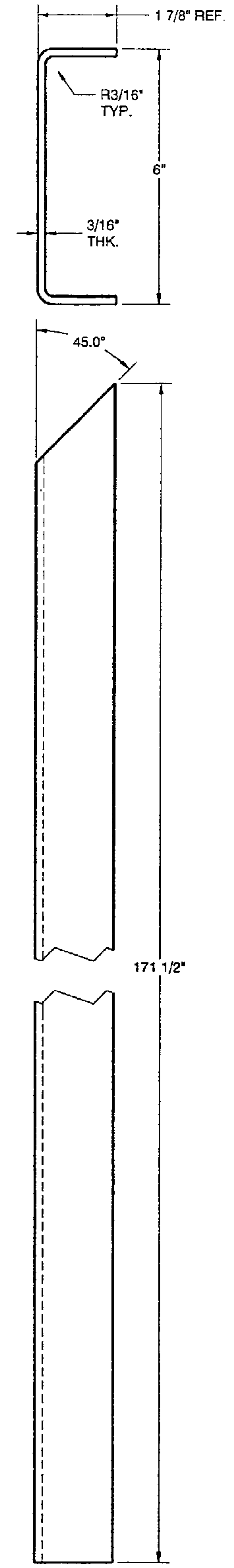
HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT: GENERAL

DESCRIPTION: HI-STORM 100S ASSEMBLY

PROJECT NO. 1024 | DRAWING NO. 3669 | SHEET 1 | TOTAL SHEETS 11

P.O. NO. N/A | FILE PATH F:\DRAWINGS\1024\3443R2\3669



ITEM 5
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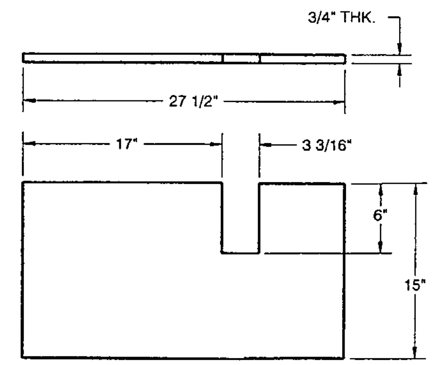

ITEM 9
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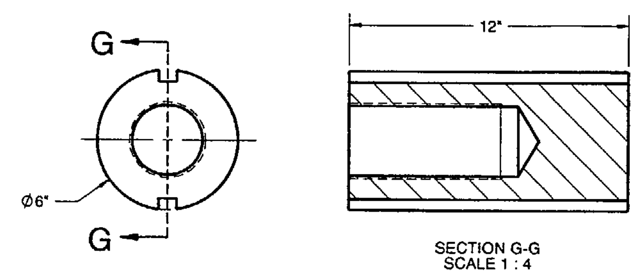
OPTIONAL



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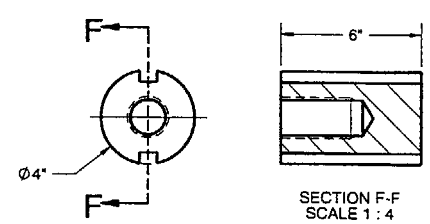
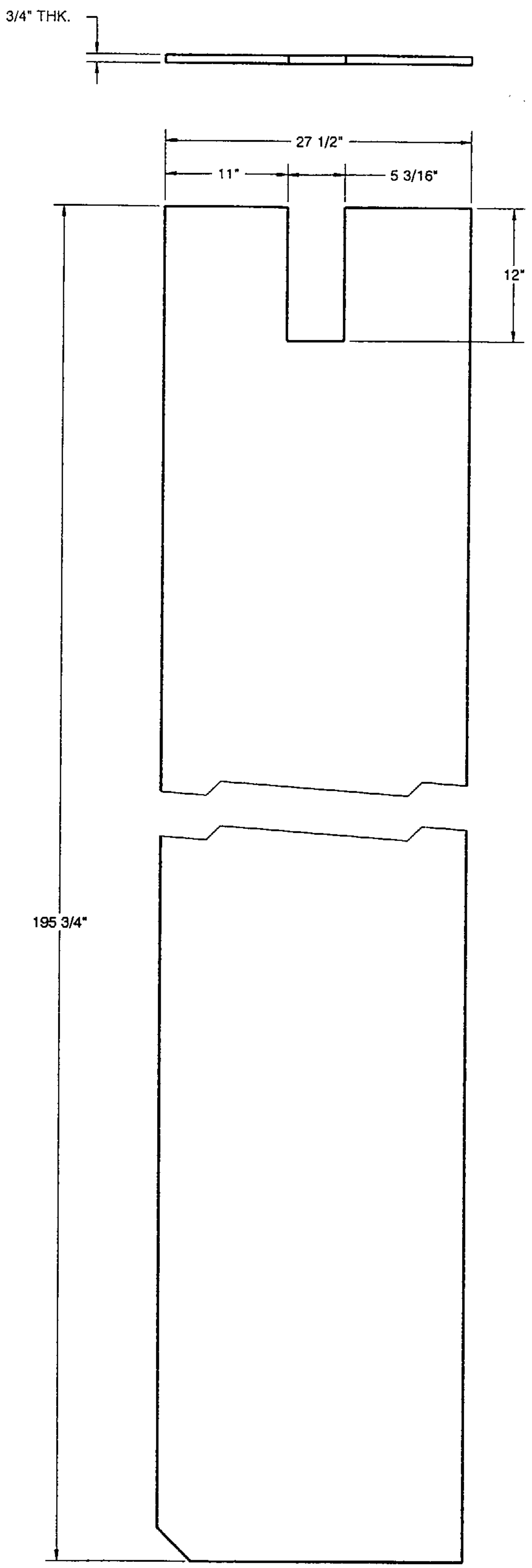


ITEM 10



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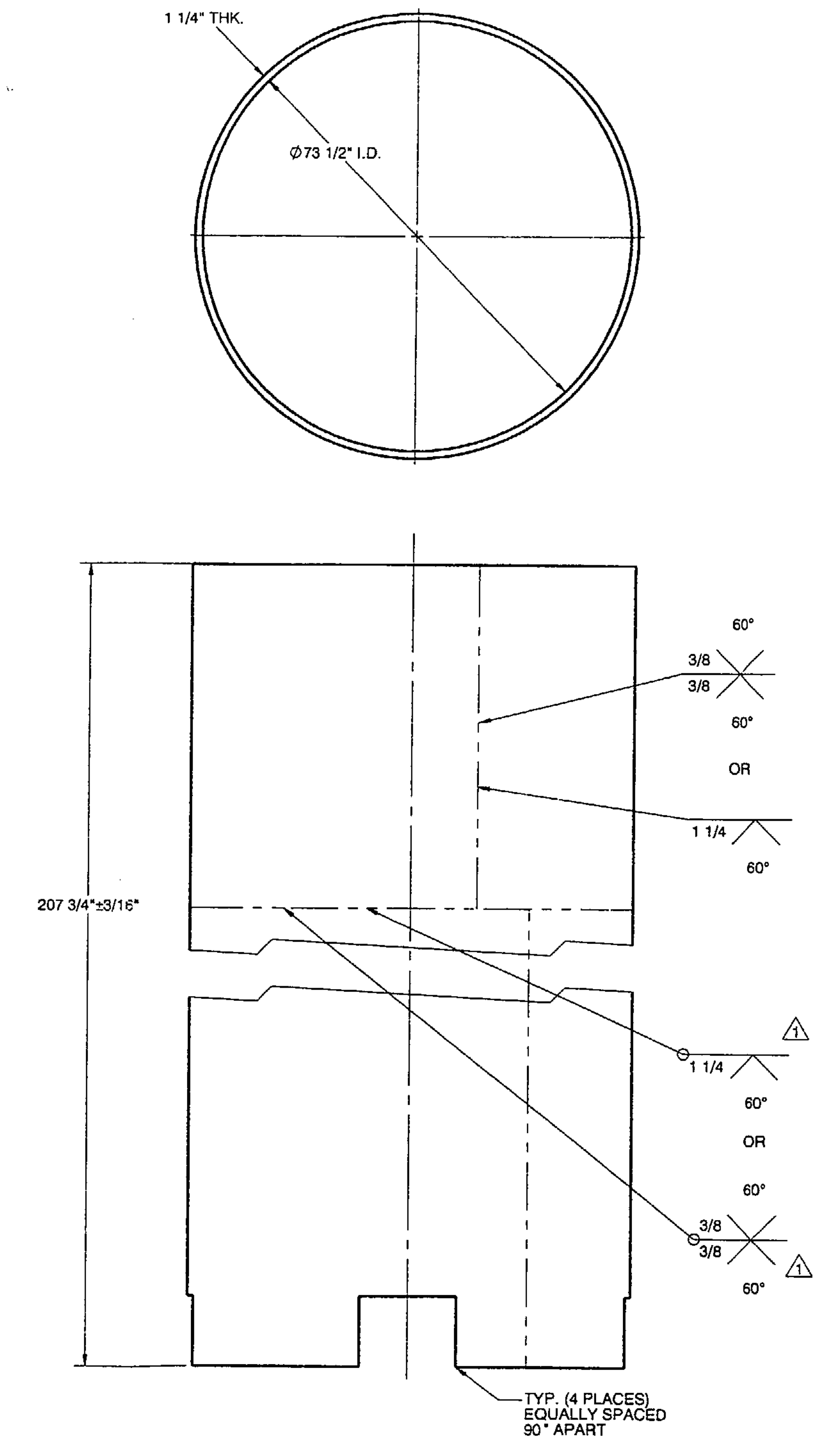

ITEM 2

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

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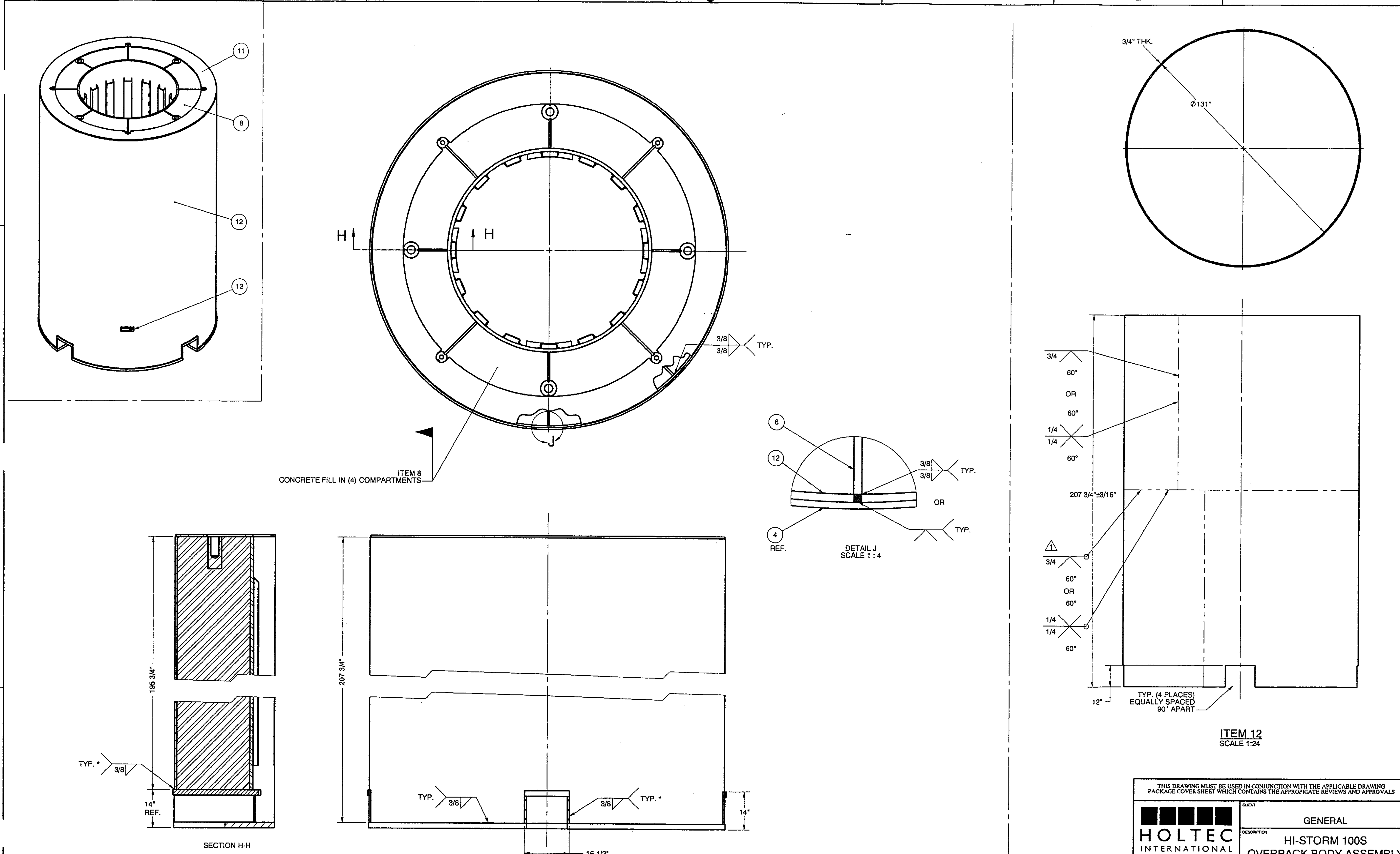
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT	GENERAL
DESCRIPTION	HI-STORM 100S OVERPACK BODY INNER SHELL PART DETAILS
PROJECT NO.	1024
P.O. NO.	N/A
COMPANION DRAWINGS	
SIZE	D
DRAWING NO.	3669
SHEET	5
REV	1
SCALE	1:16
FILE PATH	3669



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

HOLTEC INTERNATIONAL
HOLTEC CENTER
555 LINCOLN CENTER
MARLTON, NJ 08053

CLIENT: GENERAL

DESCRIPTION: HI-STORM 100S OVERPACK BODY ASSEMBLY SUB-COMPONENT A

PROJECT NO. 1024
P.O. NO. N/A
COMPANION DRAWINGS:
SIZE D
DRAWING NO. 3669
SHEET 6
REV 1
SCALE 1:16
FILE PATH: F:\DRAWINGS\1024\3443R2\3669

ADDITIONAL LAR CHANGES

ITEM	DESCRIPTION	REASON FOR CHANGE	AFFECTED LAR DOCUMENT
1	a. The weld call-out in the detail for BOM Item 2 on Sheet 5 of Drawing 3669 was corrected to point at the horizontal weld rather than the vertical weld. b. The size of the horizontal weld on BOM Item 12 shown on Sheet 6 of Drawing 3669 was increased from 3/8" to ¾".	Drafting errors.	Drawing 3669, Sheets 1, 5, and 6
2	The dose rates reported FSAR Chapter 5, for HI-STORM 100S are slightly modified.	Inconsistency in the MCNP shielding models. The concrete density in HI-STORM 100S overpack lid was inadvertently modeled as the same density as the overpack body. This has been corrected to be consistent with the densities specified in Proposed Rev. 1B of FSAR Appendix 1.D.	FSAR Chapter 5, Tables 5.1.1, 5.1.3, 5.1.4, and 5.1.6
3	Text in FSAR Chapter 5 related to changes implemented under 10 CFR 72.48 is removed.	This information is not part of the scope of the amendment request.	FSAR Chapter 5, Section 5.3.1, items 4, 5, and 6 under "HI-TRAC modeling discrepancies"
4	CoC clarification to ensure users understand the stated conditions are applicable to MPC-68F and MPC-68FF in addition to MPC-68	Clarification to avoid confusion	CoC Appendix B, Section 2.1.1.d
5	Add Figures 2.1.1, 2.1.2, and 2.1.2A through 2.1.2C to the LAR package.	Administrative oversight. These figures were in the original proposed FSAR changes for the LAR In revision 1B, the height of the container shown on Figures 2.1.2B and C is changed to "variable" from a specific height.	FSAR Chapter 2
6	FSAR correction of the stress analysis of the MPC pedestal shield	Incorrect value used in analysis	Appendix 3.D, Section 3.D.8
7	FSAR clarification regarding analysis of vertical handling of HI-STORM 100 vs. HI-STORM 100S overpacks	Text change required to reflect separate analysis performed for HI-STORM 100S	Appendix 3.D, Section 3.D.2
8	Correction to CoC to indicate PWR capacity of system will be 32 assemblies.	Addition of MPC-32 canister increases PWR capacity	CoC Section 1.a

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
1	Outer Shell Circumferential and Longitudinal welds – from ¾" groove to 3/8" 60deg. Groove or a ¼" 60 deg. Double groove	DWG. 3068	Sheet 6	All safety factors for the outer shell are greater than 2. See calculation 1 attachment for Rev. 2 of HI-2002481.
2	Inner Shell Circumferential and Longitudinal welds – from 3/4" 60deg. Groove1 to 1/4" groove or a 3/8" 60 deg. Double groove	Dwg. 3068	Sheet 5	All safety factors for the inner shell are greater than 2. See calculation 1 attachment for Rev. 2 of HI-2002481.
3	Outer Shell to the Inlet Vent Vertical Plate Weld – Revise from ¾" groove to 3/8" fillet	DWG. 3070 Item 2 to Item 13	Sheet 6 Item 12 to Item 3	App. 3D analyzes the raising of the loaded HI-STORM through the Inlet Vents, but takes no credit for the subject weld. Therefore the weld has no impact on structural integrity. The change facilitates fabrication
4	Inner Shell to the Inlet Vent Vertical Plate Weld – Revise from ¾" groove to 3/8" fillet	DWG. 3070 Item 3 to Item 13	Sheet 4 Item 3 to Item 2 (Main Assembly View)	App. 3DS in HI-2002481 analyzes the raising of the loaded HI-STORM through the Inlet Vents, but takes no credit for the subject weld. Therefore the weld has no impact on structural integrity. The change facilitates fabrication
5	Inner Shell to the Inlet Vent Horizontal Plate Weld – Revise from 5/8" groove to 3/8" fillet	DWG. 3068 Item 3 to Item 11	Sheet 4 Item 2 to Item 4 (Main Assembly View)	App. 3D analyzes the raising of the loaded HI-STORM through the Inlet Vents, but takes no credit for the subject weld. Therefore the weld has no impact on structural integrity. The change facilitates fabrication

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
6	Bolt Anchor Block – Complete re-design: 5" x 5"x 6" to 6" dia x 12" long	DWG. 3074, Item 17 BM-3065, Item 17	Sheet 4, Item 7 BM, Sheet 2, Item 7	The change facilitates procurement and fabrication without sacrificing structural integrity. See appendix 3.DS in HI-2002481, Rev. 2
7	Inlet Vent Horizontal Plate, Item 4, – Change the length from 31 ½" lg. to 33 1/8" lg.	BM-3065, Dwg. 3075, Item 11	BM Sheet 2	Increasing the length of plate allows a fillet weld to be applied between the outer shell & inlet vent horizontal plate in lieu of a groove weld. This also facilitates fit-up. No structural issue.
8	Change the weld between the Baseplate and the Inlet Vent Vertical Plate from ¼" groove, ½" fillet to 3/8" fillet .	Dwg. 3075	Sheet 4	This is considered a structural weld. Weld stress analysis is based on 3/8" fillet.
9	Delete Shield Shell	DWG. 3070, item 28 BM-3065, Item 28		Justification provided with ECO-1024-21 for an identical change to HI-STORM 100. No structural significance.
10	Increase the minimum required density of concrete in the overpack body to be 155 lbs./cubic ft.			
11	Revise dia. Of Top Lid Plate from 126.75" to 126"	DWG. 3068, Item 10B BM-3065, Item 10B	Sheet 8, Item 24 Sheet 2, Item 24	Facilitates fabrication without affecting structural integrity or any other critical characteristic of the storage cask. Appendix 3.AOS of Rev. 2 of HI-2002481 has the analysis.
12	Revise dia. Of Top Lid Plate from 124.75" to 124"	DWG. 3068, Item 10A BM-3065, Item 10A	Sheet 2, Item 25	Facilitates fabrication without affecting structural integrity or any other critical characteristic of the storage cask.
13	Delete weld between Top Plate and Inner Shell	DWG. 3074 Item 9 and item 3	Sheet 6 Item 11 and Item 2	There is no joint between the Top Plate and the Inner Shell because of the reduction in the radial width of the Top Plate .

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
14	Delete Seal weld between Top Plate and Anchor Block	DWG. 3074 Item 9 and item 17	Sheet 6 Item 11 and Item 7	The seal weld was intended to keep external moisture/water from seeping into the concrete. It has no structural function. It was a redundant feature in light of the pressure applied by the torqued Top Lid Stud Nuts between the Top Plate and the Top Lid Assembly.
15	Lid Stud Material – from SA 564-630 Age Hardened at 1075 F to SA 193-B7	BM-3065, Item 16	BM Sheet 2, Item 29	Substitution of Stud material with SA193-B7 and increasing the stud length to 24.25" in the HI-STORM 100 FSAR Appendix 3.L (Tip Over Accident), shows that all safety factors are maintained above 1. Also, top lift calculation in App. 3.SD in HI-2002481, Rev. 1 and App. 3.AOS evaluates tipover.
16	Lid Stud Length – from 22 ½" to 24 ¼"	BM-3065, Item 16	BM Sheet 2, Sheet 9, Item 29	
17	Lid Stud – Change the top thread length from 7.25" to 6" and the bottom usable thread length from 3 ¼" to 7" Lg.	Dwg. 3074, Item 16	Sheet 9, Item 29	Thread length at the bottom of the stud is increased to accommodate the change in anchor block material. Thread length on top changed to minimize required thread. See Appendix 3.SD in HI-2002481, Rev. 2.
18	Redesign of the Shear Bar, Original Item 52. See Attachment D.	BM-3074, Item 52	DWG. Sheet 8 BM Sheet 2, Item 31	Item 31, Shear Ring, serves the same function as the Shear Bar (Original Item 52) during a Tip Over event. It fits inside Item 11, Top Plate. App. 3.AOS in HI-2002481 evaluates shear ring .
19	Revise length of Lid Shield In from 32" lg to 31 ½" lg .	BM-3065, Item 6	BM Sheet 2, Item 19	

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
20	Revise length of Lid Shield Out from 74" lg to 71 ½" lg.	BM-3065, Item 7	BM Sheet 2, Item 20	
21	Revise the outer Diameter of the Lid Shield Ring from 126.5" to 126 +/- ½	Dwg. 3073	Sheet 8 BM Sheet 2, Item 18	
22	Revise length of the Lid Vent Side Plate from 26.25" lg to 27" lg.	BM-3065, Item 12	BM Sheet 2, Item 22	
23	Change the stud tube from 1/8" wall 4" OD tubing to 5" Sch. 40 Pipe and delete weld between pipe and lid shield ring	BM-3065, Item 51	BM Sheet 2, Item 21	
24	Change the weld between the Lid Shield In, Item 19, and the Lid Vent Side Plate, Item 22, from a 5/16 Fillet (or groove) to a ¼" fillet weld.	Dwg. 3073	Sheet 8	No Structural Impact (NSI)
25	Change the weld between the Lid Shield Out and the Lid Vent Side Plate from a 5/16 Fillet to a ¼" fillet weld.	Dwg. 3073	Sheet 8	NSI

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
26	Change the weld between the lid top plate to lid vent side plate and lid shield ring to lid vent side plate from a 5/16" fillet to a ¼" fillet.	Dwg. 3073	Sheet 8	NSI
27	Change the weld between the Lid Shield Out to lid top plate from a 5/16" fillet to a ¼" fillet.	Dwg. 3074	Sheet 8	NSI. All weld sizes evaluated as ¼" fillet welds in 3.ASO in HI-2002481.
28	Change the weld between the Lid Shield Ring and the Lid Shield Out from a 3/8" fillet to a ¼" fillet.	Dwg. 3074	Sheet 8	
29	Change the weld between the Lid Shield Ring and the Lid Shield In from a 3/8" fillet (or groove) to a ¼" fillet.	Dwg. 3074	Sheet 8	
30	Delete dimension of 10-1/4" +/- 3/16" on lid shield block overall height	Dwg. 3068	N/A	
31	Change the Top Plate dimensions from "132 ½" x 73 ½ ID Ring" to "132" OD, 109 ID Plate" and add 3/8" 60 degree groove weld to allow component to be made of more than one piece	BM-3065, Item 9	BM Sheet 2, Sheet 6 Item 11	

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
32	Pedestal Baseplate – Cut a 12" dia. Hole in the center	DWG. 3068, Item 23	Sheet 7, Item 14	The holes allow concrete to be poured after the (steel) pedestal assembly is fabricated. When the pedestal is lifted. The weight of the cured concrete is supported by the circumferential weld between the base-plate and the shell. The holes in the base-plate have no effect on the weld's capability. Based on standard industry equations for predicting concrete shrinkage, the amount of shrinkage is expected to be between 1 and 4 mils after a 28 day curing period. This amount is negligible and does not affect shielding calculations, which are based on nominal values. The holes in the steel pedestal base plate will have a negligible effect on shielding, as shielding is mainly provided by concrete.
33	Pedestal Baseplate – Cut four (4) 12" dia. Holes, 90 deg. Apart on a pitch circle diameter of 42"	DWG. 3068, Item 23	Sheet 7, Item 14	
34	Change the diameters of the Pedestal Baseplate and the Pedestal Platform from 67 7/8" to 67 ¾ "	BM-3065	Sheet 2	
35	Move Radial Plates 45 degrees to be positioned over the Inlet Vents	DWG. 3069, 3070, 3071 Item 14	Sheet 4	An enhancement, which facilitates operation in the field without affecting the design. The re-orientation of the Outlet Vents and the reduction of the Radial Plate length are a consequence of the re-positioning of the Radial Plates. Evaluated in 3.DS in HI-2002481.

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
36	Rotate location of the Outlet Vents by 45degrees to align with the Radial Plates and the Inlet Vents.	DWG. 3073	Sheet 5	
37	Length of Radial Plates – Revise from 207 ¾" to 195 ¾"	BM 3065 Item 14	Sheet 5 Item 6 Revised to 195 ¾"	
38	Add Optional Items 9 & 10, the MD-Radial Plate and the MD-Anchor Block	Not included in design	Sheet 2 and 5 Items 9 and 10	Provide optional tie-down locations for ancillary equipment.
39	Radial Plate to Inner Shell and Outer Shell Welds – Revise the ½" double fillet weld to 3/8" double fillet	DWG 3071 Detail Views	Sheet 4 – Main Assembly View Sheet 6 - Detail J	FSAR Appendix 3.D addresses vertical lifting of the loaded HI-STORM 100. The Radial Plate transfers the load from the Anchor Blocks to the Overpack Body. The weld area provided by the Radial Plate/Anchor Block is bounded by the weld area provided by the Radial Plates and the Inner and Outer Shells. Therefore the reduction in weld size does not adversely impact the FSAR analysis. See Appendix 3.DS in HI-2002481 Rev 2.
40	Radial Plate to Inlet Vent Horizontal Plate Weld – Revise the double fillet weld from ¾" to 3/8"	Not included in design	Sheet 4 – Main Assembly View	
41	Change weld between the anchor block and the radial plate from a ¾" double fillet weld to a ½" double fillet weld.	Dwg. 3069 & 3074	Sheet 4	See Appendix 3.DS in HI-2002481 Rev 2.

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
42	Affixing Storage Marking Nameplate to the Outer Shell- Change mounting method from welding to bolting – Use at least two, 1/4" dia.	DWG. 3068, 3077 Item 29	Sheet 2	Avoids Stainless Steel to Carbon Steel welding.
43	Attachment of Inlet and Outlet Vent Screens to the Outer Shell – Change mounting Hardware from 1/8" to #1/4 – 20 UNC X 1" long hex. Bolt & add to bill of material	DWG. 3077	Sheet 2, Item 33	Design Enhancement
44	Change the Description of Item 33 to "1/4 – 20 UNC x 1" LG Hex Bolt" and the remarks to "With ¼ Flat Washer"	Not Included	BM Sheet 2	Clarification.
45	Add Note 3: "Fabricator to make final determination of the location and total number of welds required. Weld size is to meet the sizes specified in this drawing as a minimum."	Not Included	Sheet 2	Fabrication enhancement.

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
46	Add Note 9 "Optionally, Grounding Straps may be welded directly to the HI-STORM Outer Shell using a welding procedure approved by Holtec"	Not Included	Sheet 2	Facilitate Field Assembly
47	Correct minor spelling and typographical changes on Sheets 1 & 3	Not Included	Sheets 1 & 3	Correct spelling typos.
48	Change Approximate weight from 360,000 lbs to 255,300 lbs.	Not Included	Sheet 2	Calculations have been revised to a bounding weight of 405,000 lb and show positive safety factors.
49	Change the part description of Radial Shield, from "26 ¾ Thk. Radial Shield" to 263 Cu. Ft. Per Compartment & change qty. from 1 to 4	BM-3065	BM Sheet 2	Drawing clarification.
50	Change the Remarks of Item 8, Radial Shield, from 1060 Cu. Ft. Tot. to 1052 Cu. Ft. Tot.	Not Included	BM Sheet 2	Drawing clarification.

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
51	Change the part description of Lid Shield Block, from a linear dimension of "6" THK Shield" to 4.3 Cu. Ft. Per Compartment & change qty. from 1 to 4	BM-3065	BM Sheet 2	Drawing clarification.
52	Change the Remarks of Item 23 Radial Shield, from 18 Cu. Ft. Tot. to 17.2 Cu. Ft. Tot.	Not Included	BM Sheet 2	Drawing clarification.
53	Change the part description of Pedestal Shield, from a linear dimension of "11.5" Thk. Shield" to 24 Cu. Ft.	BM-3065	BM Sheet 2	Drawing clarification.
54	Change the part description of Shield Block, from a linear dimension of "10" Thk Shield" to 33 Cu. Ft.	BM-3065	BM Sheet 2	Drawing clarification.
55	Change the description of Items 32 & 34, Lower and Upper Screen, to say: Item 32: "10 GA. X 16 ½" x 13" Frame w/Screen"; Item 34 "10 GA. X 26 5/8" x 6" Frame w/Screen" & change material from 304 to S/S	Not Included	BM Sheet 2, Sheet 9	Drawing clarification.

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
56	Change the height of the Gamma Shielding Cross Plate (Air Inlet) from 11 ¾" Ref. To 11 25/32"	Dwg. 3075	Sheet 11	Procurement of Materials.
57	Change material of Anchor Block from SA 350 LF3 or SA 203E to SA 350 LF2	Not Included	BM Sheet 2	Structural evaluation performed in Appendix 3.OS in Supplement to Rev. 2 of HI-2002481.
58	Change the material of the gamma cross plates, new Items 35 – 39, from SA 240-304 to Stainless Steel	BM-3066	BM Sheet 2	To ease in procurement in materials for fabrication.
59	Change the material of the Channel, New Item 5, from SA 516 GR 70 to SA 240 340 St. Stl.	BM-3065	BM Sheet 2	No structural implication. This component is designed to absorb energy in the event of a tipover.
60	Change the material of the Pedestal Platform from SA 516 GR 70 to A36 Or Equal.	BM-3065	BM Sheet2	
61	Redesign attachment of Channel to inner shell. Refer to Attached Detail E. Added channel mounts.	Not Included	Sheets 2 & 4	
62	Add dimensions to Section C-C.	Not Included	Sheet 3	

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
63	Add 3/8" Fillet Weld between The outer shell and the baseplate.	3068	Sheet 5	
64	Add Note to Holes in Item 17, "Fill Following Assembly of Overpack (4 Places)"	Not Included	Sheet 6	
65	Add note to the lid assembly: "Approximate Weight = 25,495 lbs."	Not Included	Sheet 8	
66	Change the vent duct opening from 24" to 25".	N/A	Sheet 8	To allow for ease in fit-up of the vent duct shield inserts.
67	Delete Cross Plate Tabs, Compression Fitting, Protection Head, Bushing, Coupling, Hex Nipple, Connection, Shims, and thermocouple/RTD.	BM-3066	Not Included	
68	Change the tolerance on the Inner Diameter of the Horizontal Vent Plate from +/- ¼" to +3/8, -1/8"	Dwg. 3070	Sheet 4	
69	Change the nomenclature listed in the Bill-of-Material	BM-3065 & BM-3066	Sheet 2	

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
70	Modify BM to state that all dimensions included in the bill-of-material are approximate	BM-3065	Sheet 2	
71	Delete Note #3 on BM-3065 that marks non-structural components by a "*"	BM-3065	N/A	
72	Delete Note #4 on BM-3065 & Note #1 on Dwg. 3072 that Item 10A & 10B may be made from one piece	BM-3065	N/A	
73	Change the quantity of the pedestal platform plate from 1 to 5. Change the description from 5" thick with the allowance to use multiple plates of lesser thickness to 1" thick plates with a qty. of 5.	BM-3065	Sheet 2	
74	Change the description of the anchor block from a 5" long hole to just specify the external dimensions in the BM .	BM-3065	Sheet 2	

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
75	Change the length of the inlet vent vertical plate in the BM from 29-1/2" to 30"	BM-3065	Sheet 2	
76	Change the quantity of the concrete radial shield and concrete lid shield from 1 to 4	BM-3065	Sheet 2	
77	Change the BM description of the outer shell from 132-1/2" OD to 131" ID	BM-3065	Sheet 2	
78	Delete the MT or PT requirement for the final surface of the inner shell circumferential and longitudinal welds.	3068, Sheet 1	Sheet 2	
79	Delete the optional 1/8" fillet weld between the pedestal platform and the pedestal shell	3068, Sheet 1	Sheet 6	
80	Delete Note #2 that requires that the inlet vent vertical plates be approx. flush with the ID of the inner shell.	3070, Sheet 1	N/A	

HI-STORM 100S CHANGES (LAR 1014-1 REVISION 1 TO REVISION 2)

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
81	Change the dimensioning of the pedestal to specify the overall pedestal height as a toleranced dimension of 17"	3068, Sheet 1	Sheet 7	
82	Change the weld between the inlet vent horizontal plate and outer shell from a 3/8" groove weld to a 3/8" fillet weld.	3068, Sheet 1	Sheet 6	
83	Delete the optional welding of the outer shell to the radial plates using two ¾" groove welds	3071, Sheet 1	N/A	
84	Delete the optional ½" NPT threaded hole for thermocouple in the middle of the top lid	3072, Sheet 1	N/A	
85	Delete the four threaded holes in the lid top plate (Item 10B) and the four through holes in the lid top plate (Item 10A).	3072, Sheet 1	Sheet 7	

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
86	Delete the optional groove weld and fillet weld underneath between the lid shield block shell and the lid shield block cover.	3074, Sheet 1	Sheet 7	
87	Delete Note #2 on Dwg. 3077 that states that the weight is to be measured and stamped onto the nameplate.	3077, Sheet 1	N/A	
88	Add the dimension across the flats of the lifting stud nuts of 4-7/8"	N/A	Sheet 8	
89	Revise BOM, Sheet 2, and Sheet 8 to add a 3/8" thick stainless steel washer with a 3-1/2" ID and 8" OD underneath the lid stud nut (Item 30).	Dwg. 3068	Sheet 2	This change is required to accommodate change #5. Increasing the through hole diameter to 5" requires the use of a structural washer. See the justification for change #5.
90	Specify a ¼" fillet weld between Item 19 and 24 in the detail of the lid weldment.	N/A	Sheet 8	This weld was inadvertently omitted from the drawing. This is an editorial change to correct an error.
91	Clarify that the approximate weight of the overpack is fully assembled.	N/A	Sheet 2	This is an editorial clarification.

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
92	Move the weld call-out between Items 31 and 18 in the bottom isometric assembly view to the lid weldment view.	N/A	Sheet 8	Editorial change to more clearly depict the weld.
93	Add the following note: "Fabricator may add additional welds with the approval of Holtec."	N/A	Sheet 2, Note 10	Additional weld may be needed to secure components in position to allow subsequent welds to be applied without the movement of the component. After the welding of the component, these temporary welds may be in accessible. This note allows the welds to remain provided Holtec has approved these additional welds.
94	Add an "*" to all non-NF welds.	Dwg. 3068	Sheet 2	These symbols were inadvertently omitted from the drawing. This is an editorial change to correct an error.
95	Change the Longitudinal and Circumferential ¾" 60° Groove weld to a full penetration weld.	Dwg. 3068, Item 3	Sheet 5, Item 2	A full penetration weld will eliminate the gap left by a partial penetration weld from one side.
96	Change the Longitudinal and Circumferential 3/8" 60° Groove weld to a full penetration weld.	Dwg. 3068, Item 2	Sheet 6, Item 12	A full penetration weld will eliminate the gap left by a partial penetration weld from one side.

ITEM NO.	DESCRIPTION OF CHANGE	HI-STORM 100S DRAWINGS ORIGINAL SERIES (3067 – 3077)	HI-STORM 100S DRAWINGS NEW SERIES 3669 REV. 0	REMARKS / JUSTIFICATION
97	Add the following notes: To the Outlet Gamma Shield Detail: "For optional Outlet Gamma Shield Cross Plates, add two additional vertical plates with all vertical plates spaced evenly." To the Inlet Gamma Shield Detail: "For optional Inlet Vent Gamma Shield Cross Plates, add one additional vertical plate and one additional horizontal plate, with all vertical plates spaced evenly. Horizontal plates spaced evenly across top 9-25/32"."	N/A	Sheet 11	These options were inadvertently omitted from the drawing. This is an editorial change to correct an error.
98	Add the following notes: "1. Quantity and location of bolts may vary." "2. Bolts may be replaced with other attachment mechanisms."	N/A	Sheet 10	Fabrication Clarification

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viii	1A		1.0-22	1B
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xvi	1A		1.0-30	1B
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xix	1A		1.0-33	1B
xx	1A		1.1-1	1B
xxi	1A		1.1-2	1B
xxii	1A		1.1-3	1B
xxiii	1A		1.1-4	1B
xxiv	1A		Fig. 1.1.1	0
xxv	1A		Fig. 1.1.1A	1
xxvi	1A		Fig. 1.1.2	0
xxvii	1A		Fig. 1.1.3	0
xxviii	1A		Fig. 1.1.3A	1B
xxix	1A		Fig. 1.1.4	1B
xxx	1A		Fig. 1.1.5	1B
xxxi	1A		1.2-1	1B
xxxii	1A		1.2-2	1B
xxxiii	1A		1.2-3	1B
xxxiv	1A		1.2-4	1B
xxxv	1A		1.2-5	1B
xxxvi	1A		1.2-6	1B
			1.2-7	1B
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1.2-25	1B		26 Drawings w/ 77 sheets	See Section 1.5
1.2-26	1B		13 Bills-of-Material w/19 sheets	See Section 1.5
1.2-27	1B		1.6-1	0
1.2-28	1B		1.6-2	0
1.2-29	1B		1.A-1	0
1.2-30	1B		1.A-2	0
1.2-31	1B		1.A-3	0
1.2-32	1B		1.A-4	0
1.2-33	1B		1.A-5	0
1.2-34	1B		1.A-6	0
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Fig. 1.2.1	0		Fig. 1.A.1	0
Fig. 1.2.1A	1B		Fig. 1.A.2	0
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Fig. 1.2.4	0		Fig. 1.A.5	0
Fig. 1.2.4A	1		1.B-1	1B
Fig. 1.2.5	0		1.B-2	1B
Fig. 1.2.6	0		1.B-3	1B
Fig. 1.2.7	1B		1.B-4	1B
Fig. 1.2.8	0		1.C-1	0
Fig. 1.2.8A	1B		1.C-2	0
Fig. 1.2.9	0		1.C-3	0
Fig. 1.2.10	0		1.C-4	0
Fig. 1.2.11	0		1.C-5	0
Fig. 1.2.12	0		1.C-6	0
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Fig. 1.2.15	0		1.D-3	1B
Fig. 1.2.16a	0		1.D-4	1B
Fig. 1.2.16b	0		1.D-5	1B
Fig. 1.2.16c	0			
Fig. 1.2.16d	0			
Fig. 1.2.16e	0			
Fig. 1.2.16f	0			
Fig. 1.2.17a	0			
Fig. 1.2.17b	0			
Fig. 1.2.17c	0			
Fig. 1.2.17d	0			
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Fig. 1.4.1	0			
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2.0-27	1B		Fig. 2.1.8	0
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2.0-31	1B		2.2-4	1B
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Fig. 3.A.25	Deleted		3.B-47	0
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Fig. 3.A.28	Deleted		3.B-50	0
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3.B-6	0		3.B-58	0
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3.B-8	0		3.B-60	0
3.B-9	0		3.B-61	0
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3.B-11	0		3.C-1	0
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3.D-6	1C		3.G-13	0
3.D-7	1C		Fig. 3.G.1	0
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3.E-7	0		3.K-1	0
3.E-8	0		3.K-2	0
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3.M-12	1		3.X-5	0
3.M-13	1		3.X-6	0
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3.M-15	1		3.X-8	0
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3.U-4	1		3.Y-9	1
3.U-5	1		3.Y-10	1
3.U-6	1		3.Y-11	1
3.U-7	1		3.Y-12	1
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3.V-2	1		3.Y-18	1
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3.V-7	1		Fig. 3.Y.2	0
3.V-8	1		3.Z-1	0
3.V-9	1		3.Z-2	0
3.V-10	1		3.Z-3	0
3.W-1	1		3.Z-4	0
3.W-2	1		3.Z-5	0
3.W-3	1		3.Z-6	0
3.W-4	1		3.Z-7	0
3.W-5	1		3.Z-8	0
3.W-6	1		3.Z-10	0
3.W-7	1		3.Z-11	0
3.W-8	1		3.Z-12	0
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Fig. 3.AA.2	0		Fig. 3.AD.2	0
Fig. 3.AA.3	0		Fig. 3.AD.3	0
Fig. 3.AA.4	0		3.AE-1	0
Fig. 3.AA.5	0		3.AE-2	0
Fig. 3.AA.6	0		3.AE-3	0
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3.AB-5	0		Fig. 3.AE.2	0
3.AB-6	0		Fig. 3.AE.3	0
3.AB-7	0		Fig. 3.AE.4	0
3.AB-8	0		3.AF-1	1
3.AB-9	0		3.AF-2	1
3.AB-10	0		3.AF-3	1
3.AB-11	0		3.AF-4	1
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3.AC-1	1		3.AF-8	1
3.AC-2	1		3.AG-1	0
3.AC-3	1		3.AG-2	0
3.AC-4	1		3.AG-3	0
3.AC-5	1		3.AG-4	0
3.AC-6	1		3.AG-5	0
3.AC-7	1		3.AG-6	0
3.AC-8	1		3.AG-7	0
3.AC-9	1		3.AG-8	0
3.AC-10	1		3.AG-9	0
3.AC-11	1		3.AG-10	0
3.AC-12	1		3.AH-1	0
3.AD-1	1		3.AH-2	0
3.AD-2	1		3.AH-3	0
3.AD-3	1		3.AH-4	0
3.AD-4	1		3.AH-5	0
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3.AI-5	0		3.AK-13	0
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3.AI-11	0		3.AL-1	0
3.AI-12	0		3.AL-2	0
3.AI-13	0		3.AL-3	0
3.AI-14	0		3.AL-4	0
3.AI-15	0		3.AL-5	0
3.AI-16	0		3.AL-6	0
3.AI-17	0		3.AL-7	0
3.AI-18	0		3.AL-8	0
3.AI-19	0		3.AL-9	0
Fig. 3.AI.1	0		3.AL-10	0
Fig. 3.AI.2	0		3.AM-1	0
Fig. 3.AI.3	0		3.AM-2	0
Fig. 3.AI.4	0		3.AM-3	0
Fig. 3.AI.5	0		3.AM-4	0
Fig. 3.AI.6	0		3.AM-5	0
3.AJ-1	0		3.AM-6	0
3.AJ-2	0		3.AM-7	0
3.AJ-3	0		3.AM-8	0
3.AJ-4	0		3.AM-9	0
3.AJ-5	0		3.AM-10	0
3.AJ-6	0		3.AM-11	0
3.AJ-7	0		3.AM-12	0
3.AJ-8	0		3.AM-13	0
3.AJ-9	0		3.AM-14	0
3.AJ-10	0		3.AM-15	0
3.AJ-11	0		3.AM-16	0
3.AJ-12	0		3.AM-17	0
3.AJ-13	0		3.AM-18	0
3.AJ-14	0		3.AM-19	0
3.AJ-15	0		3.AM-20	0
3.AJ-16	0		3.AM-21	0
Fig. 3.AJ.1	0		3.AM-22	0
Fig. 3.AJ.2	0		3.AM-23	0
Fig. 3.AJ.3	0		3.AM-24	0
3.AK-1	0		3.AM-25	0
3.AK-2	0		3.AM-26	0
3.AK-3	0		3.AM-27	0
3.AK-4	0		3.AM-28	0
3.AK-5	0		3.AM-29	0
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3.AN-6	0		3.AR-2	1
3.AN-7	0		3.AR-3	1
3.AN-8	0		3.AR-4	1
3.AN-9	0		3.AR-5	1
3.AN-10	0		3.AR-6	1
3.AN-11	0		3.AR-7	1
3.AN-12	0		3.AR-8	1
3.AN-13	0		3.AR-9	1
3.AN-14	0		3.AR-10	1
Fig. 3.AN.1	0		3.AR-11	1
Fig. 3.AN.2	0		3.AS-1	1
Fig. 3.AN.3	0		3.AS-2	1
Fig. 3.AN.4	0		3.AS-3	1
Fig. 3.AN.5	0		3.AS-4	1
Fig. 3.AN.6	0		3.AS-5	1
Fig. 3.AN.7	0		3.AS-6	1
Fig. 3.AN.8	0		3.AS-7	1
Fig. 3.AN.9	0		3.AS-8	1
Fig. 3.AN.10	0		3.AS-9	1
Fig. 3.AN.11	0		3.AS-10	1
Fig. 3.AN.12	0		3.AS-11	1
Fig. 3.AN.13	0		3.AS-12	1
Fig. 3.AN.14	0		3.AS-13	1
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Fig. 3.AN.16	0			
Fig. 3.AN.17	0			
Fig. 3.AN.18	0			
Fig. 3.AN.19	0			
Fig. 3.AN.20	0			
Fig. 3.AN.21	0			
Fig. 3.AN.22	0			
Fig. 3.AN.23	0			
Fig. 3.AN.24	0			
Fig. 3.AN.25	0			
Fig. 3.AN.26	0			
Fig. 3.AN.28	0			
Fig. 3.AN.29	0			
Fig. 3.AN.20	0			
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Fig. 4.2.1	0		4.4-24	1B
Fig. 4.2.2	0		4.4-25	1B
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4.3-23	1B		4.4-48	1B
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Fig. 4.3.3	0		4.4-51	1B
Fig. 4.3.4	0		4.4-52	1B
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Fig. 4.4.2	0		Fig. 4.5.3	1B
Fig. 4.4.3	0		4.6-1	1
Fig. 4.4.4	0		4.6-2	1
Fig. 4.4.5	0		4.7-1	1
Fig. 4.4.6	0		4.7-2	1
Fig. 4.4.7	0		4.7-3	1
Fig. 4.4.8	0		4.A-1	1B
Fig. 4.4.9	0		4.A-2	1B
Fig. 4.4.10	0		4.A-3	1B
Fig. 4.4.11	0		4.A-4	1B
Fig. 4.4.12	0		4.A-5	1B
Fig. 4.4.13	0		4.A-6	1B
Fig. 4.4.14	Deleted in Rev. 1		4.A-7	1B
Fig. 4.4.15	0		4.A-8	1B
Fig. 4.4.16	1		4.A-9	1B
Fig. 4.4.17	1		4.A-10	1B
Fig. 4.4.18	0		4.A-11	1B
Fig. 4.4.19	1		4.A-12	1B
Fig. 4.4.20	1		4.A-13	1B
Fig. 4.4.21	0		4.A-14	1B
Fig. 4.4.22	Deleted in Rev. 1		4.A-15	1B
Fig. 4.4.23	Deleted in Rev. 1		4.A-16	1B
Fig. 4.4.24	0		4.A-17	1B
Fig. 4.4.25	1		4.A-18	1B
Fig. 4.4.26	1		4.A-19	1B
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5.1-17	1B		5.2-37	1B
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Fig. 5.1.1	1		5.2-41	1B
Fig. 5.1.2	0		5.2-42	1B
Fig. 5.1.3	1		5.2-43	1B
Fig. 5.1.4	0		5.2-44	1B
Fig. 5.1.5	0		5.2-45	1B
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Fig. 5.1.7	0		5.2-47	1B
Fig. 5.1.8	0		5.2-48	1B
Fig. 5.1.9	0		5.2-49	1B
Fig. 5.1.10	0		5.2-50	1B
Fig. 5.1.11	0		5.2-51	1B
Fig. 5.1.12	1B		5.2-52	1B
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Fig. 5.3.7	0		5.A-2	0
Fig. 5.3.8	0		5.A-3	0
Fig. 5.3.9	0		5.B-1	0
Fig. 5.3.10	1B		5.B-2	0
Fig. 5.3.11	0		5.B-3	0
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5.4-4	1		5.C-8	0
5.4-5	1		5.C-9	0
5.4-6	1		5.C-10	0
5.4-7	1		5.C-11	0
5.4-8	1		5.C-12	0
5.4-9	1		5.C-13	0
5.4-10	1		5.C-14	0
5.4-11	1		5.C-15	0
5.4-12	1		5.C-16	0
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5.4-16	1		5.C-20	0
5.4-17	1		5.C-21	0
5.4-18	1		5.C-22	0
5.4-19	1		5.C-23	0
5.4-20	1		5.C-24	0
5.4-21	1		5.C-25	0
5.4-22	1		5.C-26	0
5.4-23	1		5.C-27	0
5.4-24	1		5.C-28	0
5.4-25	1		5.C-29	0
5.4-26	1		5.C-30	0
5.4-27	1		5.C-31	0
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5.4-29	1		5.C-33	0
5.4-30	1		5.C-34	0
5.4-31	1		5.C-35	0
5.4-32	1		5.C-36	0
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6.2-15	1		6.3-3	1B
6.2-16	1		6.3-4	1B
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6.4-4	1B		6.A-12	1
6.4-5	1B		6.A-13	1
6.4-6	1B		6.A-14	1
6.4-7	1B		6.A-15	1
6.4-8	1B		6.A-16	1
6.4-9	1B		6.A-17	1
6.4-10	1B		6.A-18	1
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6.4-14	1B		Fig. 6.A.2	0
6.4-15	1B		Fig. 6.A.3	0
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6.4-22	1B		6.C-2	1
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Fig. 6.4.3	1		6.C-8	1
Fig. 6.4.4	1		6.C-9	1
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Fig. 6.4.6	1		6.C-11	1
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Fig. 6.4.9	1		6.C-14	1
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Fig. 6.4.15	1		6.D-3	0
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Fig. 8.3.2a	0			
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Fig. 10.3.1c	0			
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10CFR73. Preparation of a physical security plan in accordance with 10CFR73.55.

- Review of the reactor emergency plan, quality assurance (QA) program, training program, and radiation protection program.

The generic safety analyses contained in the HI-STORM 100 FSAR may be used as input and for guidance by the licensee in performing a 10CFR72.212 evaluation.

Within this report, all figures, tables and references cited are identified by the double decimal system m.n.i, where m is the chapter number, n is the section number, and i is the sequential number. Thus, for example, Figure 1.2.3 is the third figure in Section 1.2 of Chapter 1.

Revisions to this document are made on a section level basis. Complete sections have been replaced if any material in the section changed. The specific changes are noted with revision bars in the right margin. Figures are revised individually. Drawings are controlled separately within the Holtec QA program and have individual revision numbers. Bills-of-Material (BOMs) are considered separate drawings and are not necessarily at the same revision level as the drawing(s) to which they apply. If a drawing or BOM was revised in support of the current FSAR revision, that drawing/BOM is included in Section 1.5 at its latest revision level. Drawings and BOMs appearing in this FSAR may be revised between formal updates to the FSAR. Therefore, the revisions of drawings/BOMs in Section 1.5 may not be current.

Table 1.0.1

TERMINOLOGY AND NOTATION

ALARA is an acronym for As Low As Reasonably Achievable.

Boral is a generic term to denote an aluminum-boron carbide cermet manufactured in accordance with U.S. Patent No. 4027377. The individual material supplier may use another trade name to refer to the same product.

Boral™ means Boral manufactured by AAR Advanced Structures.

BWR is an acronym for boiling water reactor.

C.G. is an acronym for center of gravity.

Confinement Boundary means the outline formed by the sealed, cylindrical enclosure of the Multi-Purpose Canister (MPC) shell welded to a solid baseplate, a lid welded around the top circumference of the shell wall, the port cover plates welded to the lid, and the closure ring welded to the lid and MPC shell providing the redundant sealing.

Confinement System means the Multi-Purpose Canister (MPC) which encloses and confines the spent nuclear fuel during storage.

Controlled Area means that area immediately surrounding an ISFSI for which the owner/user exercises authority over its use and within which operations are performed.

Cooling Time for a spent fuel assembly is the time between its discharge from the reactor (reactor shutdown) and the time the spent fuel assembly is loaded into the MPC.

DBE means Design Basis Earthquake.

DCSS is an acronym for Dry Cask Storage System.

Damaged Fuel Assembly is a fuel assembly with known or suspected cladding defects, as determined by review of records, greater than pinhole leaks or hairline cracks, ~~*missing*~~ *empty* fuel rod *locations* that are not replaced with dummy fuel rods, or those that cannot be handled by normal means. ~~*A damaged fuel assembly's inability to be handled by normal means may be due to mechanical damage and must not be due to fuel cladding damage.*~~ *Fuel assemblies that cannot be handled by normal means due to fuel cladding damage are considered fuel debris.*

Damaged Fuel Container *(or Canister)* means a specially designed enclosure for damaged fuel or fuel debris which permits gaseous and liquid media to escape while minimizing dispersal of gross spent fuel storage in accordance with 10CFR72.

Intact Fuel Assembly is defined as a fuel assembly without known or suspected cladding defects greater than pinhole leaks and hairline cracks, and which can be handled by normal means. Partial fuel assemblies, that is fuel assemblies from which fuel rods are missing, shall not be classified as Intact Fuel Assemblies unless dummy fuel rods are used to displace an amount of water greater than or equal to that displaced by the original fuel rod(s).

License Life means the duration for which the system is authorized by virtue of its certification by the U.S. NRC.

Lowest Service Temperature (LST) is the minimum metal temperature of a part for the specified service condition.

Maximum Reactivity means the highest possible k-effective including bias, uncertainties, and calculational statistics evaluated for the worst-case combination of fuel basket manufacturing tolerances.

METCON™ is a trade name for the HI-STORM 100 overpack. The trademark is derived from the **metal-concrete** composition of the HI-STORM 100 overpack.

MGDS is an acronym for Mined Geological Disposal System.

***Moderate Burnup Fuel** is a spent fuel assembly with an average burnup less than or equal to 45,000 MWD/MTU.*

Multi-Purpose Canister (MPC) means the sealed canister which consists of a honeycombed fuel basket for spent nuclear fuel storage, contained in a cylindrical canister shell which is welded to a baseplate, lid with welded port cover plates, and closure ring. MPC is an acronym for multi-purpose canister. There are different MPCs with different fuel basket geometries for storing PWR or BWR fuel, but all MPCs have identical exterior dimensions. The MPC is the confinement boundary for storage conditions. ~~*The MPCs used as part of the HI-STORM 100 System are identical to the HI-STAR 100 MPCs evaluated in the HI-STAR 100 storage (Docket No. 72-1008) and transport (Docket No. 71-9261) applications.*~~

NDT is an acronym for Nil Ductility Transition Temperature, which is defined as the temperature at which the fracture stress in a material with a small flaw is equal to the yield stress in the same material if it had no flaws.

Table 1.0.1 (continued)

TERMINOLOGY AND NOTATION

Neutron Shielding means a material used to thermalize and capture neutrons emanating from the radioactive spent nuclear fuel.

Non-Fuel Hardware is defined as Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Devices (TPDs), Control Rod Assemblies (CRAs), Axial Power Shaping Rods (APSRs), Wet Annular Burnable Absorbers (WABAs), Rod Cluster Control Assemblies (RCCAs), water displacement guide tube plugs, and orifice rod assemblies.

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

***Plain Concrete** is concrete that is unreinforced and is of density specified in this FSAR .*

***Preferential Fuel Loading** is a requirement in the CoC applicable to uniform fuel loading whenever fuel assemblies with significantly different post-irradiation cooling times (≥ 1 year) are to be loaded in the same MPC. Fuel assemblies with the longest post-irradiation cooling time are loaded into fuel storage locations at the periphery of the basket. Fuel assemblies with shorter post-irradiation cooling times are placed toward the center of the basket. Regionalized fuel loading meets the intent of preferential fuel loading. Preferential fuel loading is a requirement in addition to other restrictions in the CoC such as those for non-fuel hardware and damaged fuel containers.*

***Post-Core Decay Time (PCDT)** is synonymous with cooling time.*

PWR is an acronym for pressurized water reactor.

Reactivity is used synonymously with effective neutron multiplication factor or k-effective.

***Regionalized Fuel Loading** is a term used to describe an optional fuel loading strategy used in lieu of uniform fuel loading. Regionalized fuel loading allows high heat emitting fuel assemblies to be stored in fuel storage locations in the center of the fuel basket provided lower heat emitting fuel assemblies are stored in the peripheral fuel storage locations. Users choosing regionalized fuel loading must also consider other restrictions in the CoC such as those for non-fuel hardware and damaged fuel containers. Regionalized fuel loading meets the intent of preferential fuel loading.*

SAR is an acronym for Safety Analysis Report (10CFR71).

Service Life means the duration for which the component is reasonably expected to perform its intended function, if operated and maintained in accordance with the provisions of this FSAR. Service Life may be much longer than the Design Life because of the conservatism inherent in the

Table 1.0.1 (continued)

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codes, standards, and procedures used to design, fabricate, operate, and maintain the component.

Single Failure Proof means that the handling system is designed so that all directly loaded tension and compression members are engineered to satisfy the enhanced safety criteria of Paragraphs 5.1.6(1)(a) and (b) of NUREG-0612.

SNF is an acronym for spent nuclear fuel.

SSC is an acronym for Structures, Systems and Components.

STP is Standard Temperature and Pressure conditions.

Thermosiphon *is the term used to describe the buoyancy-driven natural convection circulation of helium within the MPC fuel basket.*

FSAR is an acronym for Final Safety Analysis Report (10CFR72).

Uniform Fuel Loading *is a fuel loading strategy where any authorized fuel assembly may be stored in any fuel storage location, subject to other restrictions in the CoC, such as preferential fuel loading, and those applicable to non-fuel hardware, and damaged fuel containers.*

ZPA is an acronym for zero period acceleration.

Table 1.0.2

HI-STORM 100 SYSTEM FSAR REGULATORY COMPLIANCE CROSS-REFERENCE MATRIX

Regulatory Guide 3.61 Section and Content	Associated NUREG-1536 Review Criteria	Applicable 10CFR72 or 10CFR20 Requirement	HI-STORM FSAR
1. General Description			
1.1 Introduction	1.III.1 General Description & Operational Features	10CFR72.24(b)	1.1
1.2 General Description	1.III.1 General Description & Operational Features	10CFR72.24(b)	1.2
1.2.1 Cask Character-istics	1.III.1 General Description & Operational Features	10CFR72.24(b)	1.2.1
1.2.2 Operational Features	1.III.1 General Description & Operational Features	10CFR72.24(b)	1.2.2
1.2.3 Cask Contents	1.III.3 DCSS Contents	10CFR72.2(a)(1) 10CFR72.236(a)	1.2.3
1.3 Identification of Agents & Contractors	1.III.4 Qualification of the Applicant	10CFR72.24(j) 10CFR72.28(a)	1.3
1.4 Generic Cask Arrays	1.III.1 General Description & Operational Features	10CFR72.24(c)(3)	1.4
1.5 Supplemental Data	1.III.2 Drawings	10CFR72.24(c)(3)	1.5
NA	1.III.6 Consideration of Transport Requirements	10CFR72.230(b) 10CFR72.236(m)	1.1
NA	1.III.5 Quality Assurance	10CFR72.24(n)	1.3
2. Principal Design Criteria			
2.1 Spent Fuel To Be Stored	2.III.2.a Spent Fuel Specifications	10CFR72.2(a)(1) 10CFR72.236(a)	2.1
2.2 Design Criteria for Environmental Conditions and Natural Phenomena	2.III.2.b External Conditions, 2.III.3.b Structural, 2.III.3.c Thermal	10CFR72.122(b)	2.2
		10CFR72.122(c)	2.2.3.3, 2.2.3.10
		10CFR72.122(b)(1)	2.2
		10CFR72.122(b)(2)	2.2.3.11
		10CFR72.122(h)(1)	2.0

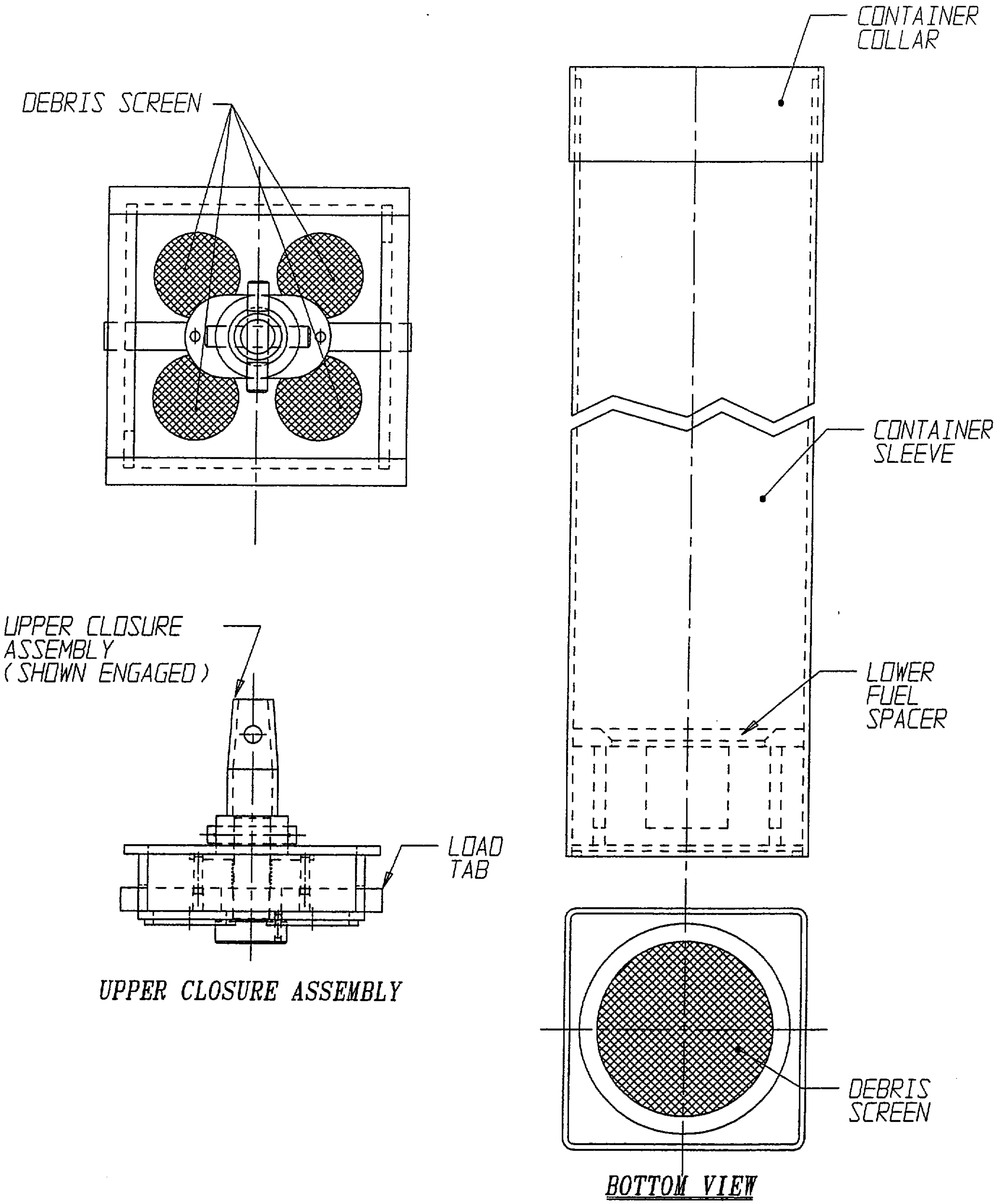
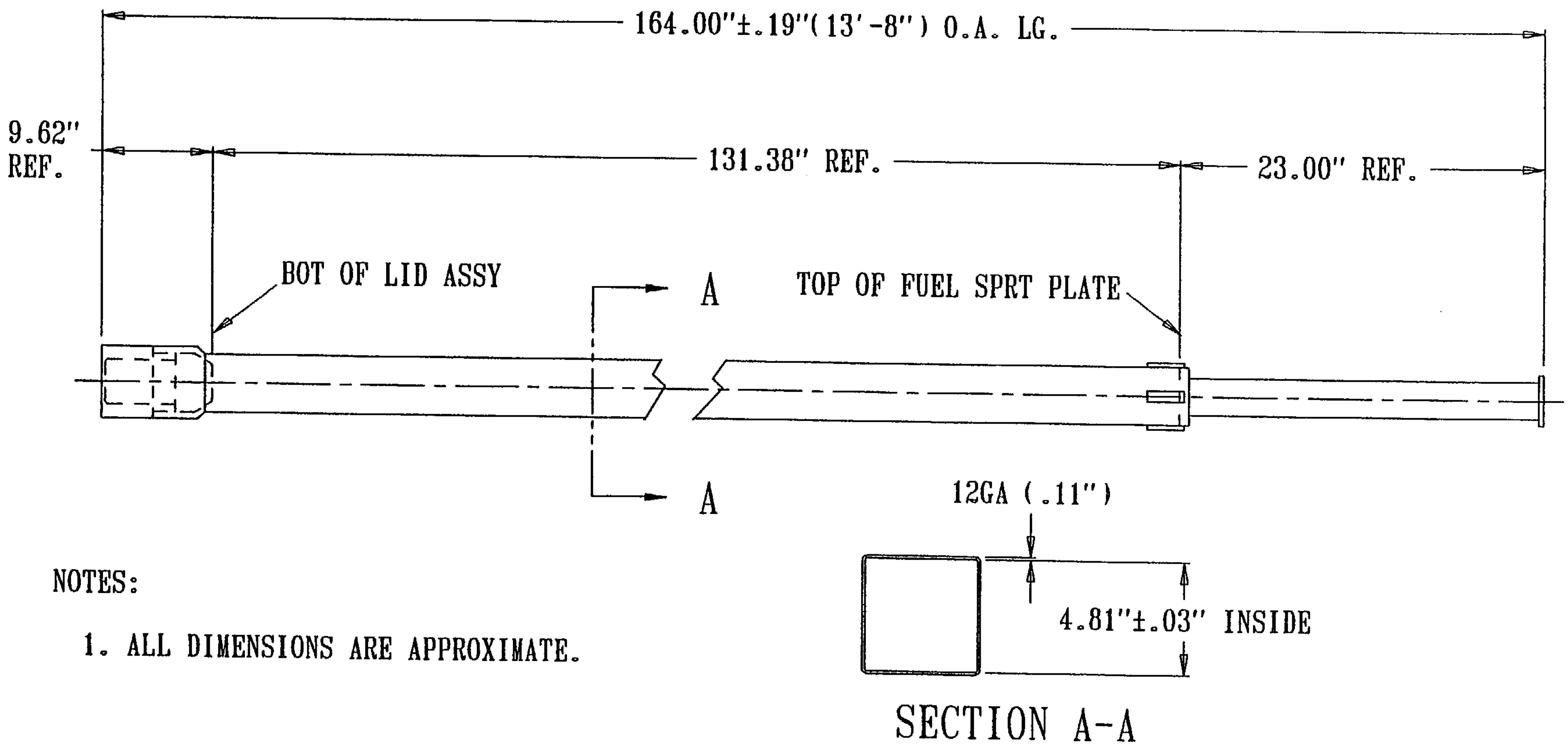


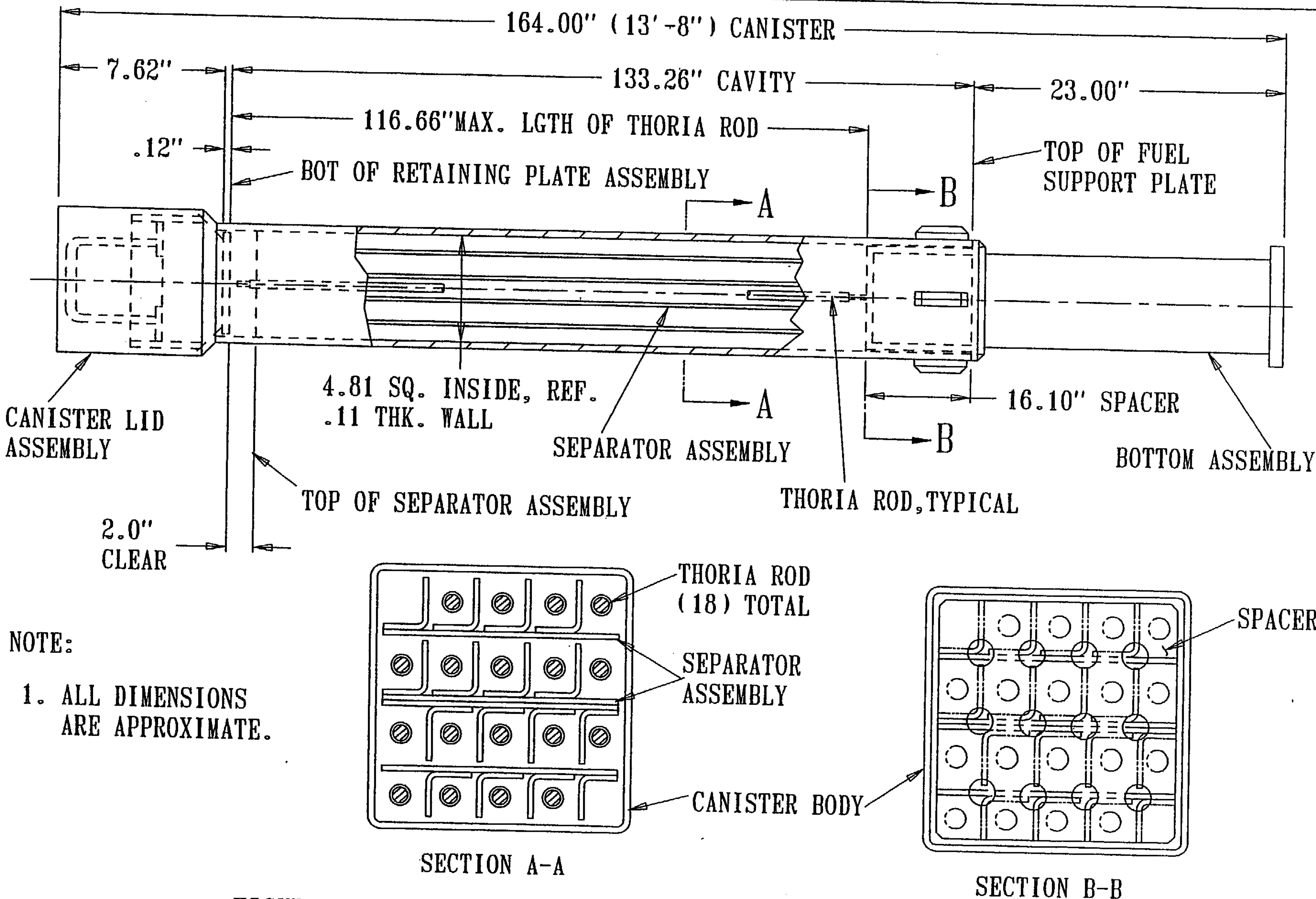
FIGURE 2.1.1; DAMAGED FUEL CONTAINER FOR DRESDEN UNIT-1/ HUMBOLT BAY SNF



NOTES:

1. ALL DIMENSIONS ARE APPROXIMATE.

FIGURE 2.1.2; TN DAMAGED FUEL CANISTER FOR DRESDEN UNIT-1



NOTE:

1. ALL DIMENSIONS ARE APPROXIMATE.

FIGURE 2.1.2A; TN THORIA ROD CANISTER FOR DRESDEN UNIT-1

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NOTES:
1. ALL DIMENSIONS ARE APPROXIMATE.
2. ALL MATERIAL IS STAINLESS STEEL.

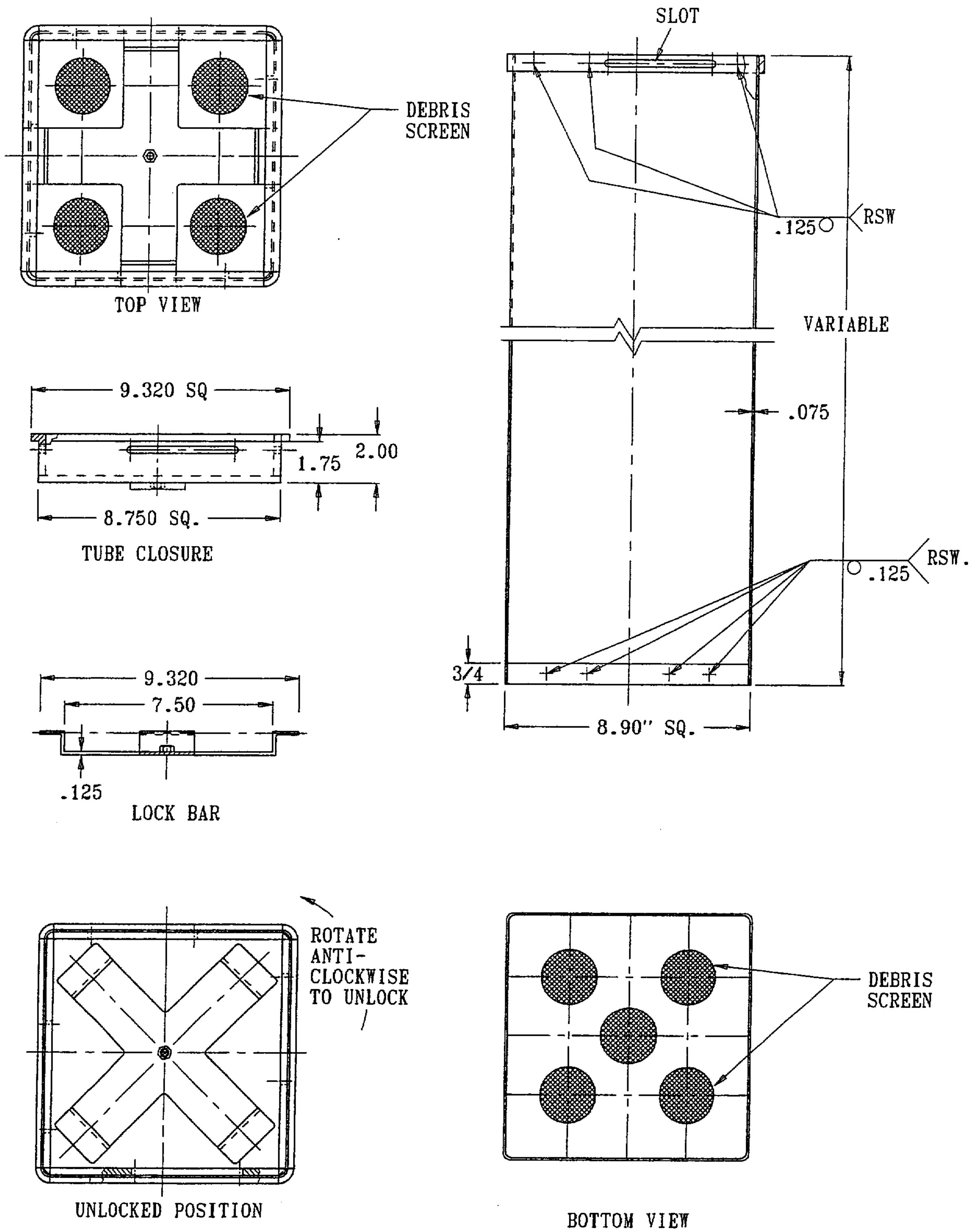


FIGURE 2.1.2B; HOLTEC DAMAGED FUEL CONTAINER FOR PWR SNF IN MPC-24E/24EF

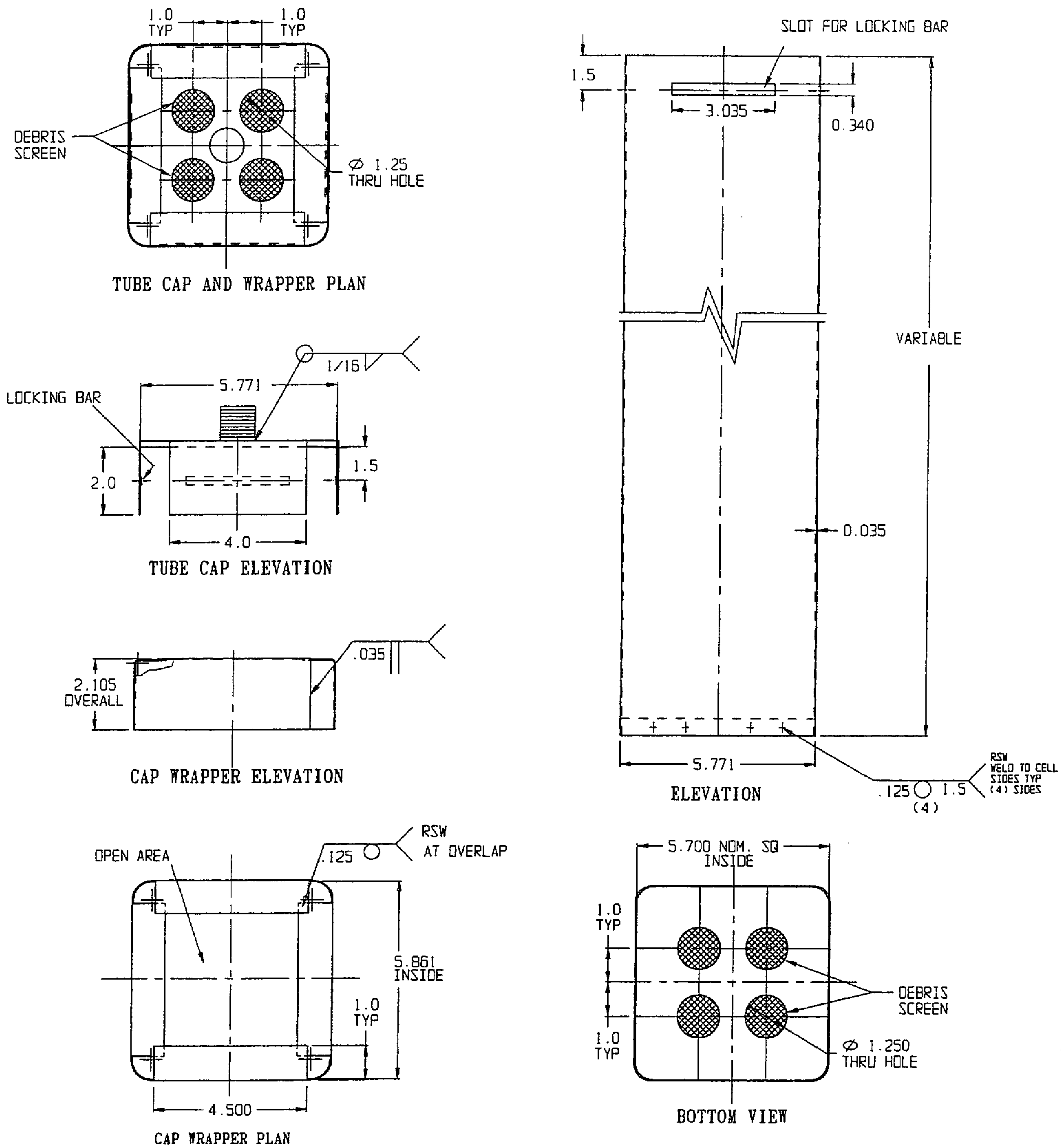


FIGURE 2.1.2C; HOLTEC DAMAGED FUEL CONTAINER FOR BWR SNF IN MPC-68/68FF

APPENDIX 2.A

GENERAL DESIGN AND CONSTRUCTION REQUIREMENTS FOR THE ISFSI PAD FOR HI-STORM 100A

2.A.1 General Comments

As stated in Section 2.0.4, an ISFSI slab that anchors a spent fuel storage cask should be classified as "important to safety." This classification of the slab follows from the provisions of 10CFR72, which require that the cask system retain its capacity to store spent nuclear fuel in a safe configuration subsequent to a seismic or other environmental event. Since the slab for anchored HI-STORM deployment is designated as ITS, the licensee is required to determine whether the reacttor site parameters, including earthquake intensity and large missiles, are enveloped by the cask deesign bases. The intent of the regulatory criteria is to ensure that the slab meets all interface requirements of the cask design and the geotechnical characteristics of the ISFSI site.

This appendix provides general requirements for design and construction of the ISFSI concrete pad as an ITS structure, and also establishes the framework for ensuring that the ISFSI design bases are clearly articulated. The detailed design of the ISFSI pad for anchored HI-STORM deployment shall comply with the technical provisions set forth in this appendix.

2.A.2 General Requirements for ISFSI Pad

1. *Consistent with the provisions of NUREG-1567 [2.0.6], all concrete work shall comply with the requirements of ACI-349-97 [2.0.2].*

2. *All reinforcing steel shall be manufactured from high strength billet steel conforming to ASTM designation A615 Grade 60.*

3. *The ISFSI owner shall develop appropriate mixing, pouring, reinforcing steel placement, curing, testing, and documentation procedures to ensure that all provisions of ACI 349-97 [2.0.2] are met.*

4. *The placement, depth, and design and construction of the slab shall take into account the depth of the frost line at the ISFSI location. The casks transmit a very small amount of heat into the cask pad through conduction. The American Concrete Institute guidelines on reinforced concrete design of ground level slabs to minimize thermal and shrinkage induced cracking shall be followed.*

5. *General Requirements for Steel Embedment: The steel embedment,* excluding *the* pre-tensioned *anchorage* studs, is *required to follow the provisions stipulated in ACI 349-97 [2.0.2], Appendix B "Steel Embedment" and the associated Commentary on Appendix B,* as applicable. Later editions of this Code may be used provided a written reconciliation is performed. *An example of one acceptable embedment configuration is provided in Figure 2.A.1. Site-specific embedment designs may vary from this example, depending on the geotechnical characteristics of the site-specific foundation. The embedment designer shall consider any current, relevant test data in designing the pad embedment for HI-STORM 100A and HI-STORM 100SA.*

6. *The ISFSI owner shall ensure that pad design analyses, using interface loads provided in this report, demonstrate that all structural requirements of NUREG-1567 and ACI-349-97 are satisfied.*

7. *Unless the load handling device is designed in accordance with ANSI N14.6 and incorporates redundant drop protection features, the ISFSI owner shall ensure that a permissible cask carry height is computed for the site-specific pad/foundation configuration such that the design basis deceleration set forth in this FSAR are not exceeded in the event of a handling accident involving a vertical drop.*

8. *The ISFSI owner shall ensure that the pad/foundation configuration provides sufficient safety margins for overall kinematic stability of the cask/pad/foundation assemblage.*

9. *The ISFSI owner shall ensure that the site--specific seismic inputs, established at the top surface of the ISFSI pad, are bounded by the seismic inputs used as the design basis for the attachment components. If required, the ISFSI owner shall perform additional analyses to ensure that the site-specific seismic event or durations greater than the design basis event duration analyzed in this report, do not produce a system response leading to structural safety factors (defined as allowable stress (load) divided by calculated stress (load)) less than 1.0. Table 2.0.5 and Table 2.2.8 provide the limiting values of ZPAs in the three orthogonal directions that must not be exceeded at an ISFSI site (on the pad top surface) to comply with the general CoC for the HI-STORM 100A (and 100SA) System.*

10. *An ISFSI pad used to support anchored HI-STORM overpacks, unlike the case of free standing overpacks, may experience tensile (vertically upward) anchorage forces in addition to compression loads. The reinforcing steel (pattern and quantity) must be selected to meet the demands of the anchorage forces under seismic and other environmental conditions that involve destabilizing loadings (such as the large tornado missile defined in this FSAR).*

2.A.3 Steel Embedment for Anchored Casks

Figure 2.A.1 shows a typical fastening arrangement-for the HI-STORM 100A System. The details of the rebars in the pad (which are influenced by the geotechnical characteristics of the foundation and its connection to the underlying continuum) are not shown in Figure 2.A.1. Representative dimensions of the embedment and anchorage system are provided in Table 2.A.1.

The embedment detail illustrated in Figure 2.A.1 is designed to resist a load equal to the ASME Code, Section III Appendix F Level D load capacity of the cask anchor studs. The figure does not show the additional reinforcement required to ensure that tensile cracking of concrete is inhibited (see Figure B-4 in the Commentary ACI-349R-97) as this depends on the depth chosen for the ITS ISFSI pad concrete. The ACI Code contemplates ductile failure of the embedment steel and requires that the ultimate load capacity of the steel embedment be less than the limit pullout strength of the concrete surrounding the embedment that resists the load transferred from the cask anchor stud. If this criterion cannot be assured, then additional reinforcement must be added to inhibit concrete cracking (per Subsection B.4.4 of Appendix B of ACI-349-97).

The anchor stud receptacle described in Figure 2.A.1 is configured so that the cask anchor studs (which interface with the overpack baseplate as well as the pad embedment per Table 2.0.5 and are designed in accordance with ASME Section III, Subsection NF stress limits), sits flush with the ISFSI top surface while the cask is being positioned. Thus, a translocation device such as an "air pad" (that requires a flat surface) can be used to position the HI-STORM at the designated location. Subsequent to positioning of the cask, the cask anchor stud is raised, the anchor stud nut installed, and the anchor stud preload applied. The transfer of load from the cask anchor stud to the embedment is through the bearing surface of the lower head of the cask anchor stud and the upper part of the anchor stud receptacle shown in the figure. The members of the anchoring system illustrated in Figure 2.A.1, as well as other geometries developed by the ISFSI designer, must meet the following criteria:

i. *The weakest structural link in the system shall be in the ductile member. In other words, the tension capacity of the anchor stud/anchor receptacle group (based on the material ultimate strengths) shall be less than the concrete pull-out strength (computed with due recognition of the rebars installed in the pad).*

ii. *The maximum ratio of embedment plus cask anchor stud effective tensile stiffness to the effective compressive stiffness of the embedment plus concrete shall not exceed 0.25 in order to ensure the effectiveness of the pre-load.*

iii. *The maximum axial stress in the cask anchor studs under normal and seismic conditions shall be governed by the provisions of ASME Section III Subsection NF (1995).*

For sites with lower ZPA DBE events, compared to the limiting ZPAs set down in this FSAR, the size of the anchor studs and their number can be appropriately reduced. However, the above three criteria must be satisfied in all cases.

Table 2.A.1 ***Typical Embedment and Anchoring Data (Figure 2.A.1)***	
Nominal diameter of the anchor stud, (-inch)	*2*
Thickness of the embedment ring, (inch)	*2*
I.D. of the embedment ring, (inch)	*130*
Anchor receptacle: *Upper Position O.D. and I.D. (inch)* *Lower portion O.D. and I.D. (inch)*	 *O.D.: 2.5 / I.D.: 2.125 (min.)* *O.D.: 4.875 / I.D.: 3.625 (min.)*
Depth of anchor receptacle collar, d, (inch)	*2.5*
Free fall height of the anchor stud, h_e, (inch)	*8*
Representative Materials of Construction are as follows: [1]	
Anchor Studs:	*Per Table 2.0.4*
Anchor Receptacle:	*Low carbon steel such as A-36, A-105*
Top Ring, Upper Collar, Anchor Ring:	*Low carbon steel such as A-36, A-516-Gr. 70*

1 The ISFSI designer shall ensure that all permanently affixed embedment parts (such as the anchor receptacle) made from materials vulnerable to deleterious environmental effects (e.g. low carbon steel) are protected through the use of suitably engineered corrosion barrier. Alternatively, the selected material of construction must be innately capable of withstanding the long term environmental conditions at the ISFSI site.

TABLE 3.3.4 (CONTINUED)
BOLTING MATERIAL PROPERTIES

SA193 Grade B7 (less than 2.5 inch diameter)					
Temp. (Deg.F)	S_y	S_u	E	α	-
<200	105.0	125.00	-	5.9	-
200	97.8	116.43	-	5.9	-
300	94.2	112.14	-	5.9	
400	91.5	108.93	-	5.91	-
Temp. (Deg.F)	SA705-630/SA564-630 (Age Hardened at 1075 degrees F)				
	S_y	S_u	E	α	S_m
200	115.6	145.0	28.5	5.9	---
300	110.7	145.0	27.9	5.9	---
400	106.9	145.0	27.3	5.91	---
SA705-630/SA564-630 (Age Hardened at 1150 degrees F)					
200	97.1	135.0	28.5	5.9	---
300	93.0	135.0	27.9	5.9	---

Definitions:

S_m = Design stress intensity (ksi)
S_y = Yield Stress (ksi)
α = Mean Coefficient of thermal expansion (in./in. per degree F x 10^{-6})
S_u = Ultimate Stress (ksi)
E = Young's Modulus (psi x 10^6)

Notes:

1. Source for S_y values is Table Y-1 of [3.3.1].
2. Source for S_u values is Table U of [3.3.1].
3. Source for α values is Tables TE-1 and TE-4 of [3.3.1], as applicable.
4. Source for E values is Table TM-1 of [3.3.1].

TABLE 3.3.5
CONCRETE AND LEAD MECHANICAL PROPERTIES

PROPERTY	VALUE					
CONCRETE:						
Compressive Strength (psi)	*Ref. Table 1.D.1*~~4,000~~					
Nominal Density (lb/ft^3)	*Ref. Table 1.D.1* ~~150 (146 minimum)~~					
Allowable Bearing Stress (psi)	2,210[†]					
Allowable Axial Compression (psi)	1,535[†]					
Allowable Flexure, extreme fiber tension (psi)	205[†,††]					
Allowable Flexure, extreme fiber compression (psi)	2,600[†]					
Mean Coefficient of Thermal Expansion (in/in/deg.F)	5.5E-06					
Modulus of Elasticity (psi)	57,000 (compressive strength (psi))$^{1/2}$					
LEAD:	-40°F	-20°F	70°F	200°F	300°F	600°F
Yield Strength (psi)	700	680	640	490	380	20
Modulus of Elasticity (ksi)	2.4E+3	2.4E+3	2.3E+3	2.0E+3	1.9E+3	1.5E+3
Coefficient of Thermal Expansion (in/in/deg.F)	15.6E-6	15.7E-6	16.1E-6	16.6E-6	17.2E-6	20.2E-6
Poisson's Ratio	0.40					
Density (lb/cubic ft.)	708					

Notes:
1. Concrete allowable stress values based on ACI 318.1.
2. Lead properties are from [3.3.5].

† *Values listed correspond to concrete compressive stress = 4,000 psi*
†† No credit for tensile strength of concrete is taken in the calculations

APPENDIX 3.D: VERTICAL HANDLING OF OVERPACK WITH HEAVIEST MPC

3.D.1 Introduction

There are two vertical lifting scenarios for the HI-STORM 100 during the normal operation procedures at the ISFSI pad. The first scenario considers the vertical lifting of a fully loaded HI-STORM 100 with four synchronized hydraulic jacks, each positioned at each of the four inlet vents located at the bottom end. This operation allows the installation of air pads under the HI-STORM 100 baseplate. The second scenario considers the lifting of a fully loaded HI-STORM 100 vertically through the four lifting lugs located at the top end. The lifting device assemblage is constructed such that the lift forces at each lug are parallel to the longitudinal axis of the HI-STORM 100 during the operation. The stress intensity induced on the cask components as a result of these operations is determined, analyzed, and the structural integrity evaluated. The finite element models for the analyses in this appendix have been color coded to differentiate cask components. The legends for the color codes are listed in Sections 3.D.3 and 3.D.4 below.

3.D.2 Assumptions

a. Conservatively, the analysis takes no credit for the structural rigidity of the radial concrete shielding between the outer and the inner shells of the HI-STORM 100 and also no credit for the structural rigidity of the MPC pedestal shield. Hence, the weight of the radial concrete shielding, the MPC pedestal shield, and the MPC are respectively applied as surface pressure on the baseplate during the vertical lifting of HI-STORM 100 from the bottom end through the inlet vents and, as lumped mass during the vertical lifting of HI-STORM 100 at the top end through the lifting lugs. Property values used are approximately equal to the final values set in the Tables in Chapter 3. Drawings 1495, 1561 and associated Bills of Materials are used for dimensions.

b. The acceleration of gravity of 1.15g is considered in order to account for a 15% dynamic load factor due to lifting. The 15% increase, according to Reference 2, is considered in crane standards as appropriate for low speed lifting operations.

c. The shield shell is not explicitly modeled. The weight of the shield is added to the weight of the inner shell for top end lift and as a lumped mass for the bottom end lift. Added weights are obtained by direct calculation.

c. *The geometry of the HI-STORM 100 is considered for the analysis of the top lift in this appendix*[1].

3.D.3 Analysis Methodology - Bottom Lift at the Inlet Vents

A 3-D, 1/4-symmetry, finite element model of the bottom segment of the HI-STORM 100 storage overpack is constructed using the ANSYS 3-D elastic shell element SHELL63. ANSYS is a general purpose finite element program. The Young's modulus, at 300 degree F, the Poisson's ratio, and material density for SA516-70 steel are respectively taken as 29.34E+06 psi, 0.29, and 0.288 pounds per-cubic-inch. The respective thickness of the HI-STORM 100 components are also appropriately considered, i.e., 1.25 inches for the inner shell, 0.75 inches for the outer shell, 2.0 inches for the baseplate, 0.5[2] inches for the radial ribs, 2 inches for the inlet vent horizontal plate, and 0.75 inches for the inlet vent vertical plates. The model is terminated approximately 20 inches above the base of the HI-STORM 100 storage overpack with the weight of the sections of the HI-STORM 100 storage overpack not modeled lumped at the top end of the finite element model. The contact surface between the inlet horizontal plate and hydraulic jack is fixed vertically.

An equivalent pressure load of 31.61 psi from the weights of the heaviest MPC and the pedestal shield is applied on the HI-STORM 100 baseplate over the surface area covered by the pedestal (the applied total load is 116,067 lb. based on a 68.375" outer diameter). The equivalent pressure load of 20.55 psi from the weight of the radial concrete shielding is applied on the baseplate as well as the inlet vent horizontal plates. The applied equivalent pressure loads include the 15% load increase above the dead load to account for inertia effects developed during a lift operation Figure 3.D.1 shows the plot of the finite element model for the bottom lift scenario. Figure 3.D.1 is color-coded to differentiate cask components as follows:

Figure 3.D.1 Cask Component Color Codes

Component	Color
Baseplate	Blue-Purple-Red
Inner Shell	Green

[1] *It is recognized that the HI-STORM 100S overpack is lighter than the HI-STORM 100 overpack and the outlet air ducts are located in the lid in the 100S. Safety factors computed in this appendix are also reported in Subsection 3.4.3.5 of this FSAR. Similar calculations have been performed in Holtec calculation packages for the 100S overpack, where differences in configurations between the two overpack design warrant. Safety factors for the HI-STORM 100S are also reported in Subsection 3.4.3.5.*

[2] Analysis is conservative since final rib thickness is 0.75 inch.

Outer Shell	Magenta
Rib	Dark Blue
Inlet Vent Vertical Plate	Mustard
Inlet Vent Horizontal Plate	Color Grid

3.D.4 Analysis Methodology - Top End Lift

3.D.4.1 Model at Top near Lift Points

A 3-D, 1/8-symmetry, finite element model of the top segment of the HI-STORM 100 is constructed using ANSYS 3-D elastic shell element SHELL63, 3-D structural solid with rotation SOLID73, and 3-D structural mass element MASS21. The material properties used, i.e., Young's Modulus, the Poisson's ratio, and material density are identical to those listed in Section 3.D.3. The respective thickness of the HI-STORM 100 components (in addition to the inner shell, the outer shell, and the ribs) are also appropriately considered, i.e., 0.75 inches for the top plate, 1.25 inches for the exit vent horizontal plate, 0.5 inches for the exit vent vertical plate, 0.75 inches for the horizontal step plate and the vertical step plate. The model is terminated at about 43 inches from the top end of the HI-STORM 100. The mass of the sections of the HI-STORM 100 not modeled, with the exception off the overpack lid and the shield blocks, are lumped at the lower end of the finite element model. A bounding value for the mass of the overpack lid and the shield blocks are lumped at the top end of the vertical step plates. All lumped masses use the ANSYS MASS21 elements. The lifting lug is explicitly modeled with the ANSYS SOLID73 element. The SOLID73 element is selected for its compatible degrees-of-freedom with the ANSYS SHELL63. The top end of the lifting lug in the finite element model is restricted from vertical translation. Since the lifting lug itself is not part of the HI-STORM 100 system, the model of this component is performed only to a level necessary to properly simulate the location of the lift point. Figures 3.D.2a, 3.D.2b, and 3.D.2c show the detailed plots of the finite element model for the top lift scenario. Figures 3.D.2a, 3.D.2b, and 3.D.2c are color-coded to differentiate cask components as follows:

Figure 3.D.2 Cask Component Color Codes

Component	Color
Inner Shell	Cyan
Outer Shell	Red
Step Horizontal Plate	Purple
Step Vertical Plate	Purple
Exit Vent Horizontal Plate	Green

Exit Vent Vertical Plate	Magenta
Rib	Mustard
Top Plate	Blue
Anchor Block	Cyan
Lug	Cyan

We note that the analysis model used here included small "step" plates. The step plate has been eliminated in the storage overpack in Revision 5 (see drawings in Chapter 1) to simplify fabrication. The removal of the "step" plates also removes a potential area of stress concentration from the configuration. Therefore, the analysis reported here, which retains the step, produces conservative stress results and is bounding for the final configuration in this area of the structure.

3.D.4.2 Model Near Baseplate

The 2-inch thick, HI-STORM 100 baseplate is fabricated from SA-516-Grade 70 carbon steel material. The baseplate is continuously welded to the inner shell, the outer shell, the inlet vents, and the MPC pedestal shell. During a vertical lift using the top end lift lugs, the baseplate supports the MPC, the MPC pedestal, and the radial concrete shielding between the inner shell and the outer shell. The stress intensity and the associated distribution on the HI-STORM 100 baseplate as a result of the vertical lift through the lifting lug is evaluated using the same finite element model as that described in Section 3.D.3 above. For this analysis, the finite element model in Figure 3.D.1 is restrained against vertical translation at the top end of the model away from the baseplate. The weight of the pedestal, the MPC, and the radial concrete shield are applied as pressure loads as described in Section 3.D.1, and no hydraulic jacks are assumed in-place in the inlet vents.

3.D.5 Stress Evaluation

For all analyses, safety evaluation is based on the consideration of all components as Class 3 plate and shell support structures per the ASME Code Section III, Subsection NF. Stress intensity distributions are obtained for all sections of the model. Although the relevant Code section places limits on maximum stresses, the use of a stress intensity based safety factor is used here for convenience. The distribution of stress intensity on the HI-STORM 100 from the bottom end lifting through the inlet vents is shown in Figure 3.D.3. The maximum surface stress intensity, located on the inlet vent plate, is 13,893 psi based on the element distribution used. As seen from Figure 3.D.3, this surface stress intensity bounds the values at all other locations and therefore could be used to provide a bounding safety factor for all sections modeled in this simulation. The nature of the finite element model is such that the surface stress intensity results near discontinuities in loading or in the structure include secondary stress intensity components as well as primary membrane and primary bending. In particular, this stress intensity component includes secondary effects both from the abrupt change in the applied load and from the joint between the horizontal and vertical plates of the inlet vent. Away from this local region, we can estimate from the distributions plotted in Figure 3.D.3 that the maximum primary membrane plus primary bending stress intensity is approximately 8000 psi.

The distributions of stress intensity on the HI-STORM 100 from the top end lifting through the lifting lugs are shown in Figures 3.D.4a and 3.D.4b, and 3.D.4c. Figures 3.D.4a and 3.D.4b show a cut through the middle surface of the radial rib and rib bolt block. The maximum stress intensity consistent with the finite element discretization, located on the rib plate, is 16,612 psi (Figure 3.D.4b). This stress is localized and represents a mean stress intensity plus secondary membrane stress intensity components introduced from the abrupt geometry change where the rib bolt block is welded to the radial rib. If attention is focused on the radial rib away from the local discontinuity, then the mean stress intensity is approximately 10,000 psi (the iso-stress intensity boundary between yellow and yellow-green in Figure 3.D.4(b)). Figure 3.D.4c shows the "step" (no longer present in the structure) and identifies the local stress intensity amplification that no longer is present.

The stress intensity distribution on the baseplate due to the lifting of HI-STORM 100 through the top end lifting lugs are shown in Figures 3.D.5a, 3.D.5b, and 3.D.5c. These three figures show different views of the components and identify the locations of maximum stress intensity. The maximum stress intensity on the baseplate occurs, as expected, just inboard of the inner shell of the storage overpack and has a maximum value, consistent with the level of discretization, of 10,070 psi (Figure 3.D.5a). It is clear from the distribution that this includes a significant secondary stress intensity component introduced by the inlet vent vertical plate. Away from this local region, the surface stress intensity reduces to approximately 7000 psi. At this location, we consider the result to represent the combined primary membrane plus primary bending stress intensity.

The results of these analyses are summarized as follows (neglecting secondary effects introduced by geometry and load changes):

For the top lift, maximum membrane stress intensity, excluding very localized secondary effects due to geometric discontinuities, is in the radial rib, and has the value 10,000 psi. Since this analysis is based on a 0.5" thickness rather than the actual final plate thickness 0.75", for the purpose of establishing a bounding safety factor, we further reduce this stress intensity by 2/3. Therefore, the appropriate safety factor (SF) is (see Table 3.1.10)

SF(membrane stress intensity in radial rib) = 17,500 psi/(10,000 psi x 2/3) = 2.63

For the same top lift, the bounding safety factor for primary membrane plus primary bending (excluding local discontinuity effects) is computed for the baseplate as:

SF(primary membrane plus primary bending stress intensity in baseplate) = 26,250psi/7000psi = 3.75

For the bottom lift,

SF(primary membrane plus primary bending in inlet vent horizontal plate) = 26,250psi/8000 psi = 3.28

The previous calculations have been based on an applied load of 115% of the lifted load with safety factors developed in accordance with ASME Section III, Subsection NF for Class 3 plate and shell support structures. To also demonstrate compliance with Regulatory Guide 3.61, safety factors based on 33.3% of the material yield strength are presented. These safety factors can be easily derived from the previous results by replacing the allowable stress by 33.3% of the material yield strength (1/3 x 33,150 psi from Table 3.3.2 for SA-516). Therefore, the following bounding results are obtained:

SF(membrane - 3W) = 2.63 x 33,150psi/(3 x 17,500 psi) = 1.66

SF(membrane plus bending - 3W) = 3.28 x 33,150 psi/(3 x 26,250 psi) = 1.38

3.D.6 Bolt and Anchor Block Thread Stress Analysis under Three Times Lifted Load

In this section, the threads of the bolt and the bolt anchor block are analyzed under three times the lifted load. The thread system is modeled as a cylindrical area of material under an axial load. The diameter of the cylinder area is the basic pitch diameter of the threads, and the length of the cylinder is the length of engagement of the threads. See Holtec HI-STORM 100 drawing numbers 1495~~1~~ (sheets 2 and 3) and 1561 (sheet 2) for details.

3.D.6.1 Geometry

The basic pitch diameter of the threads is: d_p = *3.0876*~~2.838~~"

The thread engagement length is: L = 3 in.

The shear area of the cylinder that represents the threads: $A = 3.14159 x L \times d_p$

The shear stress on this cylinder under three times the load is: 3W x 1.15/nA = 1*0,670*~~1,608~~ psi

where, the total weight, *W*, and the number of lift points, *n*, are 360,000 pounds and 4, respectively, and the 1.15 represents the inertia amplification.

3.D.6.2 Stress Evaluation

The yield strength of the anchor block material at 350 degrees F is taken as 32,700 psi per Table 3.3.3. Assuming the yield strength in shear to be 60% of the yield strength in tension gives the thread shear stress safety factor under three times the lifted load as:

SF(thread shear - 3 x lifted load) = .6 x 32,700/1*0,670*~~1,608~~ = *1.84*~~1.69~~

The lifting stud material is SA564 630 (age hardened at 1075 degrees F). The yield strength of the stud material at 350 degrees F is 108,800 psi per Table 3.3.4.

The load per lift stud is P = 3W/4 x 1.15 = 310,500 lb.

The stud tensile *stress* area is *(see Machinery's Handbook, 23rd Edition, p. 1484)*~~computed using the mean diameter of the threads~~

A = *7.10*~~6.3258~~ sq. inch.

Therefore, the tensile stress in the stud under three times the lifted load is

Stress = P/A = 4*3,733*~~9,085~~ psi

The factor of safety on tensile stress in the lifting stud, based on three times the lifted load, is:

SF(stud tension – 3 x lifted load) = 108,800/4*3,733*~~9,085~~ = 2.*49*~~217~~

It is concluded that thread shear in the anchor block governs the design.

3.D.7 Weld Evaluation

In this section, weld stress evaluations are performed for the weldments considered to be in the primary load path during lifting operations. The allowable stress for the welds is obtained from Reference [3].

3.D.7.1 Anchor Block-to-Radial Rib (Lift from Top)

There are double sided fillet welds that attach the anchor block to the radial ribs (see drawings 1495, sheet 3 and 1561 sheet 2). The following dimensions are used for analysis:

Total Length of weld = L = 12" + 5"   (Continuous weld along sides and bottom - see drawing 1561 sheet 2)

Weld leg size = t = 0.75"

Weld throat allowable shear stress = S_a = 0.3Su where S_u is the ultimate strength of the base metal (per [3]) = .3 x 65,650 psi (Table 3.3.3 gives the ultimate strength of the anchor block base material).

S_a = 19,695 psi

The following calculations provide a safety factor for the weld in accordance with the requirements of the ASME Code, Section III, Subsection NF for Class 3 plate and shell supports:

Allowable load per anchor block (2 welds) = S_a x 2 x 0.7071 x t x L = 355,072 lb.

Calculated Load (including 15% inertia amplification) = 360,000 lb x 1.15/4 = 103,500 lb.

SF(ASME Code) = 355,072 lb./103,500 lb. = 3.43

The following calculations provide a safety factor for the weld in accordance with the requirements of Regulatory Guide 3.61 (here we use the yield strength at 300 degrees F since the weld is buried in the concrete (Table 2.2.3)):

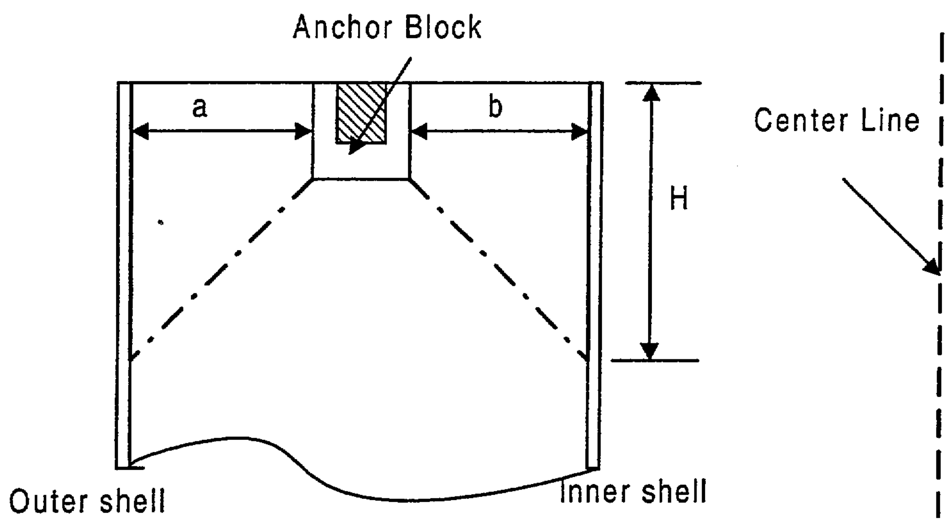
Allowable load per anchor block (2 welds) = 0.6 x 32,700 x 2 x.7071 x t x L = 353,769 lb.

Calculated Load (3 x weight) = 360,000 lb x 3/4 x 1.15 = 310,500 lb.

SF(Reg. Guide 3.61) = 353,769 lb./310,500 lb. = 1.14

3.D.7.2 Radial Rib-to-Inner and Outer Shell (Lift from Top)

The load transferred to the radial ribs from the bolt anchor blocks is dispersed through the rib and also transferred to the inner and outer shell of the storage overpacks. A conservative estimate of the safety factors inherent in the vertical welds connecting the radial ribs to the inner and outer shells is obtained by assuming that the entire load is dispersed into the shells. The length of weld assumed to act in the load transfer is based on a dispersion angle of 45 degrees as shown in the sketch below:



From the geometry of the structure,

a = 11.5" Drawing 1495, sheet 2
b = 11.0"

The depth of the effective weld to each shell is conservatively computed as the depth of the anchor block plus b, or

H = 6" + 11" = 17"

Since the effective length of the totality of weld assumed effective to transfer the load to the shells (H for each of four ½" welds) is greater than the length of weld already shown to be acceptable at the anchor block-to-radial rib connection, and since the weld size and type is structurally better than or equal to the anchor block weld, we conclude that the anchor block-to-radial rib weld safety factors conservatively bound from below the safety factors for the radial rib to inner and outer shell welds in this load application.

3.D.7.3 Baseplate-to-Inner Shell (Top Lift (bounds bottom lift))

The weld between the storage overpack baseplate and the storage overpack inner shell is an all- around fillet weld (except at the duct locations (see drawing 1495, sheet 2)). To bound both the top and bottom lift, it is conservatively assumed that this weld supports a lifted load consisting of the weights of the loaded MPC, the pedestal shield concrete and steel, and the MPC baseplate (i.e., the structural action of the weld to the outer shell is conservatively neglected).

Therefore, the weld is subject to the following total load

116,067 lb. (MPC and pedestal shield) + 7967 lb. (baseplate) (from calculation package weight tables)

so that the applied load in the weld is conservatively assumed as:

Load = 124,034 lb

The weld is a one-side fillet weld with weld leg size "t" at diameter D =73.5" + 2 x 1.25", or

t = 0.75"
D = 76"

From the Bill-of-Materials for the HI-STORM 100 storage overpack, the width of each inlet vent is

w = 16.5"

Therefore, the total linear length (around the periphery) of fillet weld available to transfer the load is

L = 3.14159 x D - 4 x w = 172.76"

Therefore, the weld throat area is

Area = 0.7071 x t x L = 91.62 sq. inches

The capacity of the weld per the ASME Code Section III Subsection NF is defined as Lc1

Lc1 = 21,000 psi x Area = 1,924,020 lb.

The capacity of the weld per Regulatory Guide 3.61 is defined as Lc2

Lc2 = .6 x 33,150 psi x Area = 1,822,322 lb.

Since 3 x lifted load bounds 1.15 x lifted load, it is clear that the Regulatory Guide 3.61 criteria produce the minimum safety factor. The calculated safety factor at this location is

SF = Lc2/(Load x 1.15) = 12.78

3.D.7.4 Inlet Vent-to Baseplate Weld (Bottom Lift)

Drawing 1561, sheet 3 identifies the weld available to transfer the lifted load to the hydraulic jacks (not part of the HI-STORM 100 System) used in the bottom lift scenario. Load carrying capacity is assigned only to the fillet welds. The weld leg length "t" and the total length of weld available for load transfer "L" (per inlet vent) are given as:

t = 0.5"

L = 2 x 29.1875" (see Bill-of-Materials item 13) = 58.375"

The load capacity of the weld (Lc3), per the more severe Regulatory Guide 3.61 requirement, is

Lc3 = 0.6 x 33,150 psi x (0.7071 x t x L) = 410,499 lb.

Therefore, the safety factor under three times lifted load (including an inertia amplifier) is

SF = 410,499 lb./(3 x 360,000 lb.x 1.15)/4 = 1.32

3.D.8 Stress Analysis of the Pedestal Shield

The pedestal shield concrete serves to support the loaded MPC and the pedestal platform during normal storage. The pedestal shield concrete is confined by the surrounding pedestal shell that serves, during the lifting operation, to resist radial expansion of the concrete cylinder due to the Poisson Ratio effect under the predominate axial compression of the concrete pedestal shield.

The compressive load capacity of the concrete making up the pedestal shield is the compression area x allowable compressive stress. From Table 3.3.5, the allowable compressive stress in the concrete is

σ_c = 1535 psi

The concrete cylinder diameter (see Bill-of-Materials, item 24) is

D_c = 67.875"

Therefore, the load capacity per the ACI 318.1 concrete code (Reference [3.3.2] in Section 3.8 of this FSAR), defined as Lc4, is

Lc4 = σ_c x compression area of concrete cylinder = 1535 psi x 3618 sq. inch = 5,554,154 lb.

The applied load is conservatively assumed as the summed weight of the loaded MPC plus the pedestal platform plus the pedestal concrete shield.

W = 90,000 lb. (Table 3.2.1) + 5120 lb. (weight spreadsheet) + 5339 lb. (weight spreadsheet) = 100,459 lb.

Conservatively applying the Regulatory Guide 3.61 criteria to the concrete (interpret the allowable compressive stress as the "yield stress" for this evaluation) gives a safety factor

SF = Lc4/3W*1.15 = 16.03 (Note that the 1.15 accounts for inertia effects during the lift)

The pedestal shell is assumed to fully confine the concrete. Therefore, during compression of the concrete, a maximum lateral (radially oriented) pressure is applied to the pedestal shell due to the Poisson Ratio effect. This pressure varies linearly with concrete depth. Assuming the Poisson's Ratio of the concrete to be ν = 0.2, the maximum pressure on the pedestal shell is

$p_{confine}$ = $\nu/(1-\nu)$ x (3W x 1.15/compression area of concrete cylinder) = 0.25 x ~~27.77~~*95.79* psi = *23.95*~~7.98~~ psi

Conservatively neglecting variations with depth of concrete, the hoop stress in the confining pedestal shell is obtained as follows:

t = pedestal shell thickness = 0.25"
R = pedestal shell mean radius = (0.5 x 68.375" + .5 x 0.25") = 34.3125"

Hoop Stress = $p_{confine}$ x R/t = *3,286*~~1,095~~ psi

This gives a safety factor based on the Regulatory Guide 3.61 criteria equal to

SF = 33,150 psi/Hoop Stress = *10.09*~~30.27~~

This results~~s~~ is bounding for the HI-STORM 100S since the height and weight of the concrete pedestal is reduced.

3.D.9 Conclusion

The design of the HI-STORM 100 is adequate for the bottom end lift through the inlet vents. The design of the HI-STORM 100 is also adequate for the top end lift through the lifting lugs. Safety factors are established based on requirements of the ASME Code Section III, Subsection NF for Class 3 plate and shell supports and also on the requirements of USNRC Regulatory Guide 3.61. *The conclusions also apply to the HI-STORM 100S.*

3.D.10 References

1. ANSYS 5.3, A General Purpose Finite Element Code, ANSYS, Inc.

2. Crane Manufacturer's Association of America (CMAA), Specification #70, 1988, Section 3.3.

3. ASME Code Section III, Subsection NF-3324.5, Table NF-3324.5(a)-1, 1995

Table 5.1.1

DOSE RATES ADJACENT TO HI-STORM 100S OVERPACK FOR NORMAL CONDITIONS MPC-32 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING BURNUP AND COOLING TIME 45,000 MWD/MTU AND 5-YEAR COOLING

Dose Point† Location	***Fuel Gammas†† (mrem/hr)***	***^{60}Co Gammas (mrem/hr)***	***Neutrons (mrem/hr)***	***Totals (mrem/hr)***	***Totals with BPRAs (mrem/hr)***
1	*10.45*	*16.45*	*7.17*	*34.07*	*34.94*
2	*37.19†††*	*0.05*	*2.13*	*39.37*	*45.15*
3	*11.74*	*17.18*	*5.63*	*34.55*	*42.17*
4	*2.41*	*1.07*	*1.98*	*5.47*	*6.16*
4a	*3.86*	*9.48*	*27.59*	*40.93*	*45.45*

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† Refer to Figure 5.1.12.

†† Gammas generated by neutron capture are included with fuel gammas.

††† The cobalt activation of incore grid spacers accounts for 8.~~7~~*5* % of this dose rate.

Table 5.1.2

DOSE RATES ADJACENT TO *HI-STORM 100* OVERPACK
FOR NORMAL CONDITIONS
MPC-24 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING
BURNUP AND COOLING TIME
~~45,000~~*52,500* MWD/MTU AND 5-YEAR COOLING

Dose Point† Location	**Fuel Gammas†† (mrem/hr)**	**^{60}Co Gammas (mrem/hr)**	**Neutrons (mrem/hr)**	**Totals (mrem/hr)**	***Totals with BPRAs (mrem/hr)***
1	*7.20*	*5.34*	*4.46*	*17.00*	*17.35*
2	*37.65*†††	*0.03*	*3.04*	*40.72*	*45.77*
3	*4.87*	*3.52*	*2.23*	*10.61*	*12.16*
4	*1.28*	*0.39*	*5.82*	*7.49*	*7.70*

† Refer to Figure 5.1.1.

†† Gammas generated by neutron capture are included with fuel gammas.

††† The cobalt activation of incore grid spacers accounts for ~~8.6~~*8.0 %* of this dose rate.

Table 5.1.3

DOSE RATES ADJACENT TO *HI-STORM 100S* OVERPACK FOR NORMAL CONDITIONS
MPC-68 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING
BURNUP AND COOLING TIME
~~45,000~~*47,500* MWD/MTU AND 5-YEAR COOLING

Dose Point† Location	**Fuel Gammas†† (mrem/hr)**	**^{60}Co Gammas (mrem/hr)**	**Neutrons (mrem/hr)**	**Totals (mrem/hr)**
1	*10.45*	*12.45*	*9.57*	*32.47*
2	*33.88*	*0.01*	*2.91*	*36.80*
3	*4.51*	*16.08*	*4.27*	*24.86*
4	*1.42*	*1.22*	*1.55*	*4.19*
4a	*1.17*	*9.88*	*20.74*	*31.79*

† Refer to Figure 5.1.12.

†† Gammas generated by neutron capture are included with fuel gammas.

Table 5.1.4

DOSE RATES AT ONE METER FROM HI-STORM 100S OVERPACK FOR NORMAL CONDITIONS MPC-32 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING BURNUP AND COOLING TIME 45,000 MWD/MTU AND 5-YEAR COOLING

Dose Point*† *Location	***Fuel Gammas*†† *(mrem/hr)***	***^{60}Co Gammas (mrem/hr)***	***Neutrons (mrem/hr)***	***Totals (mrem/hr)***	***Totals with BPRAs (mrem/hr)***
1	*5.66*	*5.51*	*1.03*	*12.20*	*12.96*
2	*18.83*†††	*0.66*	*0.91*	*20.40*	*23.44*
3	*4.84*	*4.84*	*0.91*	*10.59*	*13.09*
4	*0.67*	*0.30*	*1.03*	*2.00*	*2.16*

~~THIS TABLE INTENTIONALLY DELETED~~

† Refer to Figure 5.1.12.

†† Gammas generated by neutron capture are included with fuel gammas.

††† The cobalt activation of incore grid spacers accounts for 8.6 % of this dose rate.

Table 5.1.5

DOSE RATES AT ONE METER *FROM HI-STORM 100 OVERPACK*
FOR NORMAL CONDITIONS
MPC-24 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING BURNUP AND COOLING TIME
~~45,000~~*52,500* MWD/MTU AND 5-YEAR COOLING

Dose Point† Location	**Fuel Gammas†† (mrem/hr)**	**^{60}Co Gammas (mrem/hr)**	**Neutrons (mrem/hr)**	**Totals (mrem/hr)**	***Totals with BPRAs (mrem/hr)***
1	*5.73*	*3.18*	*0.87*	*9.79*	*10.29*
2	*19.38*†††	*0.27*	*1.26*	*20.90*	*23.48*
3	*3.28*	*2.29*	*0.34*	*5.91*	*7.05*
4	*0.58*	*0.18*	*1.77*	*2.53*	*2.63*

† Refer to Figure 5.1.1.

†† Gammas generated by neutron capture are included with fuel gammas.

††† The cobalt activation of incore grid spacers accounts for ~~8.5~~*8.0* % of this dose rate.

Table 5.1.6

DOSE RATES AT ONE METER *FROM HI-STORM 100S OVERPACK*
FOR NORMAL CONDITIONS
MPC-68 DESIGN BASIS ZIRCALOY CLAD FUEL AT BOUNDING
BURNUP AND COOLING TIME
~~45,000~~*47,500* MWD/MTU AND 5-YEAR COOLING

Dose Point† Location	Fuel Gammas†† (mrem/hr)	^{60}Co Gammas (mrem/hr)	Neutrons (mrem/hr)	Totals (mrem/hr)
1	*5.69*	*3.92*	*1.27*	*10.88*
2	*16.77*	*0.29*	*1.22*	*18.27*
3	*2.33*	*4.92*	*0.70*	*7.95*
4	*0.43*	*0.30*	*0.76*	*1.49*

† Refer to Figure 5.1.12.

†† Gammas generated by neutron capture are included with fuel gammas.

increase in shielding. The *optional* aluminum heat conduction elements are also conservatively not modeled.

4. The MPC-24 basket is fabricated from 5/16 inch thick cell plates and 9/32 inch thick angles. It is conservatively assumed for modeling purposes that the structural portion of the MPC-24 basket is uniformly fabricated from 9/32 inch thick steel. The Boral and sheathing are modeled explicitly. This is conservative since it removes steel that would provide a small amount of additional shielding.

5. In the modeling of the BWR fuel assemblies, the zircaloy flow channels were not represented. This was done because it cannot be guaranteed that all BWR fuel assemblies will have an associated flow channel when placed in the MPC. The flow channel does not contribute to the source, but does provide some small amount of shielding. However, no credit is taken for this additional shielding.

6. In the MPC-24, 12 of the 24 Boral panels on the periphery have a reduced width. Conservatively, all Boral panels on the periphery were modeled with a reduced width of 5 inches.

During this project several design changes occurred that affected the drawings, but did not significantly affect the MCNP models of the HI-STORM 100 and HI-TRAC. Therefore, the models do not exactly represent the drawings. The discrepancies between models and drawings are listed and discussed here.

<u>HI-TRAC Modeling Discrepancies</u>

1. The pocket trunnion on the 125-ton HI-TRAC was modeled as penetrating the lead. This is conservative for gamma dose rates as it reduces shielding thickness.

2. The lifting blocks in the top lid of the 125-ton HI-TRAC were not modeled. Holtite-A was modeled instead. This is a small, localized item and will not impact the dose rates.

3. The door side plates that are in the middle of the transfer lid of the 125-ton HI-TRAC are not modeled. This is acceptable because the dose location calculated on the bottom of the transfer lid is in the center.

<u>HI-STORM Modeling Discrepancies</u>

1. The steel channels in the cavity between the MPC and overpack were not modeled. This is conservative since it removes steel that would provide a small amount of additional shielding.

2. The bolt anchor blocks were not explicitly modeled. Concrete was used instead. These are small, localized items and will not impact the dose rates.

3. *In the HI-STORM 100S model, the exit vents were modeled as being inline with the inlet vents. In practice, they are rotated 45 degrees and positioned above the short radial plates. Therefore, this modeling change has the exit vents positioned above the full length radial plates. This modeling change has minimal impact on the dose rates at the exit vents.*

4. *The short radial plates in the HI-STORM 100S overpack were modeled in MCNP even though they are optional.*

5.3.1.1 Fuel Configuration

As described earlier, the active fuel region is modeled as a homogenous zone. The end fittings and the plenum regions are also modeled as homogenous regions of steel. The masses of steel used in these regions are shown in Table 5.2.1. The axial description of the design basis fuel assemblies is provided in Table 5.3.1. Figures 5.3.8 and 5.3.9 graphically depict the location of the PWR and BWR fuel assemblies within the HI-STORM 100 System. The axial locations of the Boral, basket, inlet vents, and outlet vents are shown in these figures.

5.3.1.2 Streaming Considerations

The MCNP model of the HI-STORM overpack completely describes the inlet and outlet vents, thereby properly accounting for their streaming effect. The gamma shield cross plates located in the inlet and outlet vents, which effectively reduce the gamma dose in these locations, are modeled explicitly.

The MCNP model of the HI-TRAC transfer cask describes the lifting trunnions, pocket trunnions, and the opening in the HI-TRAC top lid. The ribs through the HI-TRAC water jacket are also modeled. Streaming considerations through these trunnions and fins are discussed in Section 5.4.1.

The design of the HI-STORM 100 System, as described in the Design Drawings in Chapter 1, has eliminated all other possible streaming paths. Therefore, the MCNP model does not represent any additional streaming paths. A brief justification of this assumption is provided for each penetration.

- The lifting trunnions will remain installed in the HI-TRAC transfer cask. No credit is taken for any part of the trunnion that extends from the HI-TRAC body.

- The pocket trunnions of the HI-TRAC are modeled as solid blocks of steel. No credit is taken for any part of the pocket trunnion that extends beyond the water jacket.

- The threaded holes in the MPC lid are plugged with solid plugs during storage and, therefore, do not create a void in the MPC lid.

- The drain and vent ports in the MPC lid are designed to eliminate streaming paths. *The holes in the vent and drain port cover plates are filled with a set screw and plug weld.* The steel lost in the MPC lid at the port location is replaced with a block of steel approximately 6 inches thick located directly below the port opening and attached to the underside of the lid. This design feature is shown on the Design Drawings in Chapter 1. The MCNP model did not explicitly represent this arrangement but, rather, modeled the MPC lid as a solid plate.

5.3.2 Regional Densities

Composition and densities of the various materials used in the HI-STORM 100 System and HI-TRAC shielding analyses are given in Tables 5.3.2 and 5.3.3. All of the materials and their actual geometries are represented in the MCNP model.

The water density inside the MPC corresponds to the maximum allowable water temperature within the MPC. The water density in the water jacket corresponds to the maximum allowable temperature at the maximum allowable pressure. As mentioned, the HI-TRAC transfer cask is equipped with a water jacket providing radial neutron shielding. Demineralized water will be utilized in the water jacket. To ensure operability for low temperature conditions, ethylene glycol (25% in solution) may be added to reduce the freezing point for low temperature operations. Calculations were performed to determine the effect of the ethylene glycol on the shielding effectiveness of the radial neutron shield. Based on these calculations, it was concluded that the addition of ethylene glycol (25% in solution) does not reduce the shielding effectiveness of the radial neutron shield.

Since the HI-STORM 100S does not have the inner shield shell present, the minimum density of the concrete in the body (not the lid or pedestal) of the overpack has been increased slightly to compensate for the change in shielding relative to the HI-STORM 100 overpack. Table 5.3.2 shows the concrete composition and densities that were used for the HI-STORM 100 and HI-STORM 100S overpacks. Since the density of concrete is increased by altering the aggregate that is used, the composition of the slightly denser concrete was calculated by keeping the same mass of water as the 2.35 gm/cc composition and increasing all other components by the same ratio.

Sections 4.4 and 4.5 demonstrate that all materials used in the HI-STORM and HI-TRAC remain below their design temperatures as specified in Table 2.2.3 during all normal conditions. Therefore, the shielding analysis does not address changes in the material density or composition as a result of temperature changes.

Chapter 11 discusses the effect of the various accident conditions on the temperatures of the shielding materials and the resultant impact on their shielding effectiveness. As stated in Section 5.1.2, there is only one accident that has any significant impact on the shielding configuration. This accident is the loss of the neutron shield (water) in the HI-TRAC as a result of fire or other damage. The change in the neutron shield was conservatively analyzed by assuming that the entire volume of the liquid neutron shield was replaced by void.

CHAPTER 8: OPERATING PROCEDURES†

8.0 INTRODUCTION:

This chapter outlines the loading, unloading, and recovery procedures for the HI-STORM 100 System for storage operations. The procedures provided in this chapter are prescriptive to the extent that they provide the basis and general guidance for plant personnel in preparing detailed, written, site-specific, loading, handling, storage and unloading procedures. Users may add, *modify the sequence of, perform in parallel,* or delete steps as necessary provided that the intent of this guidance is met *and the requirements of the CoC are met.* The information provided in this chapter meets all requirements of NUREG-1536 [8.0.1].

Section 8.1 provides the guidance for loading the HI-STORM 100 System in the spent fuel pool. Section 8.2 provides the procedures for ISFSI operations and general guidance for performing maintenance and responding to abnormal events. Responses to abnormal events that may occur during normal loading operations are provided with the procedure steps. Section 8.3 provides the procedure for unloading the HI-STORM 100 System in the spent fuel pool. Section 8.4 provides the guidance for MPC transfer to the HI-STAR 100 Overpack for transport or storage. Section 8.4 can also be used for recovery of a breached MPC for transport or storage. Section 8.5 provides the guidance for transfer of the MPC into HI-STORM from the HI-STAR 100 transport overpack. The Technical Specifications in Appendix A to CoC 72-1014 provide Limiting Conditions of Operation (LCO), Surveillance Requirements (SR's), as well as administrative information, such as Use and Application. Appendix B to COC 72-1014 provides the approved contents and design features applicable to the HI-STORM 100 System. FSAR Appendix 12.A includes the Bases for the LCOs. The Technical Specifications impose restrictions and requirements that must be applied throughout the loading and unloading process. Equipment specific operating details such as vacuum drying system, valve manipulation and Transporter operation are not within the scope of this FSAR and will be provided to users based on the specific equipment selected by the users and the configuration of the site.

The procedures contained herein describe acceptable methods for performing HI-STORM 100 loading and unloading operations. *Unless otherwise stated, references to the HI-STORM 100 apply equally to the HI-STORM 100 and the HI-STORM 100S.* Users may alter these procedures to allow alternate methods and operations to be performed in parallel or out of sequence as long as the general intent of the procedure is met. In the figures following each section, acceptable configurations of rigging, piping, and instrumentation are shown. In some cases, the figures are artists renditions. Users may

† This chapter has been prepared in the format and section organization set forth in Regulatory Guide 3.61. However, the material content of this chapter also fulfills the requirements of NUREG 1536. Pagination and numbering of sections, figures, and tables are consistent with the convention set down in Chapter 1, Section 1.0, herein. Finally, all terms-of-art used in this chapter are consistent with the terminology of the glossary (Table 1.0.1) and component nomenclature of the Bill-of-Materials (Section 1.5).

select alternate configurations, equipment and methodology to accommodate their specific needs *provided that the intent of this guidance is met and the requirements of the CoC are met.* All rigging should be approved by the user's load handling authority prior to use. User-developed procedures and the design and operation of any alternate equipment must be reviewed by the Certificate holder prior to implementation.

Licensees (Users) will utilize the procedures provided in this chapter, the Technical Specifications in Appendix A to CoC 72-1014, the conditions of the Certificate of Compliance, equipment-specific operating instructions, and plant working procedures and apply them to develop the site specific written, loading and unloading procedures.

The loading and unloading procedures in Section 8.1 and 8.3 can also be appropriately revised into written site-specific procedures to allow dry loading and unloading of the system in a hot cell or other remote handling facility. The Dry Transfer Facility (DTF) loading and unloading procedures are essentially the same with respect to loading and vacuum drying, inerting, and leakage testing of the MPC. The dry transfer facility shall develop the appropriate site-specific procedures as part of the DTF facility license.

Tables 8.1.1 through 8.1.4 provide the handling weights for each of the HI-STORM 100 System major components and the loads to be lifted during various phases of the operation of the HI-STORM 100 System. Users shall take appropriate actions to ensure that the lift weights do not exceed user-supplied lifting equipment rated loads. Table 8.1.5 provides the HI-STORM 100 System bolt torque and sequencing requirements. Table 8.1.6 provides an operational description of the HI-STORM 100 System ancillary equipment along with its safety designation and QA category, where applicable. Fuel assembly selection and verification shall be performed by the licensee in accordance with written, approved procedures which ensure that only SNF assemblies authorized in the Certificate of Compliance and as defined in the Appendix B to CoC 72-1014 are loaded into the HI-STORM 100 System.

In addition to the requirements set forth in the CoC, users will be required to develop or modify existing programs and procedures to account for the operation of an ISFSI. Written procedures will be required to be developed or modified to account for such things as nondestructive examination (NDE) of the MPC welds, handling and storage of items and components identified as Important to Safety, 10CFR72.48 [8.1.1] programs, specialized instrument calibration, special nuclear material accountability at the ISFSI, security modifications, fuel handling procedures, training and emergency response, equipment and process qualifications. Users are required to take necessary actions to prevent boiling of the water in the MPC. This may be accomplished by performing a site-specific analysis to identify a time limitation to ensure that water boiling will not occur in the MPC prior to the initiation of draining operations. Chapter 4 of the FSAR provides some sample time limits for the time to initiation of draining for various spent fuel pool water temperatures using design basis heat loads.

Table 8.1.7 summarizes some of the instrumentation used to load and unload the HI-STORM 100 System. Other instrumentation that meets the requirements of the Technical Specifications is also acceptable. Tables 8.1.8, 8.1.9, and 8.1.10 provide sample receipt inspection checklists for the HI-STORM 100 overpack, the MPC, and the HI-TRAC Transfer Cask, respectively. Users ~~shall~~ *may* develop site-specific receipt inspection checklists, as required for their equipment. Fuel handling, including the handling of fuel assemblies in the Damaged Fuel Container (DFC) shall be performed in accordance with written site-specific procedures. DFCs shall be loaded in the spent fuel pool racks prior to placement into the MPC.

Technical and Safety Basis for Loading and Unloading Procedures

The procedures herein (Sections 8.1.2 through 8.1.5) are developed for the loading, storage, unloading, and recovery of spent fuel in the HI-STORM 100 System. The activities involved in loading of spent fuel in a canister system, if not carefully performed, may present risks. The design of the HI-STORM 100 System, including these procedures, the ancillary equipment and the Technical Specifications, serve to minimize risks and mitigate consequences of potential events. To summarize, consideration is given in the loading and unloading systems and procedures to the potential events listed in Table 8.0.1.

The primary objective is to reduce the risk of occurrence and/or to mitigate the consequences of the event. The procedures contain Notes, Warnings, and Cautions to notify the operators to upcoming situations and provide additional information as needed. The Notes, Warnings and Cautions are purposely bolded and boxed and immediately precede the applicable steps.

In the event of an extreme abnormal condition (e.g., cask drop or tip-over event) the user shall have appropriate procedural guidance to respond to the situation. As a minimum, the procedures shall address establishing emergency action levels, implementation of emergency action program, establishment of personnel exclusions zones, monitoring of radiological conditions, actions to mitigate or prevent the release of radioactive materials, and recovery planning and execution and reporting to the appropriate regulatory agencies, as required.

Table 8.0.1
OPERATIONAL CONSIDERATIONS

POTENTIAL EVENTS	METHODS USED TO ADDRESS EVENT	COMMENTS/ REFERENCES
Cask Drop During Handling Operations	Cask lifting and handling equipment is designed to ANSI N14.6. Procedural guidance is given for cask handling, inspection of lifting equipment, and proper engagement to the trunnions. Technical Specifications limit the cask and overpack lift height outside the fuel building.	See Section 8.1.2. See Technical Specifications in Appendix A to CoC 72-1014 for HI-TRAC and HI-STORM lift height limitations.
Cask Tip-Over Prior to welding of the MPC lid	The lid retention system is available to secure the MPC lid during movement between the spent fuel pool and the cask preparation area.	See Section 8.1.5 Step 1. See Figure 8.1.15.
Contamination of the MPC external shell	The annulus seal, pool lid, and annulus overpressure system minimize the potential for the MPC external shell to become contaminated from contact with the spent fuel pool water. Technical Specifications require surveys of certain components of the HI-STORM 100 System to monitor for removable contamination.	See Figures 8.1.13 and 8.1.14. See Technical Specifications in Appendix A to CoC 72-1014.
Contamination spread from cask process system exhausts	Processing systems are equipped with exhausts that can be directed to the plant's processing systems.	See Figures 8.1.19-8.1.22.
Damage to fuel assembly cladding from oxidation/thermal shock	Fuel assemblies are never subjected to air or oxygen during loading and unloading operations. Cool-Down System brings fuel assembly *bulk* temperatures to below water boiling temperature prior to flooding.	See Section 8.1.5 Step 24b, Section 8.3.3 ~~Step 8~~ and LCO 3.1.3.
Damage to Vacuum Drying System vacuum gauges from positive pressure	Vacuum Drying System is separate from pressurized gas and water systems.	See Figure 8.1.22 and 8.1.23.

8.1 PROCEDURE FOR LOADING THE HI-STORM 100 SYSTEM IN THE SPENT FUEL POOL

8.1.1 Overview of Loading Operations:

8.1.1.1 General Description

The HI-STORM 100 System is used to load, transfer and store spent fuel. Specific steps are performed to prepare the HI-STORM 100 System for fuel loading, to load the fuel, to prepare the system for storage and to place it in storage at an ISFSI. The MPC transfer may be performed in the *cask receiving area* ~~truck bay~~, at the ISFSI, or any other location deemed appropriate by the user. HI-TRAC and/or HI-STORM may be transferred between the ISFSI and the fuel loading facility using a specially designed transporter, heavy haul transfer trailer, or any other load handling equipment designed for such applications as long as the Technical Specification lift height restrictions are met *(lift height restrictions apply only to suspended forms of transport).* Users shall develop detailed written procedures to control on-site transport operations. Section 8.1.2 provides the general procedures for rigging and handling of the HI-STORM overpack and HI-TRAC transfer cask. Figure 8.1.1 shows a flow *general* diagram of the HI-STORM loading operations.

Refer to the boxes of Figure 8.1.2 for the following description. At the start of loading operations, an empty MPC is upended (Box 1). The empty MPC is raised and inserted into HI-TRAC (Box 2). The annulus is filled with plant demineralized water† and the MPC is filled with either spent fuel pool water or plant demineralized water (Box 3). An inflatable seal is installed in the *upper end of the* annulus between the MPC and HI-TRAC to prevent spent fuel pool water from contaminating the exterior surface of the MPC. HI-TRAC and the MPC are then raised and lowered into the spent fuel pool for fuel loading using the lift yoke (Box 4). Pre-selected assemblies are loaded into the MPC and a visual verification of the assembly identification is performed (Box 5).

While still underwater, a thick shielded lid (the MPC lid) is installed using either slings attached to the lift yoke or the optional lid retention system (Box 6). The lift yoke remotely engages to the HI-TRAC lifting trunnions to lift the HI-TRAC and loaded MPC close to the spent fuel pool surface (Box 7). When radiation dose rate measurements confirm that it is safe to remove the HI-TRAC from the spent fuel pool, the cask is removed from the spent fuel pool. If the lid retention system is being used, the HI-TRAC top lid bolts are installed to secure the MPC lid for the transfer to the cask preparation area. The lift yoke and HI-TRAC are sprayed with demineralized water to help remove contamination as they are removed from the spent fuel pool.

HI-TRAC is placed in the designated preparation area and the lift yoke and lid retention system (if utilized) are removed. The next phase of decontamination is then performed. The top surfaces of the MPC lid and the upper flange of HI-TRAC are decontaminated. The temporary shield ring (if utilized) is installed and filled with water and the neutron shield jacket is filled with water (if drained). The inflatable annulus seal is removed, and the annulus shield (if utilized) is installed. The temporary shield ring provides additional personnel shielding around the top of the

† Users may substitute domestic water in each step where demineralized water is specified.

HI-TRAC during MPC closure operations. The annulus shield provides additional personnel shielding at the top of the annulus and also prevents small items from being dropped into the annulus. Dose rates are measured at the MPC lid to ensure that the dose rates are within expected values.

The MPC water level is lowered slightly, the MPC is vented, and the MPC lid is seal welded using the automated welding system (Box 8). Visual examinations are performed on the tack welds. Liquid penetrant (PT) examinations are performed on the root and final passes. ~~A volumetric examination is performed on the MPC welds to ensure that the completed weld is satisfactory. As an alternative to volumetric examination of the MPC lid-to-shell weld, a multi-layer PT is performed including one intermediate examination after approximately every three-eighth inch of weld depth.~~ *An ultrasonic or multi-layer PT examination is performed on the MPC Lid-to-Shell weld to ensure that the weld is satisfactory. As an alternative to volumetric examination of the MPC lid-to-shell weld, a multi-layer PT is performed including one intermediate examination after approximately every three-eighth inch of weld depth.* The water level is raised to the top of the MPC and a hydrostatic test followed by an additional liquid penetrant examination is performed on the MPC Lid-to-Shell weld to verify structural integrity. A small amount of water is displaced with helium gas for leakage testing. A leakage rate test is performed on the MPC lid-to-shell weld to verify weld integrity and to ensure that leakage rates are within acceptance criteria (See Technical Specification LCO 3.1.1).

~~The water level is raised to the top of the MPC again and then the MPC water is displaced from the MPC by blowing pressurized helium or nitrogen gas into the vent port of the MPC thus displacing the water through the drain line. The volume of water displaced from the MPC is measured to determine the free volume inside the MPC. This information is used to determine the helium backfill requirements for the MPC.~~

The vacuum drying system is connected to the MPC and is used to remove all liquid water from the MPC in a stepped evacuation process (Box 9). A stepped evacuation process is used to preclude the formation of ice in the MPC and vacuum drying system lines. The internal pressure is reduced to below 3 torr and held for 30 minutes to ensure that all liquid water is removed (See Technical Specification LCO 3.1.1).

Alternatively for high-burn-up fuel, a moisture removal system is utilized to remove residual moisture from the MPC. Gas is circulated through the MPC to evaporate and remove moisture. The residual moisture is condensed until no additional moisture remains in the MPC. Gas exiting the MPC is monitored for entrained moisture until no discernable moisture is present in the MPC. Following MPC drying, the MPC is evacuated and backfilled with a predetermined pressure of helium gas (See Technical Specification LCO 3.1.1). Limitations for the at-vacuum duration are evaluated and established on a canister basis to ensure that acceptable cladding temperatures are not exceeded although a time limit of less than 2 hours at vacuum will bound any MPC. ~~Following this dryness test, the vacuum drying system is disconnected, the helium backfill system is attached, and the MPC is backfilled with a predetermined *pressure amount* of helium gas (See Technical Specification LCO 3.1.1).~~ The helium backfill ensures adequate heat transfer during storage, provides an inert atmosphere for long-term fuel integrity, and provides the means of future leakage rate testing of the MPC confinement boundary welds. Cover plates are installed and seal welded over the MPC vent and drain ports with liquid penetrant examinations performed on the root and final passes *(for multi-pass welds)* (Box 10). The cover plates are helium leakage tested to confirm that they meet the established leakage rate criteria.

The MPC closure ring is then placed on the MPC and dose rates are measured at the MPC lid to ensure that the dose rates are within expected values. The closure ring is aligned, tacked in place and seal welded providing redundant closure of the MPC confinement boundary closure welds. Tack welds are visually examined, and the root and final welds are inspected using the liquid penetrant examination technique to ensure weld integrity.

The annulus shield (if utilized) is removed and the remaining water in the annulus is drained. The temporary shield ring (if utilized) is drained and removed. The MPC lid and accessible areas of the top of the MPC shell are smeared for removable contamination (See Technical Specification LCO 3.2.2) and HI-TRAC dose rates are measured. HI-TRAC top lid is installed and the bolts are torqued (Box 11). The MPC lift cleats are installed on the MPC lid. The MPC lift cleats are the primary lifting point on the MPC. The two cleats provide redundant support of the MPC when it is lifted or supported. Two or four stays (depending on the site crane hook configuration) are installed between the MPC lift cleats and the lift yoke main pins. The stays secure the MPC within HI-TRAC while the pool lid is replaced with the transfer lid (Box 12).

The HI-TRAC is positioned approximately one inch above the transfer slide to prepare for bottom lid replacement. The transfer slide consists of an adjustable-height rolling carriage and a pair of channel tracks. The transfer slide supports the transfer step which is used to position the two lids at the same elevation and creates a tight seam between the two lids to eliminate radiation streaming. The overhead crane is shut down to prevent inadvertent operation. The transfer slide carriage is raised to support the pool lid while the bottom lid bolts are removed. The transfer slide then lowers the pool lid and simultaneously replaces the pool lid with the transfer lid. The carriage is raised and the bottom lid bolts are replaced. The MPC lift cleats and stays support the MPC during the transfer operations. Following the transfer, the MPC stays are disconnected and HI-TRAC is positioned for MPC transfer into HI-STORM.

MPC transfer may be performed inside or outside the fuel building (Box 13). Similarly, HI-TRAC and HI-STORM may be transferred to the ISFSI in several different ways (Box 14 and 15). The empty HI-STORM overpack is inspected and positioned with the lid removed. Vent duct shield inserts[1] are installed in the HI-STORM exit vent ducts. The vent duct shield inserts prevent radiation streaming *from the HI-STORM Overpack* as the MPC is lowered past the exit vents. The HI-TRAC is placed on top of HI-STORM. Alignment *guides* ~~pins~~ (or alternate alignment methods) help guide HI-TRAC during this operation[2]. The MPC may be lowered using the MPC downloader, the main crane hook or other similar devices. The MPC downloader (if used) may be attached to the HI-TRAC lid or mounted to the overhead lifting device. The MPC lift slings are attached to the MPC lift cleats. The MPC is raised slightly, the transfer lid door locking pins are removed and the doors are opened. Optional trim plates may be installed on the top and bottom of both doors and secured using hand clamps. The trim plates eliminate

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1 *Vent duct shield inserts are only used on the HI-STORM 100.*

2 *The alignment guide may be configured in many different ways to accommodate the specific sites. See Table 8.1.6.*

radiation streaming above and below the doors. The MPC is lowered into HI-STORM. Following verification that the MPC is fully lowered, the MPC lift slings are disconnected from the lifting ~~structure~~ device and lowered onto the MPC lid. The trim plates are removed, the doors are closed and the locking pins are installed. *The empty HI-TRAC must be removed with the doors open when the HI-STORM 100S is used to prevent interference with the lift cleats and slings.* HI-TRAC is removed from on top of HI-STORM *and HI-STORM 100 is moved from under HI-TRAC as necessary.* The MPC lift slings and MPC lift cleats are removed. Hole plugs are installed in the empty MPC lifting holes to fill the voids left by the lift cleat bolts. The vent duct shield inserts *(if used)* and alignment guides are removed, the HI-STORM lid is installed, and *exit vent* gamma shield cross plates and ~~thermocouples~~ *temperature elements* (if used) are installed. The inlet[3] and exit vent screens are installed. The HI-STORM lid studs and nuts are installed and torqued. The ~~shielding effectiveness test is performed and~~ HI-STORM is secured to the transporter (as applicable) and moved to the ISFSI pad. ~~If necessary, the inlet vent screens are installed.~~ The HI-STORM Overpack and HI-TRAC transfer cask may be moved using a number of methods as long as the lifting equipment requirements in the Technical Specification are met. *For sites with high seismic conditions, the HI-STORM 100A is anchored to the ISFSI.* Once located at the storage pad, *the inlet vent gamma shield cross plates are installed and the shielding effectiveness test is performed. Finally,* the ~~thermocouple~~ *temperature element* instrument connections are made (if used), and the air temperature rise testing (if required by the Technical Specifications) is performed to ensure that the system is functioning within its design parameters.

8.1.1.2 Movement of a Loaded Overpack Without the Permanent Lid Installed

For those users who complete the MPC transfer between the HI-TRAC transfer cask to the HI-STORM 100 or HI-STORM 100S overpack outside the Part 50 facility, the overpack may be moved a short distance without the permanent overpack lid installed to a nearby location where lid installation takes place.

In these site-specific cases, two options apply. An optional temporary lid may be installed to provide supplemental shielding during the overpack move. Or, the loaded overpack may be moved with no lid installed. In both cases, the following administrative controls shall be implemented:

- *The overpack shall be supported from below (e.g., on a rail car)*
- *Appropriate low speed and positive load control shall be maintained at all times during overpack movement to prevent lateral shifting of the load.*
- *The permanent overpack lid shall be installed as soon as practicable after the loaded*

3 *Depending on the mode of transport, the inlet vents may be required to be left out until placement on the ISFSI pad. This may be required to allow jacks to be inserted into the HI-STORM 100 Overpack ducts.*

overpack exits the Part 50 structure and adequate clearance is available for handling and installing the lid.

- *Loaded overpacks without the top lid installed should not be moved outdoors during inclement weather. If inclement weather arises movement of the loaded overpack outdoors without the permanent lid installed has begun, the lid should be installed immediately or the overpack should be suitably protected from the weather.*

The duration for which the HI-STORM overpack is without the top lid shall be minimized and site operating procedures shall specifically address this loading evolution from an ALARA perspective. The distance of HI-STORM movement without the lid installed shall be minimized if the overpack has to be translocated to allow installation of the permanent lid. Evaluations performed by the ISFSI owner to satisfy the provisions of 10 CFR 72.212 shall be provided to the CoC holder.

8.1.2 HI-TRAC and HI-STORM Receiving and Handling Operations:

Note:
HI-TRAC may be received and handled in several different configurations and may be transported on-site in a horizontal or vertical orientation. This section provides general guidance for HI-TRAC and HI-STORM handling. Site-specific procedures shall specify the required operational sequences based on the handling configuration at the sites. Refer to the Technical Specifications for loaded HI-TRAC and HI-STORM 100 Overpack handling limitations.

1. Vertical Handling of HI-TRAC:
   a. Verify that the lift yoke load test certifications are current.
   b. Visually inspect the lifting device (lift yoke or lift links) and the lifting trunnions for gouges, cracks, deformation or other indications of damage. Replace or repair damaged components as necessary.
   c. Engage the lift yoke to the lifting trunnions. See Figure 8.1.3.
   d. Apply lifting tension to the lift yoke and verify proper engagement of the lift yoke.

Note:
Refer to the site's heavy load handling procedures for lift height, load path, floor loading and other applicable load handling requirements. Refer to Technical Specification 4.9 for additional equipment handling requirements.

Warning:
When lifting the loaded HI-TRAC with only the pool lid, the HI-TRAC should be carried as low as practicable. This minimizes the dose rates due to radiation scattering from the floor. Personnel should remain clear of the area and the HI-TRAC should be placed in position as soon as practicable.

e. Raise HI-TRAC and position it accordingly.

2. Upending of HI-TRAC in the transfer frame:

   a. Position HI-TRAC under the lifting device. Refer to Step 1, above.

   b. If necessary, remove the missile shield from the HI-TRAC transfer frame. See Figure 8.1.4.

   c. Verify that the lift yoke load test certifications are current.

   d. Visually inspect the lift yoke and the lifting trunnions for gouges, cracks, deformation or other indications of damage. Repair or replace damaged components as necessary.

   e. *If necessary,* place a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent) on the cask trunnions and the palms of the lift yoke.

   f. Engage the lift yoke to the lifting trunnions. See Figure 8.1.3.

   g. Apply lifting tension to the lift yoke and verify proper engagement of the lift yoke.

   h. Slowly rotate HI-TRAC to the vertical position keeping all rigging as close to vertical as practicable. See Figure 8.1.4.

   i. Lift the pocket trunnions clear of the transfer frame rotation trunnions.

3. Downending of HI-TRAC in the transfer frame:

ALARA Warning:
A loaded HI-TRAC should only be downended with the transfer lid *or other auxiliary shielding* installed.

   a. Position the transfer frame under the lifting device.

   b. Verify that the lift yoke load test certifications are current.

   c. Visually inspect the lift yoke and the lifting trunnions for gouges, cracks, deformation or other indications of damage. Repair or replace damaged components as necessary.

   d. If necessary, place a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent) on the cask trunnions and the palms of the lift yoke.

   e. Place a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent) on the inside surfaces of the cask rotation trunnion pockets and the corresponding surfaces of the transfer frame.

   f. Engage the lift yoke to the lifting trunnions. See Figure 8.1.3.

   g. Apply lifting tension to the lift yoke and verify proper lift yoke engagement.

1. Remove the HI-TRAC from the spent fuel pool as follows:

   a. Visually inspect the MPC lid rigging or lid retention system in accordance with site-approved rigging procedures. Attach the MPC lid to the lift yoke so that MPC lid, drain line and trunnions will be in relative alignment. Raise the MPC lid and adjust the rigging so the MPC lid hangs level as necessary.

   b. Install the drain line to the underside of the MPC lid. Ensure that the reducer is fully seated against the bottom of the MPC lid. See Figure 8.1.17.

   c. Align the MPC lid and lift yoke so the drain line will be positioned in the MPC drain location and the cask trunnions will also engage. See Figure 8.1.11 and 8.1.17.

ALARA Note:
Pre-wetting the components that enter the spent fuel pool may reduce the amount of decontamination work to be performed later.

   d. Slowly lower the MPC lid into the pool and insert the drain line into the drain access location and visually verify that the drain line is correctly oriented. See Figure 8.1.12.

   e. Lower the MPC lid while monitoring for any hang-up of the drain line. If the drain line becomes kinked or disfigured for any reason, remove the MPC lid and replace the drain line.

Note:
The outer diameter of the MPC lid will seat flush with the top edge of the MPC shell when properly installed.

   f. Seat the MPC lid in the MPC and visually verify that the lid is properly installed.

   g. Engage the lift yoke to HI-TRAC lifting trunnions.

   h. Apply a slight tension to the lift yoke and visually verify proper engagement of the lift yoke to the lifting trunnions.

ALARA Note:
Activated debris may have settled on the top face of HI-TRAC and MPC during fuel loading. The cask top surface should be kept under water until a preliminary dose rate scan clears the cask for removal. Users are responsible for any water dilution considerations.

   i. Raise HI-TRAC until the MPC lid is just below the surface of the spent fuel pool. Survey the area above the cask lid to check for hot particles. ~~Raise and flush the upper surface of HI-TRAC and MPC with plant demineralized water as necessary to r~~*R*emove any activated *or highly radioactive* particles from HI-TRAC or MPC.

   j. Visually verify that the MPC lid is properly seated. Lower HI-TRAC, reinstall the lid, and repeat ~~Step 5,~~ as necessary.

   k. Install the lid retention system bolts if the lid retention system is used.

l. Continue to raise the HI-TRAC under the direction of the plant's radiological control personnel. Continue rinsing the surfaces with demineralized water. When the top of the HI-TRAC reaches the same elevation as the reservoir, close the annulus overpressure system reservoir valve (if used). See Figure 8.1.14.

Caution:
Users are required to take necessary actions to prevent boiling of the water in the MPC. This may be accomplished by performing a site-specific analysis to identify a time limitation to ensure that water boiling will not occur in the MPC prior to the initiation of draining operations. Chapter 4 of the FSAR provides some sample time limits for the time to initiation of draining for various spent fuel pool water temperatures using design basis heat loads. These time limits may be adopted if the user chooses not to perform a site-specific analysis. If time limitations are imposed, users shall have appropriate procedures and equipment to take action. One course of action involves initiating an MPC water flush for a certain duration and flow rate. Any site-specific analysis shall identify the methods to respond should it become likely that the imposed time limit could be exceeded. *Refer to LCO 3.3.1 for boron concentration requirements whenever water is added to the loaded MPC.*

m. Remove HI-TRAC from the spent fuel pool while spraying the surfaces with plant demineralized water. Record the time.

ALARA Note:
Decontamination of HI-TRAC bottom should be performed using remote cleaning methods, covering or other methods to minimize personnel exposure. The bottom lid decontamination may be deferred *to a convenient and practical time and location.*~~until the after bottom lid replacement.~~ Any initial decontamination should only be sufficient to preclude spread of contamination within the fuel building.

n. Decontaminate HI-TRAC bottom and HI-TRAC exterior surfaces including the pool lid bottom. Remove the bottom protective cover, if used.

o. If used, disconnect the annulus overpressure system from the HI-TRAC via the quick disconnect. See Figure 8.1.14.

p. Set HI-TRAC in the designated cask preparation area.

Note:
If the transfer cask is expected to be operated in an environment below 32 °F, the water jacket shall be filled with an ethylene glycol solution (25% ethylene glycol). Otherwise, the jacket shall be filled with demineralized water. *Depending on weight limitations, the neutron shield jacket may remain filled (with pure water or 25% ethylene glycol solution, as required). Users shall evaluate the cask weights to ensure that cask trunnion, lifting devices and equipment load limitations are not exceeded.*

q. If previously drained, fill the neutron shield jacket with plant demineralized water or an ethylene glycol solution (25% ethylene glycol) as necessary.

ALARA Warning:
It may be necessary to rotate or reposition the MPC lid slightly to achieve uniform weld gap and lid alignment. A punch mark is located on the outer edge of the MPC lid and shell. These marks are aligned with the alignment mark on the top edge of the HI-TRAC Transfer Cask (See Figure 8.1.8). If necessary, the MPC lid lift should be performed using a hand operated chain fall to closely control the lift to allow rotation and repositioning by hand. If the chain fall is hung from the crane hook, the crane should be tagged out of service to prevent inadvertent use during this operation. Continuous radiation monitoring is recommended.

a. If necessary center the lid in the MPC shell using a hand-operated chain fall.

Note:
The MPC is equipped with lid shims that serve to close the gap in the joint for MPC lid closure weld.

b. As necessary, install the MPC lid shims around the MPC lid to make the weld gap uniform.

ALARA Note:
The AWS Baseplate shield is used to further reduce the dose rates to the operators working around the top cask surfaces.

c. Install the automated welding system. See Figure 8.1.9 for rigging.

Note:
It may be necessary to remove the RVOAs to allow access for the automated welding system. In this event, the vent and drain port caps should be opened to allow for thermal expansion of the MPC water.

d. Tack weld the MPC lid.

e. Visually inspect the tack welds.

Note:

The Lid-to-Shell weld may be examined by either volumetric examination (UT) or multi-layer liquid penetrant examination. If volumetric examination is used, it shall be the ultrasonic method and shall include a liquid penetrant (PT) of the root and final weld layers. If PT alone is used, at a minimum, it must include the root and final weld layers and each 3/8-inch of weld depth.

For all liquid penetrant examinations in this procedure, ASME Boiler and Pressure Vessel Code [8.1.3], Section V, Article 6 provides the liquid penetrant examination methods. The acceptance standards for liquid penetrant examination shall be in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350 as specified on the Design Drawings. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section III and V of the Code or site-specific program.

Volumetric examination of the MPC Lid-to-Shell weld by ultrasonic test method is defined in ASME Boiler and Pressure Vessel Code, Section V, Article 5. The acceptance standards for UT examination are per Section III, Subsection NB, Article NB-5332 for UT as defined on the Design Drawings. NDE personnel shall be qualified per the requirements of Section III and V of the Code or site-specific program.

f. Lay the root weld.

g. Perform a liquid penetrant examination of the weld root.

h. Complete the MPC lid welding performing intermediate PTs as required.

i. Perform a liquid penetrant examination on the MPC lid final pass.

4. Perform hydrostatic and MPC leakage rate testing as follows:

ALARA Note:

The leakage rates are determined before the MPC is drained for ALARA reasons. A weld repair is a lower dose activity if water remains inside the MPC.

a. Attach the drain line to the vent port and route the drain line to the spent fuel pool or the plant liquid radwaste system. See Figure 8.1.20 for the hydrostatic test arrangement.

ALARA Warning:

Water flowing from the MPC may carry activated particles and fuel particles. Apply appropriate ALARA practices around the drain line.

CHAPTER 10: RADIATION PROTECTION†

This chapter discusses the design considerations and operational features that are incorporated in the HI-STORM 100 Storage System design to protect plant personnel and the public from exposure to radioactive contamination and ionizing radiation during canister loading, closure, transfer, and on-site dry storage. Occupational exposure estimates for typical canister loading, closure, transfer operations, and ISFSI inspections are provided. An off-site dose assessment for a typical ISFSI is also discussed. Since the determination of off-site doses is necessarily site-specific, similar dose assessments are to be prepared by the licensee, as part of implementing the HI-STORM 100 Storage System in accordance with 10CFR72.212 [10.0.1]. The information provided in this chapter meets all requirements of NUREG-1536.

10.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS-LOW-AS-REASONABLY-ACHIEVABLE (ALARA)

10.1.1 Policy Considerations

The HI-STORM 100 has been designed in accordance with 10CFR72 [10.0.1] and maintains radiation exposures ALARA consistent with 10CFR20 [10.1.1] and the guidance provided in Regulatory Guides 8.8 [10.1.2] and 8.10 [10.1.3]. Licensees using the HI-STORM 100 System will utilize and apply their existing site ALARA policies, procedures and practices for ISFSI activities to ensure that personnel exposure requirements of 10CFR20 [10.1.1] are met. Personnel performing ISFSI operations shall be trained on the operation of the HI-STORM 100 System, and be familiarized with the expected dose rates around the MPC, HI-STORM and HI-TRAC during all phases of loading, storage, and unloading operations. Chapter 12 provides dose rate limits at the HI-TRAC and HI-STORM surfaces to ensure that the HI-STORM 100 System is operated within design basis conditions and that ALARA goals will be met. Pre-job ALARA briefings should be held with workers and radiological protection personnel prior to work on or around the system. Worker dose rate monitoring, in conjunction with trained personnel and well-planned activities, will significantly reduce the overall dose received by the workers. When preparing or making changes to site-specific procedures for ISFSI activities, users shall ensure that ALARA practices are implemented and the 10CFR20 [10.1.1] standards for radiation protection are met in accordance with the site's written commitments. Users can further reduce dose rates around the HI-STORM 100 System by preferentially loading longer-cooled and lower-burnup spent fuel assemblies in the periphery fuel storage cells of the MPC, and loading assemblies with shorter cooling times and higher burnups in the inner MPC fuel storage cell locations. Users can also further reduce the dose rates around the HI-TRAC by the use of temporary shielding. In some cases, users may opt to upgrade their existing crane to take advantage of the increased shielding capabilities of the 125-Ton HI-TRAC transfer cask (versus the 100-Ton HI-TRAC transfer cask). This decision should be based on a cost-benefit analysis. Temporary shielding *and use of special tools to reduce dose* is discussed in Section 10.1.4.

† This chapter has been prepared in the format and section organization set forth in Regulatory Guide 3.61. However, the material content of this chapter also fulfills the requirements of NUREG 1536. Pagination and numbering of sections, figures, and tables are consistent with the convention set down in Chapter 1, Section 1.0, herein. Finally, all terms-of-art used in this chapter are consistent with the terminology of the glossary (Table 1.0.1) and component nomenclature of the Bill-of-Materials (Section 1.5).

10.1.2 Design Considerations

Consistent with the design criteria defined in Section 2.3.5, the radiological protection criteria that limit exposure to radioactive effluents and direct radiation from an ISFSI using the HI-STORM 100 Storage System are as follows:

1. 10CFR72.104 [10.0.1] requires that for normal operation and anticipated occurrences, the annual dose equivalent to any real individual located beyond the owner-controlled area boundary must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other critical organ. This dose would be a result of planned discharges, direct radiation from the ISFSI, and any other radiation from uranium fuel cycle operations in the area. The licensee is responsible for demonstrating site-specific compliance with these requirements.

2. 10CFR72.106 [10.0.1] requires that any individual located on or beyond the nearest owner-controlled area boundary may not receive from any design basis accident the more limiting of a total effective dose equivalent of 5 rem, or the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 50 rem. The lens dose equivalent shall not exceed 15 rem and the shallow dose equivalent to skin or to any extremity shall not exceed 50 rem. The licensee is responsible for demonstrating site-specific compliance with this requirement.

3. 10CFR20 [10.1.1], Subparts C and D, limit occupational exposure and exposure to individual members of the public. The licensee is responsible for demonstrating site-specific compliance with this requirement.

4. Regulatory Position 2 of Regulatory Guide 8.8 [10.1.2] provides guidance regarding facility and equipment design features. This guidance has been followed in the design of the HI-STORM 100 Storage System as described below:

- Regulatory Position 2a, regarding access control, is met by locating the ISFSI in a Protected Area in accordance with 10CFR72.212(b)(5)(ii) [10.0.1]. Depending on the site-specific ISFSI design, other equivalent measures may be used. Unauthorized access is prevented once a loaded HI-STORM 100 Storage cask is placed in an ISFSI. Due to the nature of the system, only limited monitoring is required, thus reducing occupational exposure and supporting ALARA considerations. The licensee is responsible for site-specific compliance with these criteria.

- Regulatory Position 2b, regarding radiation shielding, is met by the storage cask and transfer cask biological shielding that minimizes personnel exposure, as described in Chapter 5 or later in this chapter. Fundamental design considerations that most directly influence occupational exposures with dry storage systems in general and which have been incorporated into the HI-STORM 100 System design include:

  - system designs that reduce or minimize the number of handling and transfer operations for each spent fuel assembly;

- system designs that reduce or minimize the number of handling and transfer operations for each MPC loading;
- system designs that maximize fuel capacity, thereby taking advantage of the self-shielding characteristics of the fuel and the reduction in the number of MPCs that must be loaded and handled;
- system designs that minimize planned maintenance requirements;
- system designs that minimize decontamination requirements at ISFSI decommissioning;
- system designs that optimize the placement of shielding with respect to anticipated worker locations and fuel placement;
- thick walled overpack that provides gamma and neutron shielding;
- thick MPC lid which provides effective shielding for operators during MPC loading and unloading operations;
- multiple welded barriers to confine radionuclides;
- smooth surfaces to reduce decontamination time;
- minimization of potential crud traps on the handling equipment to reduce decontamination requirements;
- capability of maintaining water in the MPC during welding to reduce dose rates;
- capability of maintaining water in the transfer cask annulus space and water jacket to reduce dose rates during closure operations;
- MPC penetrations located and configured to reduce streaming paths;
- HI-STORM and HI-TRAC designed to reduce streaming paths;
- MPC vent and drain ports with resealable caps to prevent the release of radionuclides during loading and unloading operations and facilitate draining, drying, and backfill operations;
- use of a separate pool lid, annulus seal, and Annulus Overpressure System to prevent contamination of the MPC shell outer surfaces during in-pool activities;
- temporary and auxiliary shielding to reduce dose rates around the HI-TRAC; and
- low-maintenance design to reduce doses during storage operation.

• Regulatory Position 2c, regarding process instrumentation and controls, is met since there are no radioactive systems at an ISFSI.

- Regulatory Position 2d, regarding control of airborne contaminants, is met since the HI-STORM 100 Storage System is designed to withstand all design basis conditions without loss of confinement function, as described in Chapter 7 of this FSAR, and no gaseous releases are anticipated. No significant surface contamination is expected since the exterior of the MPC is kept clean by using clean water in the HI-TRAC transfer cask-MPC annulus and by using an inflatable annulus seal.
- Regulatory Position 2e, regarding crud control, is not applicable to a HI-STORM 100 Storage System ISFSI since there are no radioactive systems at an ISFSI that could transport crud.
- Regulatory Position 2f, regarding decontamination, is met since the exterior of the loaded transfer cask is decontaminated prior to being removed from the plant's fuel building. The exterior surface of the HI-TRAC transfer cask is designed for ease of decontamination. In addition, an inflatable annulus seal is used to prevent fuel pool water from contacting and contaminating the exterior surface of the MPC.
- Regulatory Position 2g, regarding monitoring of airborne radioactivity, is met since the MPC provides confinement for all design basis conditions. There is no need for monitoring since no airborne radioactivity is anticipated to be released from the casks at an ISFSI.
- Regulatory Position 2h, regarding resin treatment systems, is not applicable to an ISFSI since there are no treatment systems containing radioactive resins.
- Regulatory Position 2i, regarding other miscellaneous ALARA items, is met since stainless steel is used in the MPC shell, the primary confinement boundary. This material is resistant to the damaging effects of radiation and is well proven in the SNF cask service. Use of this material quantitatively reduces or eliminates the need to perform maintenance (or replacement) on the primary confinement system.

10.1.3 Operational Considerations

Operational considerations that most directly influence occupational exposures with dry storage systems in general and that have been incorporated into the design of the HI-STORM 100 System include:

- totally-passive design requiring minimal maintenance and monitoring (other than security monitoring) during storage;
- remotely operated welding system, lift yoke, transfer slide and ~~Vacuum Drying System (VDS)~~*moisture removal systems* to reduce time operators spend in the vicinity of the loaded MPC;
- maintaining water in the MPC and the annulus region during MPC closure activities to reduce dose rates;

- low fuel assembly lift-over height of the HI-TRAC maximizes water coverage over assemblies during fuel assembly loading;
- a water-filled neutron shield jacket allows filling after removal of the HI-TRAC from the spent fuel pool. This maximizes the shielding on the HI-TRAC without exceeding the crane capacity;
- descriptive operating procedures that provide guidance to reduce equipment contamination, obtain survey information, minimize dose and alert workers to possible changing radiological conditions;
- preparation and inspection of the HI-STORM and HI-TRAC in low-dose areas;
- MPC lid fit tests and inspections prior to actual loading to ensure smooth operation during loading;
- gas sampling of the MPC and HI-STAR 100 annulus (receiving from transport) to assess the condition of the cladding and MPC confinement boundary;
- fuel cool-down operations developed for fuel unloading operations which minimize thermal shock to the fuel and therefore reduce the potential for fuel cladding rupture;
- HI-STORM vent ~~thermocouples~~ *temperature elements* (See Chapter 12) allow remote monitoring of the vent operability surveillance;
- wetting of component surfaces prior to placement in the spent fuel pool to reduce the need for decontamination;
- decontamination practices which consider the effects of weeping during HI-TRAC transfer cask heat up and surveying of HI-TRAC prior to removal from the fuel handling building;
- a sequence of operations based on ALARA considerations; and
- use of mock-ups and dry run training to prepare personnel for actual work situations.

10.1.4 Auxiliary/Temporary Shielding

To minimize occupational dose during loading and unloading operations, a specially-designed set of auxiliary shielding is available. The HI-STORM 100 auxiliary shielding consists of the Automated Welding System Baseplate, the HI-TRAC Temporary Shield Ring, the annulus shield, HI-STORM vent shield insert, the HI-TRAC transfer step, and the shield panel trim plates. *Additional supplemental shielding such as lead blankets and bricks or other such shielding may also be used to help reduce dose rates.* Each auxiliary shield is described in Table 10.1.1, shown on Figure 10.1.1 and the procedures for utilization are provided in Chapter 8. *Other embodiments of the temporary shielding may also be used.* Table 10.1.2 provides the minimum requirements for use of the temporary shielding indicating optional and required shielding. Users shall evaluate the need for ~~additional~~ auxiliary and temporary shielding *and use* *of special tooling to reduce the overall exposure* based on an ALARA review of cask loading operations *and the MPC contents.*

Table 10.1.1
HI-STORM 100 AUXILIARY AND TEMPORARY SHIELDS

Temporary Shield	Description	Utilization
Automated Welding System Baseplate	Thick gamma and neutron shield circular plate that sits on the MPC lid. Plate is set directly on the MPC lid and has alignment pins for centering. Threaded lift holes are provided to assist in rigging.	Used during MPC closure and unloading operations in the cask preparation area to reduce the dose rates around the MPC lid. The design of the closure ring allows the baseplate shield to remain in place during the entire closure operation.
HI-TRAC Temporary Shield Ring	A series of eight custom-fit water-filled tanks that are placed atop of the HI-STAR or HI-TRAC neutron shield. The tanks, when secured together, form a complete shielding ring around the top flange.	Used during MPC and HI-TRAC closure operations and MPC transfers into HI-STAR to reduce dose rates to the operators around the top flange of the HI-TRAC.
Annulus Shield	A solid ring that is seated between the MPC shell and the HI-TRAC.	Used during MPC closure operations to reduce streaming from the annulus.
HI-TRAC Transfer Step	A stepped block used to position the pool lid and transfer lid at the same elevation. The transfer step creates a tight seam between the two lids to eliminate streaming during bottom lid replacement.	Used during HI-TRAC bottom lid replacement.
Shield Panel Trim Plates	Four steel plates approximately 0.25 inch by 3 inch by 80 inch that are placed at the ends of the transfer lid top and bottom plate and secured by clamps or other method deemed suitable by the user.	Used during MPC transfer to and from HI-TRAC to shield the small gap above and below the sliding doors on the transfer lid.
HI-STORM Vent Shield Inserts	Custom-fit concrete blocks shaped to fit into the HI-STORM exit vents.	Used during MPC transfer to and from HI-STORM to eliminate the streaming path from the exit vents during MPC transfer operations.

Table 10.1.2
HI-STORM 100 AUXILIARY AND TEMPORARY SHIELD REQUIREMENTS

Auxiliary Shielding	Required for the 100-Ton HI-TRAC	Required for the 125-ton HI-TRAC
Temporary Shield Ring	~~Yes~~*Note 1*	No
Automated Welding System Baseplate Shield	No	No
Annulus Shield	*Note 1*~~Yes~~	*Note 1*~~Yes~~
Vent Duct Shield Inserts	*Note 2*~~Yes~~	*Note 2*~~Yes~~
Transfer Step	Yes	Yes
Trim Plates	No	No

Notes:

1. *Users shall determine the need for this temporary shielding based on the specific operations and the MPC contents.*
2. *Not required for the HI-STORM 100S Overpack.*

10.3 ESTIMATED ON-SITE COLLECTIVE DOSE ASSESSMENT

This section provides the estimates of the cumulative exposure to personnel performing loading, unloading and transfer operations using the HI-STORM system. This section uses the shielding analysis provided in Chapter 5 and the operations procedures provided in Chapter 8 to develop a dose assessment. The dose assessment is provided in Tables 10.3.1, 10.3.2, and 10.3.3.

The dose rates from the HI-STORM 100 overpack, MPC lid, HI-TRAC transfer cask, and HI-STAR 100 overpack are calculated to determine the dose to personnel during the various loading and unloading operations. The dose rates are also calculated for the various conditions of the cask that may affect the dose rates to the operators (e.g., MPC water level, HI-TRAC annulus water level, neutron shield water level, presence of temporary shielding). The dose rates around the 100-Ton HI-TRAC transfer cask are based on 24 PWR fuel assemblies with a burnup of ~~35,000~~*42,500* MWD/MTU and cooling of 5 years *including BPRAs*. The dose rates around the 125-Ton HI-TRAC transfer cask are based on 24 PWR fuel assemblies with a burnup of *57,500*~~45,000~~ MWD/MTU and cooling of *12*~~9~~ years *including BPRAs*. The dose rates around the HI-STORM 100 overpack are based on 24 PWR fuel assemblies with a burnup of *52,500*~~45,000~~ MWD/MTU and cooling of 5 years. The selection of these fuel assembly types in all fuel cell locations bound all possible PWR and BWR loading scenarios for the HI-STORM System from a dose-rate perspective. No assessment is made with respect to background radiation since background radiation can vary significantly by site. In addition, exposures are based on work being performed with the temporary shielding described in Table 10.1.2.

The choice of burnup and cooling times used in this chapter is extremely conservative. The bounding burnup and cooling time that resulted in the highest dose rates around the 100-ton and 125-ton HI-TRACs were used in conjunction with the very conservative burnup and cooling time for the HI-STORM 100 overpack (as discussed in Section 5.1). In addition, including the source term from BPRAs increases the level of conservatism. The maximum dose rate due to BPRAs was used in this analysis. As stated in Chapter 5, using the maximum source for the BPRAs in conjunction with the bounding burnup and cooling time for fuel assemblies is very conservative as it is not expected that burnup and cooling times of the BPRAs and fuel assemblies would be such that they are both at the maximum design basis values. This combined with the already conservative dose rates for the HI-TRACs and HI-STORMs results in an upper bound estimate of the occupational exposure. Users' radiation protection programs will assure appropriate temporary shielding is used based on actual fuel to be loaded and resulting dose rates in the field.

For each step in Tables 10.3.1 through 10.3.3, the operator work location is identified. These correspond to the locations identified in Figure 10.3.1. *The relative locations refer to both the HI-STORM 100 Overpack and the HI-STORM 100s Overpack.* The dose rate location points around the transfer cask and overpack were selected to model actual worker locations and cask conditions during the operation. Cask operators typically work at an arms-reach distance from the cask. To account for this, an 18-inch distance was used to estimate the dose rate for the worker. This assessment addresses only the operators that perform work on or immediately adjacent to the cask.

Justification for the duration of operations along with the corresponding procedure steps from Chapter 8 are also provided in the tables. The assumptions used in developing time durations are based on mockups of the MPC, review of design drawings, walk-downs using other equipment to represent the HI-TRAC transfer cask and HI-STORM 100 overpack the HI-STAR 100 overpack and MPC-68 prototype, consultation with UST&D (weld examination) and consultation with cask operations personnel from Calvert Cliffs Nuclear Power Plant (for items such as lid installation and decontamination). In addition, for the shielding calculations, only the Temporary Shield Ring was assumed to be in place for applicable portions of the operations.

Tables 10.3.1a and 10.3.1b provide a summary of the dose assessment for a HI-STORM 100 System loading operation using the 125-ton HI-TRAC and the 100-ton HI-TRAC, respectively. Tables 10.3.2a and 10.3.2b provide a summary of the dose assessment for HI-STORM 100 System unloading operations operation using the 125-ton HI-TRAC transfer cask and the 100-ton HI-TRAC transfer cask, respectively. Tables 10.3.3a and 10.3.3.b provide a summary of the dose assessment for transferring the MPC to a HI-STAR 100 overpack as described in Section 8.5 of the operating procedures using the 125-ton HI-TRAC and the 100-ton HI-TRAC transfer cask, respectively.

10.3.1 Estimated Exposures for Loading and Unloading Operations

The assumptions used to estimate personnel exposures are conservative by design. The main factors attributed to actual personnel exposures are the age and burnup of the spent fuel assemblies and good ALARA practices. To estimate the dose received by a single worker, it should be understood that a canister-based system requires a diverse range of disciplines to perform all the necessary functions. The high visibility and often critical path nature of fuel movement activities have prompted utilities to load canister systems in a round-the-clock mode in most cases. This results in the exposure being spread out over several shifts of operators and technicians with no single shift receiving a majority of the exposure.

The total person-rem exposure from operation of the HI-STORM 100 System is proportional to the number of systems loaded. A typical utility will load approximately four MPCs per reactor cycle to maintain the current available spent fuel pool capacity. Utilities requiring dry storage of spent fuel assemblies typically have a large inventory of spent fuel assemblies that date back to the reactor's first cycle. The older fuel assemblies will have a significantly lower dose rate than the design basis fuel assemblies due to the extended cooling time (i.e., much greater than the values used to compute the dose rates). Users shall assess the cask loading for their particular fuel types (burnup, cooling time) to satisfy the requirements of 10CFR20 [10.1.1].

For licensees using the 100-Ton HI-TRAC transfer cask, design basis dose rates will be higher (than a corresponding 125-Ton HI-TRAC) due to the decreased mass of shielding~~ and longer cooling time for the 125-ton HI-TRAC transfer cask~~. Due to the higher expected dose rates from the 100-Ton HI-TRAC, users *may* need to use the auxiliary shielding (See Table 10.1.2), and should consider preferential loading, and increased precautions (e.g., additional temporary or auxiliary shielding, remotely operated equipment, additional contamination prevention measures). Actual use of optional dose reduction measures must be decided by each user based on the fuel to be loaded.

10.3.2 Estimated Exposures for Surveillance and Maintenance

Table 10.3.4 provides the maximum occupational exposure required for security surveillance and maintenance of an ISFSI. Although the HI-STORM 100 System requires only minimal maintenance during storage, maintenance will be required around the ISFSI for items such as security equipment maintenance, grass cutting, snow removal, vent system surveillance, drainage system maintenance, and lighting, telephone, and intercom repair. Security surveillance time is based on a daily security patrol around the perimeter of the ISFSI security fence. The estimated dose rates described below are based on a sample array of HI-STORM 100 overpacks fully loaded with design basis fuel assemblies, placed at their minimum required pitch, in a 2 x 6 HI-STORM array. The maintenance worker is assumed to be at a distance of 5 meters from the center of the long edge of the array. The security worker is assumed to be at a distance of 15 meters from the center of the long edge of the array. Users may opt to utilize electronic temperature monitoring of the HI-STORM modules or remote viewing methods instead of performing direct visual observation of the modules. Since security surveillances can be performed from outside the ISFSI, a dose rate of 3 mrem/hour is estimated. For maintenance of the casks and the ISFSI, a dose rate of 10 mrem/hour is estimated

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.1.4								
LOAD PRE-SELECTED FUEL ASSEMBLIES INTO MPC	2	1020	1	2	*1*	*17.0*	*34.0*	15 MINUTES PER ASSEMBLY/68 ASSY
PERFORM POST-LOADING VISUAL VERIFICATION OF ASSEMBLY IDENTIFICATION	3	68	1	2	*1*	*1.1*	2.3	1 MINUTES PER ASSY/68 ASSY
Section 8.1.5								
INSTALL MPC LID AND ATTACH LIFT YOKE	*1.g*	45	2	2	2	*1.5*	*3.0*	CONSULTATION WITH CALVERT CLIFFS
RAISE HI-TRAC TO SURFACE OF SPENT FUEL POOL	*1.i*	20	2	2	2	*0.7*	*1.3*	40 FEET @ 2 FT/MINUTE (CRANE SPEED)
SURVEY MPC LID FOR HOT PARTICLES	*1.i*	3	3A	1	*18.35*	*0.9*	*0.9*	TELESCOPING DETECTOR USED
VERIFY MPC LID IS SEATED	*1.j*	0.5	3A	1	*18.35*	*0.2*	*0.2*	VISUAL VERIFICATION FROM 3 METERS
INSTALL LID RETENTION SYSTEM BOLTS	*1.k*	6	3B	2	*19.45*	*1.9*	*3.9*	24 BOLTS @ 1/PERSON-MINUTE
REMOVE HI-TRAC FROM SPENT FUEL POOL	*1.m*	8.5	3C	1	*38.9*	*5.5*	*5.5*	17 FEET @ 2 FT/MIN (CRANE SPEED)
DECONTAMINATE HI-TRAC BOTTOM	*1.n*	10	3D	1	*51.45*	*8.6*	*8.6*	LONG HANDLED TOOLS, PRELIMINARY DECON
TAKE SMEARS OF HI-TRAC EXTERIOR SURFACES	*1.n*	5	5B	1	*59.31*	*4.9*	*4.9*	50 SMEARS @ 10 SMEARS/MINUTE
DISCONNECT ANNULUS OVERPRESSURE SYSTEM	*1.o*	0.5	5C	1	*31.89*	*0.3*	*0.3*	QUICK DISCONNECT COUPLING
SET HI-TRAC IN CASK PREPARATION AREA	*1.p*	10	4A	1	*19.45*	*3.2*	*3.2*	100 FT @ 10 FT/MIN (CRANE SPEED)
REMOVE NEUTRON SHIELD JACKET FILL PLUG	*1.q*	2	4A	1	*19.45*	*0.6*	*0.6*	SINGLE PLUG, NO SPECIAL TOOLS
INSTALL NEUTRON SHIELD JACKET FILL PLUG	*1.q*	2	5B	1	*59.31*	*2.0*	*2.0*	SINGLE PLUG, NO SPECIAL TOOLS

† See notes at bottom of Table 10.3.4.

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
DISCONNECT LID RETENTION SYSTEM	*1.r*	6	5A	2	*21.35*	*2.1*	*4.3*	24 BOLTS @ 1 BOLT/PERSON MINUTES
MEASURE DOSE RATES AT MPC LID	*1.t*	3	5A	1	*21.35*	*1.1*	*1.1*	TELESCOPING DETECTOR USED
DECONTAMINATE AND SURVEY HI-TRAC	*1.t*	103	5B	1	*59.31*	*101.8*	*101.8*	490 SQ-FT@5 SQ-FT/PRERSON-MINUTE+50 SMEARS@10 SMEARS/MINUTE
INSTALL TEMPORARY SHIELD	*1.v*	16	6A	2	*11.05*	*2.9*	*5.9*	8 SEGMENTS @ 1 SEGMENT/PERSON MIN
FILL TEMPORARY SHIELD RING	*1.v*	25	6A	1	*11.05*	*4.6*	*4.6*	230 GAL @10GPM, LONG HANDLED SPRAY WAND
ATTACH DRAIN LINE TO HI-TRAC DRAIN PORT	*1.w*	*0.5*	5C	1	*31.89*	*0.3*	*0.3*	QUICK DISCONNECT COUPLING
INSTALL RVOAs	*2.a*	2	6A	1	*11.05*	*0.4*	*0.4*	SINGLE THREADED CONNECTION X 2 RVOAs
ATTACH WATER PUMP TO DRAIN PORT	*2.b*	2	6A	1	*11.05*	*0.4*	*0.4*	POSITION PUMP SELF PRIMING
DISCONNECT WATER PUMP	*2.c*	5	6A	1	*11.05*	*0.9*	*0.9*	DRAIN HOSES MOVE PUMP
DECONTAMINATE MPC LID TOP SURFACE AND SHELL AREA ABOVE INFLATABLE ANNULUS SEAL	*2.d*	6	6A	1	*11.05*	*1.1*	*1.1*	30 SQ-FT @5 SQ-FT/MINUTE+10 SMEARS@10 SMEARS/MINUTE
REMOVE INFLATABLE ANNULUS SEAL	*2.e*	3	6A	1	*11.05*	*0.6*	*0.6*	SEAL PULLS OUT DIRECTLY
SURVEY MPC LID TOP SURFACES AND ACCESSIBLE AREAS OF TOP THREE INCHES OF MPC SHELL	*2.f*	1	6A	1	*11.05*	*0.2*	*0.2*	10 SMEARS@10 SMEARS/MINUTE
INSTALL ANNULUS SHIELD	*2.g*	2	6A	1	*11.05*	*0.4*	*0.4*	SHIELD PLACED BY HAND
CENTER LID IN MPC SHELL	*3.a*	20	6A	3	*11.05*	*3.7*	*11.1*	CONSULTATION WITH CALVERT CLIFFS
INSTALL MPC LID SHIMS	*3.b*	12	6A	2	*11.05*	*2.2*	*4.4*	MEASURED DURING WELD MOCKUP TESTING
POSITION AWS BASEPLATE SHIELD ON MPC LID	*3.c*	20	7A	2	*11.05*	*3.7*	*7.4*	ALIGN AND REMOVE 4 SHACKLES

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
INSTALL AUTOMATED WELDING SYSTEM ROBOT	3.c	8	7A	2	11.05	1.5	2.9	ALIGN AND REMOVE 4 SHACKLES/4 QUICK CONNECTS@1/MIN
VISUALLY INSPECT TACK WELD	3.e	5	7A	1	11.05	0.9	0.9	MEASURED DURING WELD MOCKUP TESTING
PERFORM LIQUID PENETRANT EXAMINATION OF WELD ROOT	3.g	45	7A	1	11.05	8.3	8.3	MEASURED DURING WELD MOCKUP TESTING
PERFORM INTERMEDIATE LIQUID PENETRANT EXAMINATION (3 SETS)	3.h	135	7A	1	11.05	24.9	24.9	MEASURED DURING WELD MOCKUP TESTING
PERFORM LIQUID PENETRANT EXAMINATION ON MPC LID FINAL PASS	3.i	45	7A	1	11.05	8.3	8.3	MEASURED DURING WELD MOCKUP TESTING
ATTACH DRAIN LINE TO VENT PORT	4.a	1	7A	1	11.05	0.2	0.2	1" THREADED FITTING NO TOOLS
VISUALLY EXAMINE MPC LID-TO-SHELL WELD FOR LEAKAGE OF WATER	4.c	10	7A	1	11.05	1.8	1.8	10 MIN TEST DURATION
DISCONNECT WATER FILL LINE AND DRAIN LINE	4.c	2	7A	1	11.05	0.4	0.4	1" THREADED FITTING NO TOOLS X 2
REPEAT LIQUID PENETRANT EXAMINATION ON MPC LID FINAL PASS	4.d	45	7A	1	11.05	8.3	8.3	5 MIN TO APPLY, 7 MIN TO WIPE, 5 APPLY DEV, INSP (24 IN/MIN)
ATTACH GAS SUPPLY TO VENT PORT	4.e	1	7A	1	11.05	0.2	0.2	1" THREADED FITTING NO TOOLS
ATTACH DRAIN LINE TO DRAIN PORT	4.e	1	7A	1	11.05	0.2	0.2	1" THREADED FITTING NO TOOLS
CONNECT MSLD SNIFFER TO AUTOMATED WELDING SYSTEM	4.i	4	8A	1	15.4	1.0	1.0	SIMPLE ATTACHMENT NO TOOLS
DISCONNECT MSLD SNIFFER FROM AUTOMATED WELDING SYSTEM	4.i	4	8A	1	15.4	1.0	1.0	SIMPLE ATTACHMENT NO TOOLS
ATTACH DRAIN LINE TO VENT PORT	5.a	1	8A	1	15.4	0.3	0.3	1" THREADED FITTING NO TOOLS
ATTACH WATER FILL LINE TO DRAIN PORT	5.a	1	8A	1	15.4	0.3	0.3	1" THREADED FITTING NO TOOLS

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
DISCONNECT WATER FILL DRAIN LINES FROM MPC	*5.b*	2	8A	1	*15.4*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS X 2
ATTACH HELIUM ~~OR NITROGEN~~ SUPPLY TO VENT PORT	*5.c*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
ATTACH DRAIN LINE TO DRAIN PORT	*5.d*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
DISCONNECT GAS SUPPLY LINE FROM MPC	*5.i*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
DISCONNECT DRAIN LINE FROM *MPC*	*5.j*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
ATTACH ~~VACUUM DRYING~~*M MOISTURE REMOVAL* SYSTEM ~~(VDS)~~ TO VENT AND DRAIN PORT RVOAs	*6.a*	2	8A	1	*15.4*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS
DISCONNECT ~~VDS~~ *MOISTURE REMOVAL SYSTEM* FROM MPC	*6.j*	2	8A	1	*15.4*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS X 2
CLOSE DRAIN PORT RVOA CAP AND REMOVE DRAIN PORT RVOA	*6.l*	1.5	8A	1	*15.4*	*0.4*	*0.4*	SINGLE THREADED CONNECTION (1 RVOA)
ATTACH HELIUM BACKFILL SYSTEM TO VENT PORT	*7.c*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
DISCONNECT HBS FROM MPC	*7.f*	1	8A	1	*15.4*	*0.3*	*0.3*	1" THREADED FITTING NO TOOLS
CLOSE VENT PORT RVOA AND DISCONNECT VENT PORT RVOA	*7.g*	1.5	8A	1	*15.4*	*0.4*	*0.4*	SINGLE THREADED CONNECTION (1 RVOA)
WIPE INSIDE AREA OF VENT AND DRAIN PORT RECESSES	*8.a*	2	8A	1	*15.4*	*0.5*	*0.5*	2 PORTS, 1 MIN/PORT
PLACE COVER PLATE OVER VENT PORT RECESS	*8.b*	1	8A	1	*15.4*	*0.3*	*0.3*	INSTALLED BY HAND NO TOOLS (2/MIN)
VISUALLY INSPECT TACK WELDS	*8.d*	10	8A	1	*15.4*	*2.6*	*2.6*	MEASURED DURING WELD MOCKUP TESTING

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
PERFORM LIQUID PENETRANT EXAMINATION ON VENT AND DRAIN COVER PLATE ROOT WELD	*8.f*	45	8A	1	*15.4*	*11.6*	*11.6*	MEASURED DURING WELD MOCKUP TESTING
PERFORM A LIQUID PENETRANT EXAMINATION ON VENT AND DRAIN PORT COVER WELD	*8.h*	45	8A	1	*15.4*	*11.6*	*11.6*	CONSULTATION WITH UST&D ON PROTOTYPE
FLUSH CAVITY WITH HELIUM AND INSTALL SET SCREWS	*9.b*	2	8A	1	*15.4*	*6.7*	*6.7*	4 SET SCREWS @2/MINUTE
PLUG WELD OVER SET SCREWS	*9.b*	8	8A	1	*15.4*	*6.7*	*6.7*	FOUR SINGLE SPOT WELDS @ 1 PER 2 MINTES
INSTALL MSLD OVER VENT PORT COVER PLATE	*9.f*	2	8A	1	*15.4*	*0.5*	*0.5*	INSTALLED BY HAND NO TOOLS
INSTALL MSLD OVER DRAIN PORT COVER PLATE	*9.f*	2	8A	1	*15.4*	*0.5*	*0.5*	INSTALLED BY HAND NO TOOLS
INSTALL AND ALIGN CLOSURE RING	*10.a*	5	8A	1	*15.4*	*1.3*	*1.3*	INSTALLED BY HAND NO TOOLS
VISUALLY INSPECT TACK WELDS	*10.c*	5	8A	1	*15.4*	*1.3*	*1.3*	10 TACKS @ 2/MIN
PERFORM A LIQUID PENETRANT EXAMINATION ON CLOSURE RING ROOT WELDS	*10.g*	90	8A	1	*15.4*	*23.1*	*23.1*	MEASURED DURING WELD MOCKUP TESTING
PERFORM A LIQUID PENETRANT EXAMINATION ON CLOSURE RING FINAL WELD	*10.g*	90	8A	1	*15.4*	*23.1*	*23.1*	MEASURED DURING WELD MOCKUP TESTING
RIG AWS TO CRANE	*10.j*	12	8A	1	*15.4*	*3.1*	*3.1*	10 MIN TO DISCONNECT LINES, 4 SHACKLES@2/MIN
Section 8.1.6								
REMOVE ANNULUS SHIELD	*1*	1	8A	1	*15.4*	*0.3*	*0.3*	SHIELD PLACED BY HAND
ATTACH DRAIN LINE TO HI-TRAC	2	1	9D	1	*135.28*	2.3	2.3	1" THREADED FITTING NO TOOLS
POSITION HI-TRAC TOP LID	*3*	10	9B	2	*15.4*	2.6	*5.1*	VERTICAL FLANGED CONNECTION
TORQUE TOP LID BOLTS	*4*	*12*	9B	1	*15.4*	*3.1*	*3.1*	24 BOLTS AT 2/MIN (INSTALL AND TORQUE,1 PASS)
INSTALL MPC LIFT CLEATS AND MPC SUPPORT STAYS	*5*	25	9A	2	*67.84*	*28.3*	*56.5*	INSTALL CLEATS AND HYDRO TORQUE 4 BOLTS

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
REMOVE TEMPORARY SHIELD RING DRAIN PLUGS	6	1	9B	1	15.4	0.3	0.3	8 PLUGS @ 8/MIN
REMOVE TEMPORARY SHIELD RING SEGMENTS	6	4	9A	1	67.84	4.5	4.5	REMOVED BY HAND NO TOOLS (8 SEGS@2/MIN)
ATTACH MPC SUPPORT STAYS TO LIFT YOKE	7.a	4	9A	2	67.84	4.5	9.0	INSTALLED BY HAND NO TOOLS
POSITION HI-TRAC ABOVE TRANSFER STEP	7.c	15	9C	1	38.9	9.7	9.7	100 FT @ 10 FT/MIN (CRANE SPEED)+ 5MIN TO ALIGN
REMOVE BOTTOM LID BOLTS	7.f	6	10A	1	135.28	13.5	13.5	36 BOLTS@6 BOLTS/MIN IMPACT TOOLS USED
INSTALL TRANSFER LID BOLTS	7.j	18	11B	1	135.28	40.6	40.6	36 BOLTS @ 2/MIN IMPACT TOOLS USED 1 PASS
DISCONNECT MPC SUPPORT STAYS	7.l	4	9A	2	67.84	4.5	9.0	INSTALLED BY HAND NO TOOLS
Section 8.1.7								
POSITION HI-TRAC ON TRANSPORT DEVICE	1	20	11A	2	38.9	13.0	25.9	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
TRANSPORT HI-TRAC TO OUTSIDE TRANSFER LOCATION	1.b	90	12A	3	18.64	28.0	83.9	DRIVER AND 2 SPOTTERS
ATTACH OUTSIDE LIFTING DEVICE LIFT LINKS	5	2	12A	2	18.64	0.6	1.2	2 LINKS@1/MIN
MATE OVERPACKS	6	10	13B	2	41.91	7.0	14.0	ALIGNMENT GUIDES USED
ATTACH MPC LIFT SLINGS TO MPC LIFT CLEATS	7	10	13A	2	67.84	11.3	22.6	2 SLINGS@5MIN/SLING NO TOOLS
REMOVE TRANSFER LID DOOR LOCKING PINS AND OPEN DOORS	10	4	13B	2	41.91	2.8	5.6	2 PINS@2MIN/PIN
INSTALL TRIM PLATES	11	4	13B	2	41.91	2.8	5.6	INSTALLED BY HAND
DISCONNECT SLINGS FROM MPC LIFTING DEVICE	13	10	13A	2	67.84	11.3	22.6	2 SLINGS@5MIN/SLING
REMOVE MPC LIFT CLEATS AND MPC LIFT SLINGS	15	10	14A	1	200.07	33.3	33.3	4 BOLTS,NO TORQUING

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
INSTALL HOLE PLUGS IN EMPTY MPC BOLT HOLES	*15*	2	14A	1	*200.07*	*6.7*	*6.7*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE HI-STORM VENT DUCT SHIELD INSERTS	*16.a*	2	15A	1	*7.85*	*0.3*	*0.3*	4 SHACKLES@2/MIN
REMOVE ALIGNMENT DEVICE	*16.c*	4	15A	1	*7.85*	*0.5*	*0.5*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)
INSTALL HI-STORM LID AND INSTALL LID STUDS/NUTS	*16.c*	25	16A	2	*2.96*	*1.2*	*2.5*	INSTALL LID AND HYDRO TORQUE 4 BOLTS
INSTALL HI-STORM EXIT VENT GAMMA SHIELD CROSS PLATES	*16.e*	4	16B	1	*22.88*	*1.5*	*1.5*	4 PCS @ 1/MIN INSTALL BY HAND NO TOOLS
INSTALL ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*16.e*	20	16B	1	*22.88*	*7.6*	*7.6*	4@5MIN/~~THERMOCOUPLE~~*TEMPERATURE ELEMENT*
INSTALL EXIT VENT SCREENS	*16.e*	20	16B	1	*22.88*	*7.6*	*7.6*	4 SCREENS@5MIN/SCREEN
REMOVE HI-STORM LID LIFTING DEVICE	*16.f*	2	16A	1	*2.96*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HOLE PLUGS IN EMPTY HOLES	*16.f*	2	16A	1	*2.96*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING
PERFORM SHIELDING EFFECTIVENESS TESTING	*16.g*	16	16D	2	*9.96*	*2.7*	*5.3*	16 POINTS@1 MIN
SECURE HI-STORM TO TRANSPORT DEVICE	*16.h*	10	16A	2	*2.96*	*0.5*	*1.0*	ASSUMES AIR PAD
TRANSFER HI-STORM TO ITS DESIGNATED STORAGE LOCATION	*17.a*	40	16C	1	*7.89*	*5.3*	*5.3*	200 FEET @ 4FT/MIN
INSERT HI-STORM LIFTING JACKS	*17.b*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
REMOVE AIR PAD	*17.b*	5	16D	2	*9.96*	*0.8*	*1.7*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*17.c*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
INSTALL INLET VENT SCREENS/CROSS PLATES	*18*	20	16D	1	*9.96*	*3.3*	*3.3*	4 SCREENS@5MIN/SCREEN
PERFORM AIR TEMPERATURE RISE TEST	*19*	8	16B	1	*22.88*	*3.1*	*3.1*	8 MEASUREMENTS@1/MIN

Table 10.3.1a
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
TOTAL							*787.4 PERSON-MREM*	

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.1.4								
LOAD PRE-SELECTED FUEL ASSEMBLIES INTO MPC	2	1020	1	2	3	51.0	102.0	15 MINUTES PER ASSEMBLY/68 ASSY
PERFORM POST-LOADING VISUAL VERIFICATION OF ASSEMBLY IDENTIFICATION	3	68	1	2	3	3.4	6.8	1 MINUTES PER ASSY/68 ASSY
Section 8.1.5								
INSTALL MPC LID AND ATTACH LIFT YOKE	*1.g*	45	2	2	3	2.3	4.5	CONSULTATION WITH CALVERT CLIFFS
RAISE HI-TRAC TO SURFACE OF SPENT FUEL POOL	*1.i*	20	2	2	3	1.0	2.0	40 FEET @ 2 FT/MINUTE (CRANE SPEED)
SURVEY MPC LID FOR HOT PARTICLES	*1.i*	3	3A	1	*18.35*	*0.9*	*0.9*	TELESCOPING DETECTOR USED
VERIFY MPC LID IS SEATED	*1.j*	0.5	3A	1	*18.35*	*0.2*	*0.2*	VISUAL VERIFICATION FROM 3 METERS
INSTALL LID RETENTION SYSTEM BOLTS	*1.k*	6	3B	2	*64.04*	*6.4*	*12.8*	24 BOLTS @ 1/PERSON-MINUTE
REMOVE HI-TRAC FROM SPENT FUEL POOL	*1.m*	8.5	3C	1	*295.96*	*41.9*	*41.9*	17 FEET @ 2 FT/MIN (CRANE SPEED)
DECONTAMINATE HI-TRAC BOTTOM	*1.n*	10	3D	1	*234.04*	*39.0*	*39.0*	LONG HANDLED TOOLS, PRELIMINARY DECON
TAKE SMEARS OF HI-TRAC EXTERIOR SURFACES	*1.n*	5	5B	1	*376.05*	*31.3*	*31.3*	50 SMEARS @ 10 SMEARS/MINUTE
DISCONNECT ANNULUS OVERPRESSURE SYSTEM	*1.o*	0.5	5C	1	*125.48*	*1.0*	*1.0*	QUICK DISCONNECT COUPLING
SET HI-TRAC IN CASK PREPARATION AREA	*1.p*	10	4A	1	*64.04*	*10.7*	*10.7*	100 FT @ 10 FT/MIN (CRANE SPEED)

† See notes at bottom of Table 10.3.4.

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
REMOVE NEUTRON SHIELD JACKET FILL PLUG	*1.q*	2	4A	1	*64.04*	*2.1*	*2.1*	SINGLE PLUG, NO SPECIAL TOOLS
INSTALL NEUTRON SHIELD JACKET FILL PLUG	*1.q*	2	5B	1	*376.05*	*12.5*	*12.5*	SINGLE PLUG, NO SPECIAL TOOLS
DISCONNECT LID RETENTION SYSTEM	*1.r*	6	5A	2	*55.41*	*5.5*	*11.1*	24 BOLTS @ 1 BOLT/PERSON MINUTES
MEASURE DOSE RATES AT MPC LID	*1.t*	3	5A	1	*55.41*	*2.8*	*2.8*	TELESCOPING DETECTOR USED
DECONTAMINATE AND SURVEY HI-TRAC	*1.t*	103	5B	1	*376.05*	*645.6*	*645.6*	490 SQ-FT@5 SQ-FT/PRERSON-MINUTE+50 SMEARS@10 SMEARS/MINUTE
INSTALL TEMPORARY SHIELD	*1.v*	16	6A	2	*30.91*	*8.2*	*16.5*	8 SEGMENTS @ 1 SEGMENT/PERSON MIN
FILL TEMPORARY SHIELD RING	*1.v*	25	6A	1	*30.91*	*12.9*	*12.9*	230 GAL @10GPM, LONG HANDLED SPRAY WAND
ATTACH DRAIN LINE TO HI-TRAC DRAIN PORT	*1.w*	0.5	5C	1	*125.48*	*1.0*	*1.0*	QUICK DISCONNECT COUPLING
INSTALL RVOAs	*2.a*	2	6A	1	*30.91*	*1.0*	*1.0*	SINGLE THREADED CONNECTION X 2 RVOAs
ATTACH WATER PUMP TO DRAIN PORT	*2.b*	2	6A	1	*30.91*	*1.0*	*1.0*	POSITION PUMP SELF PRIMING
DISCONNECT WATER PUMP	*2.c*	5	6A	1	*30.91*	*2.6*	*2.6*	DRAIN HOSES MOVE PUMP
DECONTAMINATE MPC LID TOP SURFACE AND SHELL AREA ABOVE INFLATABLE ANNULUS SEAL	*2.d*	6	6A	1	*30.91*	*3.1*	*3.1*	30 SQ-FT @5 SQ-FT/MINUTE+10 SMEARS@10 SMEARS/MINUTE
REMOVE INFLATABLE ANNULUS SEAL	*2.e*	3	6A	1	*30.91*	*1.5*	*1.5*	SEAL PULLS OUT DIRECTLY
SURVEY MPC LID TOP SURFACES AND ACCESSIBLE AREAS OF TOP THREE INCHES OF MPC SHELL	*2.f*	1	6A	1	*30.91*	*0.5*	*0.5*	10 SMEARS@10 SMEARS/MINUTE
INSTALL ANNULUS SHIELD	*2.g*	2	6A	1	*30.91*	*1.0*	*1.0*	SHIELD PLACED BY HAND

Table 10.3.1b

HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
CENTER LID IN MPC SHELL	*3.a*	20	6A	3	*30.91*	*10.3*	*30.9*	CONSULTATION WITH CALVERT CLIFFS
INSTALL MPC LID SHIMS	*3.b*	12	6A	2	*30.91*	*6.2*	*12.4*	MEASURED DURING WELD MOCKUP TESTING
POSITION AWS BASEPLATE SHIELD ON MPC LID	*3.c*	20	7A	2	*30.91*	*10.3*	*20.6*	ALIGN AND REMOVE 4 SHACKLES
INSTALL AUTOMATED WELDING SYSTEM ROBOT	*3.c*	8	7A	2	*30.91*	*4.1*	*8.2*	ALIGN AND REMOVE 4 SHACKLES/4 QUICK CONNECTS@1/MIN
VISUALLY INSPECT TACK WELD	*3.e*	5	7A	1	*30.91*	*2.6*	*2.6*	MEASURED DURING WELD MOCKUP TESTING
PERFORM LIQUID PENETRANT EXAMINATION OF WELD ROOT	*3.g*	45	7A	1	*30.91*	*23.2*	*23.2*	MEASURED DURING WELD MOCKUP TESTING
PERFORM INTERMEDIATE LIQUID PENETRANT EXAMINATION (3 SETS)	*3.h*	135	7A	1	*30.91*	*69.5*	*69.5*	MEASURED DURING WELD MOCKUP TESTING
PERFORM LIQUID PENETRANT EXAMINATION ON MPC LID FINAL PASS	*3.i*	45	7A	1	*30.91*	*23.2*	*23.2*	MEASURED DURING WELD MOCKUP TESTING
ATTACH DRAIN LINE TO VENT PORT	*4.a*	1	7A	1	*30.91*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS
VISUALLY EXAMINE MPC LID-TO-SHELL WELD FOR LEAKAGE OF WATER	*4.c*	10	7A	1	*30.91*	*5.2*	*5.2*	10 MIN TEST DURATION
DISCONNECT WATER FILL LINE AND DRAIN LINE	*4.c*	2	7A	1	*30.91*	*1.0*	*1.0*	1" THREADED FITTING NO TOOLS X 2
REPEAT LIQUID PENETRANT EXAMINATION ON MPC LID FINAL PASS	*4.d*	45	7A	1	*30.91*	*23.2*	*23.2*	5 MIN TO APPLY, 7 MIN TO WIPE, 5 APPLY DEV, INSP (24 IN/MIN)
ATTACH GAS SUPPLY TO VENT PORT	*4.e*	1	7A	1	*30.91*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS
ATTACH DRAIN LINE TO DRAIN PORT	*4.e*	1	7A	1	*30.91*	*0.5*	*0.5*	1" THREADED FITTING NO TOOLS

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
CONNECT MSLD SNIFFER TO AUTOMATED WELDING SYSTEM	*4.i*	4	8A	1	*52.84*	*3.5*	*3.5*	SIMPLE ATTACHMENT NO TOOLS
DISCONNECT MSLD SNIFFER FROM AUTOMATED WELDING SYSTEM	*4.i*	4	8A	1	*52.84*	*3.5*	*3.5*	SIMPLE ATTACHMENT NO TOOLS
ATTACH DRAIN LINE TO VENT PORT	*5.a*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
ATTACH WATER FILL LINE TO DRAIN PORT	*5.a*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
DISCONNECT WATER FILL DRAIN LINES FROM MPC	*5.b*	2	8A	1	*52.84*	*1.8*	*1.8*	1" THREADED FITTING NO TOOLS X 2
ATTACH HELIUM ~~OR NITROGEN~~ SUPPLY TO VENT PORT	*5.c*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
ATTACH DRAIN LINE TO DRAIN PORT	*5.d*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
DISCONNECT GAS SUPPLY LINE FROM ~~MPC~~*MPC*	*5.i*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
DISCONNECT DRAIN LINE FROM ~~MPC~~*MPC*	*5.j*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
ATTACH ~~VACUUM DRYING~~*MOISTURE REMOVAL* SYSTEM (~~VDS~~) TO VENT AND DRAIN PORT RVOAs	*6.a*	2	8A	1	*52.84*	*1.8*	*1.8*	1" THREADED FITTING NO TOOLS
DISCONNECT ~~VDS~~ *MOISTURE REMOVAL SYSTEM* FROM MPC	*6.j*	2	8A	1	*52.84*	*1.8*	*1.8*	1" THREADED FITTING NO TOOLS X 2
CLOSE DRAIN PORT RVOA CAP AND REMOVE DRAIN PORT RVOA	*6.l*	1.5	8A	1	*52.84*	*1.3*	*1.3*	SINGLE THREADED CONNECTION (1 RVOA)
ATTACH HELIUM BACKFILL SYSTEM TO VENT PORT	*7.c*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
DISCONNECT HBS FROM MPC	*7.f*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
CLOSE VENT PORT RVOA AND DISCONNECT VENT PORT RVOA	*7.g*	1.5	8A	1	*52.84*	*1.3*	*1.3*	SINGLE THREADED CONNECTION (1 RVOA)
WIPE INSIDE AREA OF VENT AND DRAIN PORT RECESSES	*8.a*	2	8A	1	*52.84*	*1.8*	*1.8*	2 PORTS, 1 MIN/PORT
PLACE COVER PLATE OVER VENT PORT RECESS	*8.b*	1	8A	1	*52.84*	*0.9*	*0.9*	INSTALLED BY HAND NO TOOLS (2/MIN)
VISUALLY INSPECT TACK WELDS	*8.d*	10	8A	1	*52.84*	*8.8*	*8.8*	MEASURED DURING WELD MOCKUP TESTING
PERFORM LIQUID PENETRANT EXAMINATION ON VENT AND DRAIN COVER PLATE ROOT WELD	*8.f*	45	8A	1	*52.84*	*39.6*	*39.6*	MEASURED DURING WELD MOCKUP TESTING
PERFORM A LIQUID PENETRANT EXAMINATION ON VENT AND DRAIN PORT COVER WELD	*8.h*	45	8A	1	*52.84*	*39.6*	*39.6*	CONSULTATION WITH UST&D ON PROTOTYPE
FLUSH CAVITY WITH HELIUM AND INSTALL SET SCREWS	*9.b*	2	8A	1	*52.84*	*1.8*	*23.9*	4 SET SCREWS @2/MINUTE
PLUG WELD OVER ET SCREWS	*9.b*	8	8A	1	*52.84*	*7.0*	*23.9*	FOUR SINGLE SPOT WELDS @ 1 PER 2 MINTES
INSTALL MSLD OVER VENT PORT COVER PLATE	*9.f*	2	8A	1	*52.84*	*1.8*	*1.8*	INSTALLED BY HAND NO TOOLS
INSTALL MSLD OVER DRAIN PORT COVER PLATE	*9.f*	2	8A	1	*52.84*	*1.8*	*1.8*	INSTALLED BY HAND NO TOOLS
INSTALL AND ALIGN CLOSURE RING	*10.a*	5	8A	1	*52.84*	*4.4*	*4.4*	INSTALLED BY HAND NO TOOLS
VISUALLY INSPECT TACK WELDS	*10.c*	5	8A	1	*52.84*	*4.4*	*4.4*	10 TACKS @ 2/MIN
PERFORM A LIQUID PENETRANT EXAMINATION ON CLOSURE RING ROOT WELDS	*10.g*	90	8A	1	*52.84*	*79.3*	*79.3*	MEASURED DURING WELD MOCKUP TESTING
PERFORM A LIQUID PENETRANT EXAMINATION ON CLOSURE RING FINAL WELD	*10.g*	90	8A	1	*52.84*	*79.3*	*79.3*	MEASURED DURING WELD MOCKUP TESTING

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
RIG AWS TO CRANE	*10.j*	12	8A	1	*52.84*	*10.6*	*10.6*	10 MIN TO DISCONNECT LINES, 4 SHACKLES@2/MIN
Section 8.1.6								
REMOVE ANNULUS SHIELD	*1*	1	8A	1	*52.84*	*0.9*	*0.9*	SHIELD PLACED BY HAND
ATTACH DRAIN LINE TO HI-TRAC	*2*	1	9D	1	*804.79*	*13.4*	*13.4*	1" THREADED FITTING NO TOOLS
POSITION HI-TRAC TOP LID	*3*	10	9B	2	*52.84*	*8.8*	*17.6*	VERTICAL FLANGED CONNECTION
TORQUE TOP LID BOLTS	*4*	12	9B	1	*52.84*	*10.6*	*10.6*	24 BOLTS AT 2/MIN (INSTALL AND TORQUE,1 PASS)
INSTALL MPC LIFT CLEATS AND MPC SUPPORT STAYS	*5*	25	9A	2	*177.55*	*74.0*	*148.0*	INSTALL CLEATS AND HYDRO TORQUE 4 BOLTS
REMOVE TEMPORARY SHIELD RING DRAIN PLUGS	*6*	1	9B	1	*52.84*	*0.9*	*0.9*	8 PLUGS @ 8/MIN
REMOVE TEMPORARY SHIELD RING SEGMENTS	*6*	4	9A	1	*177.55*	*11.8*	*11.8*	REMOVED BY HAND NO TOOLS (8 SEGS@2/MIN)
ATTACH MPC SUPPORT STAYS TO LIFT YOKE	*7.a*	4	9A	2	*177.55*	*11.8*	*23.7*	INSTALLED BY HAND NO TOOLS
POSITION HI-TRAC ABOVE TRANSFER STEP	*7.c*	15	9C	1	*316.83*	*79.2*	*79.2*	100 FT @ 10 FT/MIN (CRANE SPEED)+ 5MIN TO ALIGN
REMOVE BOTTOM LID BOLTS	*7.f*	6	10A	1	*804.79*	*80.5*	*80.5*	36 BOLTS@6 BOLTS/MIN IMPACT TOOLS USED
INSTALL TRANSFER LID BOLTS	*7.j*	18	11B	1	*804.79*	*241.4*	*241.4*	36 BOLTS @ 2/MIN IMPACT TOOLS USED 1 PASS
DISCONNECT MPC SUPPORT STAYS	*7.l*	4	9A	2	*177.55*	*11.8*	*23.7*	INSTALLED BY HAND NO TOOLS
Section 8.1.7								
POSITION HI-TRAC ON TRANSPORT DEVICE	*1*	20	11A	2	*316.83*	*105.6*	*211.2*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
TRANSPORT HI-TRAC TO OUTSIDE TRANSFER LOCATION	*1.b*	90	12A	3	*18.64*	*28.0*	*83.9*	DRIVER AND 2 SPOTTERS

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
ATTACH OUTSIDE LIFTING DEVICE LIFT LINKS	*5*	2	12A	2	*18.64*	*0.6*	*1.2*	2 LINKS@1/MIN
MATE OVERPACKS	*6*	10	13B	2	*284.51*	*47.4*	*94.8*	ALIGNMENT GUIDES USED
ATTACH MPC LIFT SLINGS TO MPC LIFT CLEATS	*7*	10	13A	2	*177.55*	*29.6*	*59.2*	2 SLINGS@5MIN/SLING NO TOOLS
REMOVE TRANSFER LID DOOR LOCKING PINS AND OPEN DOORS	*10*	4	13B	2	*284.51*	*19.0*	*37.9*	2 PINS@2MIN/PIN
INSTALL TRIM PLATES	*11*	4	13B	2	*284.51*	*19.0*	*37.9*	INSTALLED BY HAND
DISCONNECT SLINGS FROM MPC LIFTING DEVICE	*13*	10	13A	2	*177.55*	*29.6*	*59.2*	2 SLINGS@5MIN/SLING
REMOVE MPC LIFT CLEATS AND MPC LIFT SLINGS	15	10	14A	1	*255.57*	*42.6*	*42.6*	4 BOLTS,NO TORQUING
INSTALL HOLE PLUGS IN EMPTY MPC BOLT HOLES	15	2	14A	1	*255.57*	*8.5*	*8.5*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE HI-STORM VENT DUCT SHIELD INSERTS	*16.a*	2	15A	1	*27.85*	*0.9*	*0.9*	4 SHACKLES@2/MIN
REMOVE ALIGNMENT DEVICE	*16.c*	4	15A	1	*27.85*	*1.9*	*1.9*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)
INSTALL HI-STORM LID AND INSTALL LID STUDS/NUTS	*16.c*	25	16A	2	*4.26*	*1.8*	*3.6*	INSTALL LID AND HYDRO TORQUE 4 BOLTS
INSTALL HI-STORM EXIT VENT GAMMA SHIELD CROSS PLATES	*16.e*	4	16B	1	*34.58*	*2.3*	*2.3*	4 PCS @ 1/MIN INSTALL BY HAND NO TOOLS
INSTALL ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*16.e*	20	16B	1	*34.58*	*11.5*	*11.5*	4@5MIN/~~THERMOCOUPLE~~*TEMPERATURE ELEMENT*
INSTALL EXIT VENT SCREENS	*16.e*	20	16B	1	*34.58*	*11.5*	*11.5*	4 SCREENS@5MIN/SCREEN
REMOVE HI-STORM LID LIFTING DEVICE	*16.f*	2	16A	1	*4.26*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HOLE PLUGS IN EMPTY HOLES	*16.f*	2	16A	1	*4.26*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING

Table 10.3.1b
HI-STORM 100 SYSTEM LOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† *(42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
PERFORM SHIELDING EFFECTIVENESS TESTING	*16.g*	16	16D	2	*34.76*	*9.3*	*18.5*	16 POINTS@1 MIN
SECURE HI-STORM TO TRANSPORT DEVICE	*16.h*	10	16A	2	*4.26*	*0.7*	*1.4*	ASSUMES AIR PAD
TRANSFER HI-STORM TO ITS DESIGNATED STORAGE LOCATION	*17.a*	40	16C	1	*11.79*	*7.9*	*7.9*	200 FEET @ 4FT/MIN
INSERT HI-STORM LIFTING JACKS	*17.b*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
REMOVE AIR PAD	*17.b*	5	16D	2	*34.76*	*2.9*	*5.8*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*17.c*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
INSTALL INLET VENT SCREENS/CROSS PLATES	*18*	20	16D	1	*34.76*	*11.6*	*11.6*	4 SCREENS@5MIN/SCREEN
PERFORM AIR TEMPERATURE RISE TEST	*19*	8	16B	1	*34.58*	*4.6*	*4.6*	8 MEASUREMENTS@1/MIN
TOTAL							***2906.5 PERSON- MREM***	

Table 10.3.2a
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.3.2 (Step Sequence Varies By Site and Mode of Transport)								
REMOVE INLET VENT SCREENS	*1*	20	16D	1	*9.96*	*3.3*	*3.3*	4 SCREENS@5MIN/SCREEN
INSERT HI-STORM LIFTING JACKS	*1*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
INSERT AIR PAD	*1*	5	16D	2	*9.96*	*0.8*	*1.7*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*1*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
TRANSFER HI-STORM TO MPC TRANSFER LOCATION	*1*	40	16C	1	*7.89*	*5.3*	*5.3*	200 FEET @ 4FT/MIN
REMOVE HI-STORM LID STUDS/NUTS	*1*	10	16A	1	*2.96*	*0.5*	*0.5*	4 BOLTS NO TORQUE
REMOVE HI-STORM LID LIFTING HOLE PLUGS AND INSTALL LID LIFTING SLING	*1*	2	16A	1	*2.96*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE GAMMA SHIELD CROSS PLATES	*1*	4	16B	1	*22.88*	*1.5*	*1.5*	4 PLATES@1/MIN
REMOVE ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*1*	8	16B	1	*22.88*	*3.1*	*3.1*	4 ~~THERMCPL~~*TEMP. ELEMENTS* @ 2MIN/~~THERMCPL~~*TEMP. ELEMENT* NO TORQUE
REMOVE HI-STORM LID	*1*	2	16A	1	*2.96*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HI-STORM VENT DUCT SHIELD INSERTS	*1*	2	15A	1	*7.85*	*0.3*	*0.3*	4 SHACKLES@2/MIN
INSTALL ALIGNMENT DEVICE	*1*	4	15A	1	*7.85*	*0.5*	*0.5*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)
REMOVE MPC LIFT CLEAT HOLE PLUGS	*1*	2	14A	1	*200.07*	*6.7*	*6.7*	4 PLUGS AT 2/MIN NO TORQUING
INSTALL MPC LIFT CLEATS AND MPC LIFT SLINGS	*1*	2	14A	1	*200.07*	*6.7*	*6.7*	4 PLUGS AT 2/MIN NO TORQUING

† See notes at bottom of Table 10.3.4.

Table 10.3.2a
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
ALIGN HI-TRAC OVER HI-STORM AND MATE OVERPACKS	*7*	10	13B	2	*41.91*	*7.0*	*14.0*	ALIGNMENT GUIDES USED
PULL MPC LIFT SLINGS THROUGH TOP LID HOLE	*9*	10	13A	2	*67.84*	*11.3*	22.6	2 SLINGS@5MIN/SLING
INSTALL TRIM PLATES	*10*	4	13B	2	*41.91*	2.8	5.6	INSTALLED BY HAND NO FASTENERS
ATTACH MPC LIFT SLING TO LIFTING DEVICE	*11*	10	13A	1	*67.84*	*11.3*	*11.3*	2 SLINGS@5MIN/SLING NO BOLTING
CLOSE HI-TRAC DOORS AND INSTALL DOOR LOCKING PINS	*14*	4	13B	2	*41.91*	2.8	5.6	2 PINS@2MIN/PIN
DISCONNECT SLINGS FROM MPC LIFT CLEATS	*16*	10	13A	2	*67.84*	*11.3*	22.6	2 SLINGS@5MIN/SLING
DOWNEND HI-TRAC ON TRANSPORT FRAME	*1*	20	12A	2	*18.64*	6.2	*12.4*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
TRANSPORT HI-TRAC TO FUEL BUILDING	*1*	90	12A	1	*18.64*	28.0	28.0	DRIVER RECEIVES MOST DOSE
UPEND HI-TRAC	*1*	20	12A	2	*18.64*	6.2	*12.4*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
Section 8.3.3								
MOVE HI-TRAC TO TRANSFER SLIDE	*1.a*	20	11A	2	*38.9*	*13.0*	*25.9*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
ATTACH MPC SUPPORT STAYS	*1.a*	4	9A	2	*67.84*	*4.5*	*9.0*	INSTALLED BY HAND NO TOOLS
REMOVE TRANSFER LID BOLTS	*1.e*	6	11B	1	*135.28*	*13.5*	*13.5*	36 BOLTS@6 BOLTS/MIN IMPACT TOOLS USED
INSTALL POOL LID BOLTS	*1.i*	18	10A	1	*135.28*	*40.6*	*40.6*	36 BOLTS @ 2/MIN IMPACT TOOLS USED 1 PASS
DISCONNECT MPC SUPPORT STAYS AND LIFT CLEATS	*1.k*	10	9A	1	*67.84*	*11.3*	*11.3*	4 BOLTS,NO TORQUING
PLACE HI-TRAC IN PREPARATION AREA	*1.m*	15	9C	1	*38.9*	*9.7*	*9.7*	100 FT @ 10 FT/MIN (CRANE SPEED)+ 5MIN TO ALIGN
REMOVE TOP LID BOLTS	*2.a*	6	9B	1	*15.4*	*1.5*	*1.5*	24 BOLTS AT 4/MIN (NO TORQUE IMPACT TOOLS)

Table 10.3.2a
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
REMOVE HI-TRAC TOP LID	2.a	2	6A	1	11.05	0.4	0.4	4 SHACKLES@2/MIN
ATTACH WATER FILL LINE TO HI-TRAC DRAIN PORT	2.b	0.5	9D	1	135.28	1.1	1.1	QUICK DISCONNECT NO TOOLS
INSTALL BOLT PLUGS OR WATERPROOF TAPE FROM HI-TRAC TOP BOLT HOLES	3.a	9	8A	1	15.4	2.3	2.3	18 HOLES@2/MIN
CORE DRILL CLOSURE RING AND VENT AND DRAIN PORT COVER PLATES	3.b	40	7A	2	11.05	7.4	14.7	20 MINUTES TO INSTALL/ALIGN +10 MIN/COVER
REMOVE CLOSURE RING SECTION AND VENT AND DRAIN PORT COVER PLATES	3.c	1	8A	1	15.4	0.3	0.3	2 COVERS@2/MIN NO TOOLS
ATTACH RVOAS	4.a	2	8A	1	15.4	0.5	0.5	SINGLE THREADED CONNECTION (1 RVOA)
ATTACH A SAMPLE BOTTLE TO VENT PORT RVOA	4.b	0.5	8A	1	15.4	0.1	0.1	1" THREADED FITTING NO TOOLS
GATHER A GAS SAMPLE FROM MPC	4.d	0.5	8A	1	15.4	0.1	0.1	SMALL BALL VALVE
CLOSE VENT PORT CAP AND DISCONNECT SAMPLE BOTTLE	4.e	1	8A	1	15.4	0.3	0.3	1" THREADED FITTING NO TOOLS
ATTACH COOL-DOWN SYSTEM TO RVOAs	5.a	2	8A	1	15.4	0.5	0.5	1" THREADED FITTING NO TOOLS X 2
DISCONNECT GAS LINES TO VENT AND DRAIN PORT RVOAs	5.k	1	8A	1	15.4	0.3	0.3	1" THREADED FITTING NO TOOLS
VACUUM TOP SURFACES OF MPC AND HI-TRAC	5.m	10	6A	1	11.05	1.8	1.8	SHOP VACUUM WITH WAND + HAND WIPE
REMOVE ANNULUS SHIELD	6.a	1	8A	1	15.4	0.3	0.3	SHIELD PLACED BY HAND
MANUALLY INSTALL INFLATABLE SEAL	6.b	10	6A	2	11.05	1.8	3.7	CONSULTATION WITH CALVERT CLIFFS
OPEN NEUTRON SHIELD JACKET DRAIN VALVE	7.a	2	5C	1	31.89	1.1	1.1	SINGLE THREADED CONNECTION

Table 10.3.2a
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 125-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (57,500 MWD/MTU, 12-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
CLOSE NEUTRON SHIELD JACKET DRAIN VALVE	*7.a*	2	5C	1	*31.89*	*1.1*	*1.1*	SINGLE THREADED CONNECTION
REMOVE MPC LID LIFTING HOLE PLUGS	*7.b*	2	5A	1	*21.35*	*0.7*	*0.7*	4 PLUGS AT 2/MIN NO TORQUING
ATTACH LID RETENTION SYSTEM	*7.d*	12	5A	1	*21.35*	*4.3*	*4.3*	24 BOLTS @ 2 MINUTES/BOLT
ATTACH ANNULUS OVERPRESSURE SYSTEM	*7.e*	0.5	5C	1	*31.89*	*0.3*	*0.3*	QUICK DISCONNECT NO TOOLS
POSITION HI-TRAC OVER CASK LOADING AREA	*7.f*	10	5C	1	*31.89*	*5.3*	*5.3*	100 FT @ 10 FT/MIN (CRANE SPEED)
LOWER HI-TRAC INTO SPENT FUEL POOL	*7.g*	8.5	3C	1	*38.9*	*5.5*	*5.5*	17 FEET @ 2 FT/MIN (CRANE SPEED)
REMOVE LID RETENTION BOLTS	*7.i*	12	3B	1	*19.45*	*3.9*	*3.9*	24 BOLTS @ 2/MINUTE
PLACE HI-TRAC ON FLOOR	*7.j*	20	2	2	*2*	*0.7*	*1.3*	40 FEET @ 2 FT/MINUTE (CRANE SPEED)
REMOVE MPC LID	*7.l*	20	2	2	*2*	*0.7*	*1.3*	CONSULTATION WITH CALVERT CLIFFS
Section 8.3.4								
REMOVE SPENT FUEL ASSEMBLIES FROM MPC	1	1020	1	2	1	17.0	34.0	15 MINUTES PER ASSEMBLY/68 ASSY
TOTAL							***362.2 PERSON-MREM***	

Table 10.3.2b
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.3.2 (Step Sequence Varies By Site and Mode of Transport)								
REMOVE INLET VENT SCREENS	*1*	20	16D	1	*34.76*	*11.6*	*11.6*	4 SCREENS@5MIN/SCREEN
INSERT HI-STORM LIFTING JACKS	*1*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
INSERT AIR PAD	*1*	5	16D	2	*34.76*	*2.9*	*5.8*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*1*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
TRANSFER HI-STORM TO MPC TRANSFER LOCATION	*1*	40	16C	1	*11.79*	*7.9*	*7.9*	200 FEET @ 4FT/MIN
REMOVE HI-STORM LID STUDS/NUTS	*1*	10	16A	1	*4.26*	*0.7*	*0.7*	4 BOLTS NO TORQUE
REMOVE HI-STORM LID LIFTING HOLE PLUGS AND INSTALL LID LIFTING SLING	*1*	2	16A	1	*4.26*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE GAMMA SHIELD CROSS PLATES	*1*	4	16B	1	*34.58*	*2.3*	*2.3*	4 PLATES@1/MIN
REMOVE ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*1*	8	16B	1	*34.58*	*4.6*	*4.6*	4 ~~THERMCPL~~*TEMP. ELEMENTS* @ 2MIN/~~THERMCPL~~*TEMP. ELEMENT* NO TORQUE
REMOVE HI-STORM LID	*1*	2	16A	1	*4.26*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HI-STORM VENT DUCT SHIELD INSERTS	*1*	2	15A	1	*27.85*	*0.9*	*0.9*	4 SHACKLES@2/MIN
INSTALL ALIGNMENT DEVICE	*1*	4	15A	1	*27.85*	*1.9*	*1.9*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)
REMOVE MPC LIFT CLEAT HOLE PLUGS	*1*	2	14A	1	*255.57*	*8.5*	*8.5*	4 PLUGS AT 2/MIN NO TORQUING
INSTALL MPC LIFT CLEATS AND MPC LIFT SLINGS	*1*	2	14A	1	*255.57*	*8.5*	*8.5*	4 PLUGS AT 2/MIN NO TORQUING

† See notes at bottom of Table 10.3.4.

Table 10.3.2b

HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
ALIGN HI-TRAC OVER HI-STORM AND MATE OVERPACKS	*7*	10	13B	2	*284.51*	*47.4*	*94.8*	ALIGNMENT GUIDES USED
PULL MPC LIFT SLINGS THROUGH TOP LID HOLE	*9*	10	13A	2	*177.55*	*29.6*	*59.2*	2 SLINGS@5MIN/SLING
INSTALL TRIM PLATES	*10*	4	13B	2	*284.51*	*19.0*	*37.9*	INSTALLED BY HAND NO FASTENERS
ATTACH MPC LIFT SLING TO LIFTING DEVICE	*11*	10	13A	1	*177.55*	*29.6*	*29.6*	2 SLINGS@5MIN/SLING NO BOLTING
CLOSE HI-TRAC DOORS AND INSTALL DOOR LOCKING PINS	*14*	4	13B	2	*284.51*	*19.0*	*37.9*	2 PINS@2MIN/PIN
DISCONNECT SLINGS FROM MPC LIFT CLEATS	*16*	10	13A	2	*177.55*	*29.6*	*59.2*	2 SLINGS@5MIN/SLING
DOWNEND HI-TRAC ON TRANSPORT FRAME	*1*	20	12A	2	*18.64*	*6.2*	*12.4*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
TRANSPORT HI-TRAC TO FUEL BUILDING	*1*	90	12A	1	*18.64*	*28.0*	*28.0*	DRIVER RECEIVES MOST DOSE
UPEND HI-TRAC	*1*	20	12A	2	*18.64*	*6.2*	*12.4*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
Section 8.3.3								
MOVE HI-TRAC TO TRANSFER SLIDE	*1.a*	20	11A	2	*316.83*	*105.6*	*211.2*	ALIGN TRUNNIONS, DISCONNECT LIFT YOKE
ATTACH MPC SUPPORT STAYS	*1.a*	4	9A	2	*177.55*	*11.8*	*23.7*	INSTALLED BY HAND NO TOOLS
REMOVE TRANSFER LID BOLTS	*1.e*	6	11B	1	*804.79*	*80.5*	*80.5*	36 BOLTS@6 BOLTS/MIN IMPACT TOOLS USED
INSTALL POOL LID BOLTS	*1.i*	18	10A	1	*804.79*	*241.4*	*241.4*	36 BOLTS @ 2/MIN IMPACT TOOLS USED 1 PASS
DISCONNECT MPC SUPPORT STAYS AND LIFT CLEATS	*1.k*	10	9A	1	*177.55*	*29.6*	*29.6*	4 BOLTS,NO TORQUING
PLACE HI-TRAC IN PREPARATION AREA	*1.m*	15	9C	1	*316.83*	*79.2*	*79.2*	100 FT @ 10 FT/MIN (CRANE SPEED)+ 5MIN TO ALIGN
REMOVE TOP LID BOLTS	*2.a*	6	9B	1	*52.84*	*5.3*	*5.3*	24 BOLTS AT 4/MIN (NO TORQUE IMPACT TOOLS)

Table 10.3.2b
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
REMOVE HI-TRAC TOP LID	*2.a*	2	6A	1	*30.91*	*1.0*	*1.0*	4 SHACKLES@2/MIN
ATTACH WATER FILL LINE TO HI-TRAC DRAIN PORT	*2.b*	0.5	9D	1	*804.79*	*6.7*	*6.7*	QUICK DISCONNECT NO TOOLS
INSTALL BOLT PLUGS OR WATERPROOF TAPE FROM HI-TRAC TOP BOLT HOLES	*3.a*	9	8A	1	*52.84*	*7.9*	*7.9*	18 HOLES@2/MIN
CORE DRILL CLOSURE RING AND VENT AND DRAIN PORT COVER PLATES	*3.b*	40	7A	2	*30.91*	*20.6*	*41.2*	20 MINUTES TO INSTALL/ALIGN +10 MIN/COVER
REMOVE CLOSURE RING SECTION AND VENT AND DRAIN PORT COVER PLATES	*3.c*	1	8A	1	*52.84*	*0.9*	*0.9*	2 COVERS@2/MIN NO TOOLS
ATTACH RVOAS	*4.a*	2	8A	1	*52.84*	*1.8*	*1.8*	SINGLE THREADED CONNECTION (1 RVOA)
ATTACH A SAMPLE BOTTLE TO VENT PORT RVOA	*4.b*	0.5	8A	1	*52.84*	*0.4*	*0.4*	1" THREADED FITTING NO TOOLS
GATHER A GAS SAMPLE FROM MPC	*4.d*	0.5	8A	1	*52.84*	*0.4*	*0.4*	SMALL BALL VALVE
CLOSE VENT PORT CAP AND DISCONNECT SAMPLE BOTTLE	*4.e*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
ATTACH COOL-DOWN SYSTEM TO RVOAs	*5.a*	2	8A	1	*52.84*	*1.8*	*1.8*	1" THREADED FITTING NO TOOLS X 2
DISCONNECT GAS LINES TO VENT AND DRAIN PORT RVOAs	*5.k*	1	8A	1	*52.84*	*0.9*	*0.9*	1" THREADED FITTING NO TOOLS
VACUUM TOP SURFACES OF MPC AND HI-TRAC	*5.m*	10	6A	1	*30.91*	*5.2*	*5.2*	SHOP VACUUM WITH WAND + HAND WIPE
REMOVE ANNULUS SHIELD	*6.a*	1	8A	1	*52.84*	*0.9*	*0.9*	SHIELD PLACED BY HAND
MANUALLY INSTALL INFLATABLE SEAL	*6.b*	10	6A	2	*30.91*	*5.2*	*10.3*	CONSULTATION WITH CALVERT CLIFFS
OPEN NEUTRON SHIELD JACKET DRAIN VALVE	*7.a*	2	5C	1	*125.48*	*4.2*	*4.2*	SINGLE THREADED CONNECTION

Table 10.3.2b
HI-STORM 100 SYSTEM UNLOADING OPERATIONS USING THE 100-TON HI-TRAC TRANSFER CASK ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
CLOSE NEUTRON SHIELD JACKET DRAIN VALVE	*7.a*	2	5C	1	*125.48*	*4.2*	*4.2*	SINGLE THREADED CONNECTION
REMOVE MPC LID LIFTING HOLE PLUGS	*7.b*	2	5A	1	*55.41*	*1.8*	*1.8*	4 PLUGS AT 2/MIN NO TORQUING
ATTACH LID RETENTION SYSTEM	*7.d*	12	5A	1	*55.41*	*11.1*	*11.1*	24 BOLTS @ 2 MINUTES/BOLT
ATTACH ANNULUS OVERPRESSURE SYSTEM	*7.e*	0.5	5C	1	*125.48*	*1.0*	*1.0*	QUICK DISCONNECT NO TOOLS
POSITION HI-TRAC OVER CASK LOADING AREA	*7.f*	10	5C	1	*125.48*	*20.9*	*20.9*	100 FT @ 10 FT/MIN (CRANE SPEED)
LOWER HI-TRAC INTO SPENT FUEL POOL	*7.g*	8.5	3C	1	*295.96*	*41.9*	*41.9*	17 FEET @ 2 FT/MIN (CRANE SPEED)
REMOVE LID RETENTION BOLTS	*7.i*	12	3B	1	*64.04*	*12.8*	*12.8*	24 BOLTS @ 2/MINUTE
PLACE HI-TRAC ON FLOOR	*7.j*	20	2	2	*3*	*1.0*	2.0	40 FEET @ 2 FT/MINUTE (CRANE SPEED)
REMOVE MPC LID	*7.l*	20	2	2	*3*	*1.0*	2.0	CONSULTATION WITH CALVERT CLIFFS
Section 8.3.4								
REMOVE SPENT FUEL ASSEMBLIES FROM MPC	*1*	1020	1	2	*3*	*51.0*	*102.0*	15 MINUTES PER ASSEMBLY/68 ASSY
TOTAL							*1384.2 PERSON-MREM*	

Table 10.3.3a
MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 125-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (*57,500* MWD/MTU, *12*-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.5.2								
MEASURE HI-STAR DOSE RATES	*2*	16	17A	2	*14.1*	*3.8*	*7.5*	16 POINTS@1 POINT/MIN
REMOVE PERSONNEL BARRIER	*3*	10	17C	2	*21.5*	*3.6*	*7.2*	ATTACH SLING REMOVE 8 LOCKS
PERFORM REMOVABLE CONTAMINATION SURVEYS	*4*	1	17C	1	*21.5*	*0.4*	*0.4*	10 SMEARS@10 SMEARS/MINUTE
REMOVE IMPACT LIMITERS	*5*	16	17A	2	*14.1*	*3.8*	*7.5*	ATTACH FRAME REMOVE 22 BOLTS IMPACT TOOLS
REMOVE TIE-DOWN	*6*	6	17A	2	*14.1*	*1.4*	*2.8*	ATTACH 2-LEGGED SLING REMOVE 4 BOLTS
PERFORM A VISUAL INSPECTION OF OVERPACK	*7*	10	17B	1	*9*	*1.5*	*1.5*	CHECKSHEET USED
REMOVE REMOVABLE SHEAR RING SEGMENTS	*8*	4	17A	1	*14.1*	*0.9*	*0.9*	4 BOLTS EACH @2/MIN X 2 SEGMENTS
UPEND HI-STAR OVERPACK	*9*	20	17B	2	*9*	*3.0*	*6.0*	DISCONNECT LIFT YOKE
INSTALL TEMPORARY SHIELD RING SEGMENTS	*10*	16	18A	1	*7.9*	*2.1*	*2.1*	8 SEGMENTS @ 2 MIN/SEGMENT
FILL TEMPORARY SHIELD RING SEGMENTS	*11*	25	18A	1	*7.9*	*3.3*	*3.3*	230 GAL @10GPM, LONG HANDLED SPRAYER
REMOVE OVERPACK VENT PORT COVER PLATE	*11.a*	2	18A	1	*7.9*	*0.3*	*0.3*	4 BOLTS @2/MIN
ATTACH BACKFILL TOOL	*11.a*	2	18A	1	*7.9*	*0.3*	*0.3*	4 BOLTS @2/MIN
OPEN/CLOSE VENT PORT PLUG	*11.c*	0.5	18A	1	*7.9*	*0.1*	*0.1*	SINGLE TURN BY HAND NO TOOLS
REMOVE CLOSURE PLATE BOLTS	*14*	39	18A	2	*7.9*	*5.1*	*10.3*	52 BOLTS@4/MIN X 3 PASSES
REMOVE OVERPACK CLOSURE PLATE	*14*	2	18A	1	*7.9*	*0.3*	*0.3*	4 SHACKLES@2/MIN

† See notes at bottom of Table 10.3.4.

Table 10.3.3a
MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 125-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (*57,500* MWD/MTU, *12*-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
INSTALL HI-STAR SEAL SURFACE PROTECTOR	*15*	2	19B	1	*7.9*	*0.3*	*0.3*	PLACED BY HAND NO TOOLS
INSTALL TRANSFER COLLAR ON HI-STAR	*16*	10	19B	2	*7.9*	*1.3*	*2.6*	ALIGN AND POSITION REMOVE 4 SHACKLES
REMOVE MPC LIFT CLEAT HOLE PLUGS	*17*	2	19A	1	*200.07*	*6.7*	*6.7*	4 PLUGS AT 2/MIN NO TORQUING
INSTALL MPC LIFT CLEATS AND LIFT SLING	*18*	25	19A	2	*200.07*	*83.4*	*166.7*	INSTALL CLEATS AND HYDRO TORQUE 4 BOLTS
MATE OVERPACKS	*27*	10	20B	2	*41.91*	*7.0*	*14.0*	ALIGNMENT GUIDES USED
REMOVE DOOR LOCKING PINS AND OPEN DOORS	*28*	4	20B	2	*41.91*	*2.8*	*5.6*	2 PINS@2/MIN
INSTALL TRIM PLATES	*29*	4	20B	2	*41.91*	*2.8*	*5.6*	INSTALLED BY HAND NO FASTENERS
				Section 8.5.3				
REMOVE TRIM PLATES	*3*	4	20B	2	*41.91*	*2.8*	*5.6*	INSTALLED BY HAND NO FASTENERS
DISCONNECT SLINGS FROM MPC LIFTING DEVICE	*6*	10	20A	2	*67.84*	*11.3*	*22.6*	2 SLINGS@5/MIN
INSTALL~~REMOVE~~ TRIM PLATES	*6*	4	13B	2	*41.91*	*2.8*	*5.6*	INSTALLED BY HAND NO FASTENERS
REMOVE MPC LIFT CLEATS AND MPC LIFT SLINGS	*6*	10	14A	1	*200.07*	*33.3*	*33.3*	4 BOLTS,NO TORQUING
INSTALL HOLE PLUGS IN EMPTY MPC BOLT HOLES	*6*	2	14A	1	*200.07*	*6.7*	*6.7*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE HI-STORM VENT DUCT SHIELD INSERTS	*6*	2	15A	1	*7.85*	*0.3*	*0.3*	4 SHACKLES@2/MIN
REMOVE ALIGNMENT DEVICE	*6*	4	15A	1	*7.85*	*0.5*	*0.5*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)
INSTALL HI-STORM LID AND INSTALL LID STUDS/NUTS	*6*	25	16A	2	*2.96*	*1.2*	*2.5*	INSTALL LID AND HYDRO TORQUE 4 BOLTS

Table 10.3.3a
MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 125-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (*57,500* MWD/MTU, *12*-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
INSTALL HI-STORM EXIT VENT GAMMA SHIELD CROSS PLATES	*6*	4	16B	1	*22.88*	*1.5*	*1.5*	4 PCS @ 1/MIN INSTALL BY HAND NO TOOLS
INSTALL ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*6*	20	16B	1	*22.88*	*7.6*	*7.6*	4@5MIN/~~THERMOCOUPLE~~*TEMPERATURE ELEMENT*
INSTALL EXIT VENT SCREENS	*6*	20	16B	1	*22.88*	*7.6*	*7.6*	4 SCREENS@5MIN/SCREEN
REMOVE HI-STORM LID LIFTING DEVICE	*6*	2	16A	1	*2.96*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HOLE PLUGS IN EMPTY HOLES	*6*	2	16A	1	*2.96*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING
PERFORM SHIELDING EFFECTIVENESS TESTING	*8*	16	16D	1	*9.96*	*2.7*	*2.7*	16POINTS@1 MIN
SECURE HI-STORM TO TRANSPORT DEVICE	*6*	10	16A	1	*2.96*	*0.5*	*0.5*	ASSUMES AIR PAD
TRANSFER HI-STORM TO ITS DESIGNATED STORAGE LOCATION	*6*	40	16C	1	*7.89*	*5.3*	*5.3*	200 FEET @ 4FT/MIN
INSERT HI-STORM LIFTING JACKS	*6*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
REMOVE AIR PAD	*6*	5	16D	1	*9.96*	*0.8*	*0.8*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*6*	4	16D	1	*9.96*	*0.7*	*0.7*	4 JACKS@1/MIN
INSTALL INLET VENT SCREENS	*6*	20	16D	1	*9.96*	*3.3*	*3.3*	4 SCREENS@5MIN/SCREEN
PERFORM AIR TEMPERATURE RISE TEST	*9*	8	16B	1	*22.88*	*3.1*	*3.1*	8 MEASMT@1/MIN
TOTAL							***362.8 PERSON–MREM***	

Table 10.3.3b
MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 100-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
Section 8.5.2								
MEASURE HI-STAR DOSE RATES	*2*	16	17A	2	14.1	3.8	7.5	16 POINTS@1 POINT/MIN
REMOVE PERSONNEL BARRIER	*3*	10	17C	2	21.5	3.6	7.2	ATTACH SLING REMOVE 8 LOCKS
PERFORM REMOVABLE CONTAMINATION SURVEYS	*4*	1	17C	1	21.5	0.4	0.4	10 SMEARS@10 SMEARS/MINUTE
REMOVE IMPACT LIMITERS	*5*	16	17A	2	14.1	3.8	7.5	ATTACH FRAME REMOVE 22 BOLTS IMPACT TOOLS
REMOVE TIE-DOWN	*6*	6	17A	2	14.1	1.4	2.8	ATTACH 2-LEGGED SLING REMOVE 4 BOLTS
PERFORM A VISUAL INSPECTION OF OVERPACK	*7*	10	17B	1	9	1.5	1.5	CHECKSHEET USED
REMOVE REMOVABLE SHEAR RING SEGMENTS	*8*	4	17A	1	14.1	0.9	0.9	4 BOLTS EACH @2/MIN X 2 SEGMENTS
UPEND HI-STAR OVERPACK	*9*	20	17B	2	9	3.0	6.0	DISCONNECT LIFT YOKE
INSTALL TEMPORARY SHIELD RING SEGMENTS	*10*	16	18A	1	7.9	2.1	2.1	8 SEGMENTS @ 2 MIN/SEGMENT
FILL TEMPORARY SHIELD RING SEGMENTS	*11*	25	18A	1	7.9	3.3	3.3	230 GAL @10GPM, LONG HANDLED SPRAYER
REMOVE OVERPACK VENT PORT COVER PLATE	*11.a*	2	18A	1	7.9	0.3	0.3	4 BOLTS @2/MIN
ATTACH BACKFILL TOOL	*11.a*	2	18A	1	7.9	0.3	0.3	4 BOLTS @2/MIN
OPEN/CLOSE VENT PORT PLUG	*11.c*	0.5	18A	1	7.9	0.1	0.1	SINGLE TURN BY HAND NO TOOLS
REMOVE CLOSURE PLATE BOLTS	*14*	39	18A	2	7.9	5.1	10.3	52 BOLTS@4/MIN X 3 PASSES

† See notes at bottom of Table 10.3.4.

Table 10.3.3b
MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 100-TON HI-TRAC TRANSFER CASK
ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
REMOVE OVERPACK CLOSURE PLATE	*14*	2	18A	1	7.9	0.3	0.3	4 SHACKLES@2/MIN
INSTALL HI-STAR SEAL SURFACE PROTECTOR	*15*	2	19B	1	*7.9*	*0.3*	*0.3*	PLACED BY HAND NO TOOLS
INSTALL TRANSFER COLLAR ON HI-STAR	*16*	10	19B	2	*7.9*	*1.3*	*2.6*	ALIGN AND POSITION REMOVE 4 SHACKLES
REMOVE MPC LIFT CLEAT HOLE PLUGS	*17*	2	19A	1	*255.57*	*8.5*	*8.5*	4 PLUGS AT 2/MIN NO TORQUING
INSTALL MPC LIFT CLEATS AND LIFT SLING	*18*	25	19A	2	*255.57*	*106.5*	*213.0*	INSTALL CLEATS AND HYDRO TORQUE 4 BOLTS
MATE OVERPACKS	*27*	10	20B	2	*284.51*	*47.4*	*94.8*	ALIGNMENT GUIDES USED
REMOVE DOOR LOCKING PINS AND OPEN DOORS	*28*	4	20B	2	*284.51*	*19.0*	*37.9*	2 PINS@2/MIN
INSTALL TRIM PLATES	*29*	4	20B	2	*284.51*	*19.0*	*37.9*	INSTALLED BY HAND NO FASTENERS
Section 8.5.3								
REMOVE TRIM PLATES	*3*	4	20B	2	*284.51*	*19.0*	*37.9*	INSTALLED BY HAND NO FASTENERS
DISCONNECT SLINGS FROM MPC LIFTING DEVICE	*6*	10	20A	2	*177.55*	*179.1*	*358.3*	2 SLINGS@5/MIN
REMOVE TRIM PLATES	*6*	4	13B	2	*284.51*	*19.0*	*37.9*	INSTALLED BY HAND NO FASTENERS
REMOVE MPC LIFT CLEATS AND MPC LIFT SLINGS	*6*	10	14A	1	*255.57*	*42.6*	*42.6*	4 BOLTS,NO TORQUING
INSTALL HOLE PLUGS IN EMPTY MPC BOLT HOLES	*6*	2	14A	1	*255.57*	*8.5*	*8.5*	4 PLUGS AT 2/MIN NO TORQUING
REMOVE HI-STORM VENT DUCT SHIELD INSERTS	*6*	2	15A	1	*27.85*	*0.9*	*0.9*	4 SHACKLES@2/MIN
REMOVE ALIGNMENT DEVICE	*6*	4	15A	1	*27.85*	*1.9*	*1.9*	REMOVED BY HAND NO TOOLS (4 PCS@1/MIN)

Table 10.3.3b

MPC TRANSFER INTO THE HI-STORM 100 SYSTEM DIRECTLY FROM TRANSPORT USING THE 100-TON HI-TRAC TRANSFER CASK

ESTIMATED OPERATIONAL EXPOSURES† (*42,500* MWD/MTU, 5-YEAR COOLED PWR FUEL)

ACTION	CHAPTER 8 STEP	DURATION (MINUTES)	OPERATOR LOCATION (FIGURE 10.3.1)	NUMBER OF OPERATORS	DOSE RATE AT OPERATOR LOCATION (MREM/HR)	DOSE TO INDIVIDUAL (MREM/HR)	TOTAL DOSE (PERSON-MREM)	ASSUMPTIONS
INSTALL HI-STORM LID AND INSTALL LID STUDS/NUTS	*6*	25	16A	2	*4.26*	*1.8*	*3.6*	INSTALL LID AND HYDRO TORQUE 4 BOLTS
INSTALL HI-STORM EXIT VENT GAMMA SHIELD CROSS PLATES	*6*	4	16B	1	*34.58*	*2.3*	*2.3*	4 PCS @ 1/MIN INSTALL BY HAND NO TOOLS
INSTALL ~~THERMOCOUPLE~~*TEMPERATURE ELEMENTS*	*6*	20	16B	1	*34.58*	*11.5*	*11.5*	4@5MIN/~~THERMOCOUPLE~~*TEMPERATURE ELEMENT*
INSTALL EXIT VENT SCREENS	*6*	20	16B	1	*34.58*	*11.5*	*11.5*	4 SCREENS@5MIN/SCREEN
REMOVE HI-STORM LID LIFTING DEVICE	*6*	2	16A	1	*4.26*	*0.1*	*0.1*	4 SHACKLES@2/MIN
INSTALL HOLE PLUGS IN EMPTY HOLES	*6*	2	16A	1	*4.26*	*0.1*	*0.1*	4 PLUGS AT 2/MIN NO TORQUING
PERFORM SHIELDING EFFECTIVENESS TESTING	*8*	16	16D	1	*34.76*	*9.3*	*9.3*	16POINTS@1 MIN
SECURE HI-STORM TO TRANSPORT DEVICE	*6*	10	16A	1	*4.26*	*0.7*	*0.7*	ASSUMES AIR PAD
TRANSFER HI-STORM TO ITS DESIGNATED STORAGE LOCATION	*6*	40	16C	1	*11.79*	*7.9*	*7.9*	200 FEET @ 4FT/MIN
INSERT HI-STORM LIFTING JACKS	*6*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
REMOVE AIR PAD	*6*	5	16D	1	*34.76*	*2.9*	*2.9*	1 PAD MOVED BY HAND
REMOVE HI-STORM LIFTING JACKS	*6*	4	16D	1	*34.76*	*2.3*	*2.3*	4 JACKS@1/MIN
INSTALL INLET VENT SCREENS	*6*	20	16D	1	*34.76*	*11.6*	*11.6*	4 SCREENS@5MIN/SCREEN
PERFORM AIR TEMPERATURE RISE TEST	*9*	8	16B	1	*34.58*	*4.6*	*4.6*	8 MEASMT@1/MIN
TOTAL							***1004.3 PERSON-MREM***	

Table 10.3.4
ESTIMATED EXPOSURES FOR HI-STORM 100 SURVEILLANCE AND MAINTENANCE

ACTIVITY	ESTIMATED PERSONNEL	ESTIMATED HOURS PER YEAR	ESTIMATED DOSE RATE (MREM/HR)	OCCUPATIONAL DOSE TO INDIVIDUAL (PERSON-MREM)
SECURITY SURVEILLANCE	1	30	3	90
ANNUAL MAINTENANCE	2	15	10	300

Notes for Tables 10.3.1a, 10.3.1b, 10.3.2a, 10.3.2b, 10.3.3a, 10.3.3b and 10..3.4:

1. Refer to Chapter 8 for detailed description of activities.
2 Number of operators may be set to 1 to simplify calculations where the duration is indirectly proportional to the number of operators. The total dose is equivalent in both respects.
3 HI-STAR 100 Operations assume that the cooling time is at least 10 years.