Evaluation of the Proposed Change

Subject: License Amendment Request 11-001, "Revision to Technical Specifications 1.1, 2.0, 3.1.1, 3.1.2, 4.1.2, and 5.1.3; Addition of Technical Specifications 2.3 and 3.1.4; Request for an exemption from the requirements of 10 CFR 72.236(f)"

ATTACHMENTS:

1. Proposed Technical Specification Changes (markup)

2. Proposed Technical Specification Changes (retyped)

3. Proposed Technical Specification Bases Changes

4. Proposed Final Safety Analysis Report Update (FSARU) Changes

5. Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8

6. Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8 - Proprietary Version

7 Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3

8. Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3 - Proprietary Version, with three discs of proprietary data files on optical storage medium (OSM) DVD-ROM.

9. Holtec Affidavit for Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8 - Proprietary Version

10. Holtec Affidavit for Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 2 - Proprietary Version, with three discs of proprietary data files on optical storage medium (OSM) DVD-ROM

EVALUATION

1.0 SUMMARY DESCRIPTION

This license amendment request (LAR) proposes to amend Materials License SNM-2511 (Reference 1) for the Diablo Canyon Independent Spent Fuel Storage Installation (DC ISFSI).

This proposed license amendment would expand the allowable contents and loading capabilities for the Diablo Canyon dry cask storage system. Specifically, it would: (1) allow loading of high burnup fuel (HBF) in accordance with the requirements of ISG-11, Rev. 3 (Reference 16), (2) allow loading of fuel assemblies susceptible to top nozzle cracking that have been structurally repaired using instrument tube tie rods (ITTRs); (3) allow loading of neutron source assemblies (NSAs), (4) allow loading of fuel assemblies with currently approved characteristics, if the brand name and nonrelevant features are changed, (5) remove the vacuum drying option, (6) allow the HI-STORM 100SA to be considered operable with up to 50 percent vent blockage (although removal of any blockage is still required on discovery), (7) allow use of a supplemental cooling system (SCS) to accommodate transporting HBF in the loaded and backfilled multi-purpose canister (MPC) when it is in the HI-TRAC transfer cask, and (8) restore the requirement for maintaining the annular gap between the loaded MPC and the transfer cask full of water during MPC reflood operations (unloading).

This proposed license amendment would revise the licensing basis as described in the DC ISFSI Final Safety Analysis Report Update (FSARU) to: (1) upgrade the thermal analysis methodology to a three dimensional (3D) Computational Fluid Dynamics (CFD) model, (2) remove the requirement for 100 percent fuel failure coincident with 100 percent vent blockage, (3) changing of some allowed component temperatures in the thermal evaluation (peak cladding, concrete, overpack metal, transfer cask lid neutron shielding), (4) reduce the required bolt torquing for the MPC lift cleats, and (5) addition of a new accident for loss of SCS.

This proposed license amendment requires an exemption from the requirements of 10 CFR 72.236(f) to allow use of a nonpassive SCS.

This proposed license amendment also proposes three administrative corrections, specifically:

- Identification that the specified MPC backfill pressure range is based on a 70°F reference temperature,

- Limit the B4C content in METAMIC to ≤33.0 wt%, and
- Restore the requirement to maintain water in the MPC/HI-TRAC annular gap during reflood operations (unloading).

2.0 DETAILED DESCRIPTION

Proposed Amendment

The DC ISFSI Materials License, SNM-2511, Amendment 1 (Reference 1), contains a limitation on maximum burnup of 45,000 MWD/MTU. Pacific Gas and Electric Company (PG&E) has loaded 16 casks at Diablo Canyon, removing the vast majority of the fuel eligible under the current license. Since the original materials license submittal there have been numerous amendments approved by the NRC for the Holtec HI-STORM Certificate of Compliance (CoC) (72-1014), which have been the result of developments in product evolution and analytical methods, and expansion of data available on spent fuel characteristics. PG&E captured some of these changes in License Amendment 1 to SNM-2511 (e.g., Metamic as an alternate neutron absorber, removal of helium leak testing of the lid to shell weld).

The proposed change would modify the definitions in Technical Specification (TS) 1.1, "Definitions" to add the definition of "Minimum Enrichment" and to modify the definition of "Nonfuel Hardware" to include NSAs, ITTRs, and components of these devices such as individual rods.

The proposed change would modify TS 2.0, "Approved Contents," by revising Tables 2.1-1, 2.1-2, 2.1-3, and 2.1-4 to permit a single NSA to be loaded into a MPC (i.e., MPC-24, MPC-24E, MPC-24EF, and MPC-32). The proposed change would also modify Table 2.1-4 to add a reference to alternative fuel selection criteria from TS 2.3 and to revise Note 1 to specify fuel assemblies with or without ITTRs; modify Table 2.1-5 to include a note to allow loading of fuel with currently approved characteristics even if the brand name is different; modify Tables 2.1-6 and 2.1-8 to delete the notes that limit Zirlo clad fuel to a burnup of 45,000 MWD/MTU and replace with a note that refers to new TS 2.3, "Alternate MPC-32 Fuel Selection Criteria;" modify Tables 2.1-7 and 2.1-9 to revise the MPC-32 Assembly Decay Heat maximums; and modify Table 2.1-10 to include NSAs and to add Note 4 signifying nonfuel hardware burnup and cooling times are not applicable to ITTRs.

TS 2.0, "Approved Contents," is also revised to add a new TS 2.3 "Alternate MPC-32 Fuel Selection Criteria" and Table 2.3-1 to provide alternative fuel selection criteria, which is contained in the Holtec HI-STORM 100 CoC No.1014, Amendment 3 (Reference 2), for burnup limits for fuel assemblies allowed to be loaded in an MPC-32. The HI-STORM 100 CoC No. 1014, Amendment 3 criteria is used as it has the same heat load limitations for MPC, individual assembly, and regionalized loading as the current DC ISFSI License. This will allow the selection of HBF for loading.

The proposed change would modify LCO 3.1.1 and the Surveillance Requirement (SR) 3.1.1.1 in TS 3.1.1, "Multi-Purpose Canister (MPC)," to delete the vacuum drying option criteria. The proposed change would also modify SR 3.1.1.2 to identify the specified MPC Helium backfill pressure range is at a reference temperature of 70°F.

The proposed change would modify TS 3.1.2, "Spent Fuel Storage Cask (SFSC) Heat Removal System," to allow the HI-STORM to be operable with up to 50 percent vent blockage. This was evaluated in Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3 (Attachments 7 and 8), which is consistent with the Holtec International HI-STORM 100 CoC No.1014, Amendment 5, for the HI-STORM 100 system (Reference 3). Additionally, the balance of this TS is revised to be consistent with the HI-STORM 100 CoC No. 1014, Amendment 5 TS, within the limits of the Diablo Canyon ISFSI thermal analysis.

The proposed change would add TS 3.1.4, "Supplemental Cooling System," to accommodate transporting HBF in the loaded and backfilled MPC when it is in the HI-TRAC transfer cask to ensure fuel cladding temperatures remain within limits. Because the SCS is not a completely passive system, PG&E is requesting an exemption from the requirements of 10 CRF 72.236(f).

The proposed change would revise TS 4.1.2b, "Design Features Important to Criticality Control," to change the B4C content in METAMIC from < 33.0 wt% to ≤33.0 wt% to conform to the Holtec HI-STORM 100 CoC (72-1014).

The proposed change would modify TS 5.1.3b, "MPC and SFSC Loading, Unloading, and Preparation Program," to delete the requirement for maintaining the annulus full during vacuum drying, since vacuum drying is deleted as an option in TS 3.1.1, and to restore the requirement for maintaining annulus full during reflood (unloading).

In addition, the proposed change would:

Remove the requirement to assume simultaneous 100 percent rod rupture and 100 percent vent blockage, since the thermal analysis demonstrates that temperatures that would result in fuel cladding failure do not occur during the 100 percent vent blockage event.

Remove the requirement to determine a dose component from confinement boundary leakage if the boundary is tested to the leaktight criteria of ANSI N14.5-1997.

Allow the use of a 3D CFD model for performing the thermal analyses.

Revise component temperature limits. Cladding temperature limits are based on ISG-11 Rev. 3. Overpack concrete temperature limit for normal storage is increased to 300°F, using the provisions allowed per NUREG-1536. Accident temperature limits are increased for HI-STORM steel (800°F), and transfer cask lid neutron absorber (350°F) as previously approved for the HI-STORM 100 CoC.

Also the proposed change would result in the following changes to the DC ISFSI FSARU:

DC ISFSI FSARU, Revision 3 (Reference 4), Section 10.2.2.1 will be revised to provide the design requirements for the SCS required by proposed new TS 3.1.4. As noted in the thermal analysis the SCS only needs to maintain the water in the MPC/HI-TRAC at or below boiling (232°F), and as such, a keep full system could be used in lieu of a pump driven system. See Attachment 4, "FSARU Markups," for specific wording.

In addition, to address the new accident created by the loss of SCS, FSARU Section 8.2.17 will be added.

FSARU Table 3.4-2, "Maximum Confinement Boundary Leak Rate," will be revised to add "Leaktight criteria of ANSI N14.5-1997, for MPCs containing high burnup fuel assemblies." This will ensure the assumptions used in the revised off-site dose analysis are met.

FSARU Section 4.3.2.5 will be revised to specify the torquing requirement for MPC lift cleat attachments as wrench tight.

Attachments 1 and 2 contain markup and revised TS pages, respectively. Attachment 3 contains changes to the TS Bases related to this request. The TS Bases changes are provided here for information only. TS Bases changes will be implemented pursuant to the TS 5.1.1, "Technical Specifications (TS) Bases Control Program," at the time the related license amendment is implemented. Attachment 4 contains proposed changes to the FSARU, also provided here for information only, pending implementation of the issued license amendment.

Purpose for Proposed Amendment

On March 22, 2004, the NRC issued Materials License No. SNM-2511 to PG&E to allow PG&E to receive, possess, store, and transfer spent fuel and associated radioactive materials resulting from operation of DCPP in an ISFSI. The DC ISFSI uses the HI-STORM 100 system, which includes the HI-STORM 100SA Overpack, the HI-TRAC 125D Transfer Cask, and a multiple purpose canister (MPC). The DC ISFSI operation uses the transfer cask to transport a loaded MPC from the spent fuel pool (SFP) to a cask transfer facility (CTF) located in the vicinity of the ISFSI storage area entrance. At the CTF the MPC is transferred from the transfer cask to the overpack for storage in the ISFSI.

The DC ISFSI Materials License SNM-2511 was developed to HI-STORM 100 CoC No. 1014, Amendment 1 (Reference 5). At the time it was being issued in March 2004, the HI-STORM 100 CoC had not been revised to address the loading of HBF to comply with ISG-11, Revision 3, and as such the license restricted the burnup limits for loading fuel to avoid loading fuel that was designated high burnup. PG&E requested, and the NRC issued License Amendment 1 to SNM-2511 on Feb.10, 2010 (Reference 17), which added Metamic as an alternate neutron absorber in the MPC, and made other changes based on selected HI-STORM 100 System updates and NRC guidance, since the original license development.

PG&E requests to amend the current materials license to load HBF, fuel assemblies repaired with ITTRs, and additional fuel associated components, in order to be able to load the current inventory of the SFP.

In support of the proposed TS changes, future loading of the HBF, and to enhance the current license and design bases, DCPP is proposing the following methodology changes:

- The DC ISFSI dose analysis HI-2002563, (Attachments 5 and 6), is updated to allow HBF (up to 68,200 MWD/MTU), and neutron sources.

- The DC ISFSI thermal evaluation HI-2104625, (Attachments 7 and 8), is added using a 3D-CFD model for both the MPC in HI-STORM and for the MPC in HI-TRAC.

- Based on the DC ISFSI thermal evaluation HI-2104625, (Attachments 7 and 8), DCPP is eliminating the requirement to assume 100 percent fuel failure occurs simultaneously with 100 percent vent blockage.

- DC ISFSI is reducing the torquing requirements for the MPC lift cleats to wrench tight.

- DC ISFSI is not revising the Confinement Analysis HI-2002513 (Reference 6) for the high burnup loads since the MPCs to be loaded with HBF will meet the "leaktight criteria" of ANSI N14.5-1997.

- DC ISFSI is removing the burnup limit of 45,000 MWD/MTU for Zirlo clad fuel.

The updated analysis reports are provided as attachments to this submittal.

To minimize the review burden, PG&E is specifically limiting this LAR, as follows:

- MPC and fuel assembly specific maximum heat load limitations will not be increased;

- Allowed Regionalized Fuel Loading conditions are not changed;

- Changes to allow HBF are limited to the Diablo Canyon specific MPC-32;

- MPC backfill pressure requirements will be unchanged;

- Where possible TS changes will be applicable for all loading scenarios, and are not different for high burnup and nonhigh burnup fuel; and

- No optional HI-STORM designs are requested to be added.

3.0 TECHNICAL ANALYSIS

TS 1.1 Definitions

The definition of MINIMUM ENRICHMENT is being added to TS 1.1 as a result of its use in TS 2.3 "Alternate MPC-32 Fuel Selection Criteria." In TS 2.3, alternative criteria for selecting fuel assemblies for loading into the MPC-32 are established. This criterion is used to calculate the maximum allowable fuel assembly average burnup for a given MINIMUM ENRICHMENT.

The definition of NONFUEL HARDWARE is being revised to add NSAs, ITTRs, and components of these devices such as individual rods. In its review of Amendment 1 to the HI-STORM 100 cask system (67 FR 46369; July 15, 2002), the NRC staff found that nonfuel hardware, as defined in that amendment, can be stored safely in the HI-STORM 100 cask system. The basis for the staff's finding is explained in the safety evaluation report (SER) for Amendment 1. Amendment 3 to the HI-STORM 100 cask system (Reference 2) added NSAs to the definition of allowable nonfuel hardware and limits the number and the locations of NSAs to one per MPC stored in one of the four center-most fuel basket positions.

Holtec HI-STORM 100 CoC No. 1014, Amendment 6, to the HI-STORM 100 cask system (Reference 7) adds ITTRs to approved contents. That amendment allows for the use of ITTRs to maintain the structural integrity of the fuel assembly. Based on the SER for Amendment 6, the NRC staff found the addition of the ITTR acceptable to the MPC-24 and MPC-32 with 15x15 and 17x17 fuel lattices for both intact and damaged fuel assemblies.

<u>TS 2.0 Approved Contents</u>

DCPP TS Tables 2.1-1 through 2.1-4 are revised to add NSAs as allowed nonfuel hardware for storage into MPC-24, MPC-24E/F, and MPC-32 at the rate of no more than one per MPC. Each table specifically identifies acceptable fuel storage locations for storage of NSAs within the MPC. This change is the same as in the Holtec HI-STORM 100 CoC No. 1014, Amendment 3 (Reference 2), which allows for adding NSAs. For ease of implementation in the CoC, the restriction concerning the number of NSAs is applied to all types of NSAs. In addition, conservatively, NSAs are required to be stored in the inner region of the MPC basket as specified in Section 2.1.9 of the HI-STORM 100 FSAR, Revision 7 (Reference 8).

In the site boundary dose calculations, Appendix P of Holtec International Report HI-2002563, (Attachments 5 and 6), it states:

> *By the time NSAs are stored in the MPC, the primary neutron sources will have been decaying for many years since they were first inserted into the reactor (typically greater than 10 years). For the 252Cf source, with a half-life of 2.64 years, this means a significant reduction in the source intensity; while the 210Po-Be source, with a half-life of 138 days, is virtually eliminated. The 238Pu-Be and 241Am-Be sources, however, have a significantly longer half-life, 87.4 years and 433 years, respectively.*

As a result, their source intensity does not decrease significantly before storage in the MPC. Since the 238Pu-Be and 241Am-Be sources may have a source intensity similar to a design-basis fuel assembly when they are stored in the MPC, only a single NSA is permitted for storage in the MPC. Since storage of a single NSA would not significantly increase the total neutron source in an MPC, storage of NSAs is acceptable and detailed dose rate analysis of the neutron source from NSAs is not performed.

Based on the HI-2002563, (Attachments 5 and 6), site dose calculation, for DCPP the limited inclusion of NSAs would be acceptable.

TS Table 2.1-4 is also updated to identify that ITTRs can be stored in conjunction with other nonfuel hardware in a single fuel assembly by adding "with or without ITTRs." This is based on the ITTRs being installed post-irradiation and that they provide no additional dose. The storage of ITTRs was accepted in the Holtec 100 system in Holtec HI-STORM 100 CoC No.1014, Amendment 6.

TS Table 2.1-5 is revised to include a note to allow loading of fuel that has the same characteristics of the listed fuel assembly category types, even if the name designation is different. This is consistent with the HI-STORM 100 CoC, which has always characterized fuel in a generic fashion (e.g., 17X17A, 17X17B) with the characteristics for the given fuel assembly type listed. The addition of this note will allow Diablo Canyon to load fuel that meets the existing evaluated characteristics to be loaded, even if the fuel has a different name, without having to burden the NRC through the LAR process.

TS Tables 2.1-6 and 2.1-8 were revised to delete the Notes (Note 2 to Table 2.1-6 and Note 3 to Table 2.1-8) which limited loading of fuel with Zirlo cladding to a burnup of less than or equal to 45,000 MWD/MTU. Fuel performance data obtained since the original DC ISFSI license application was submitted has allowed the NRC to allow the burnup limits to be the same for all zirconium based cladding alloys under the HI-STORM CoC. Diablo Canyon Power Plant (DCPP) is removing the limit of 45,000 MWD/MTU limit for Zirlo-clad fuel in the MPC-32 to accommodate HBF by providing alternate fuel selection criteria as discussed in the section covering the addition of TS 2.3.

TS Tables 2.1-6 and 2.1-8 are revised to include TS 2.3 alternative fuel selection criteria for HBF stored in an MPC-32 by changing Note 2 in Table 2.1-6 and Note 3 in Table 2.1-8. The alternative fuel selection criteria are discussed below in the discussion of TS 2.3. TS Tables 2.1-7 and 2.1-9 are revised to establish time independent individual fuel assembly decay heat limits for the MPC-32 for HBF. This change is the same as provided in Tables 2.1.26 and 2.1.27 of the HI-STORM 100 FSAR, Revision 5 (Reference 9).

Table 2.1-10 is revised to add NSAs and to note that nonfuel hardware burnup and cooling times are not applicable to ITTRs since they are installed post-irradiation. In addition, NSAs have the same cooling requirements as thimble plug devices (TPD), particularly for burnups greater than 180,000 MWD/MTU and less than or equal to 630,000 MWD/MTU when cooling time must be greater than or equal to 14 years.

TS 2.3, "Alternate MPC-32 Fuel Selection Criteria," is added to provide alternative calculations for burnup limits for fuel assemblies allowed to be loaded in an MPC-32. The maximum allowable fuel assembly average burnup for a given MINIMUM ENRICHMENT is calculated as described in TS 2.3 for minimum cooling times between 5 and 20 years using the maximum permissible decay heat determined in TS 2.1.1. Different fuel assembly average burnup limits may be calculated for different minimum enrichments (by individual fuel assembly) for use in choosing the fuel assemblies to be loaded into the MPC-32. This alternate method was approved by the NRC staff in Holtec HI-STORM 100 CoC No. 1014, Amendment 3 (Reference 2).

As shown in TS 2.4.3, of HI-STORM 100 CoC No. 1014, Amendment 2 (Reference 10), the maximum burnup was increased to 68,200 MWD/MTU for HBF, as part of the generic implementation of ISG-11, Revision 3 for the HI-STORM system.

The revised off-site dose analysis (HI-2002563, Attachments 5 and 6) and thermal analysis (HI-2104625, Attachments 7 and 8) demonstrate that loading fuel with burnup to the proposed selection criteria are acceptable.

<u>TS 3.1.1 Multil-Purpose Canister (MPC)</u>

Use of the Forced Helium Dehydration (FHD) System, (a closed-loop system) was an alternative to vacuum drying some MPCs for moderate burnup fuel (less than 45,000 MWD/MTU). However, use of the FHD system is mandatory for drying MPCs containing one or more HBF assemblies per Holtec HI-STORM 100 CoC No. 1014, Amendment 3 (Reference 2). To date, the FHD System has been used to dry all loaded casks at DCPP and with the proposed changes to allow loading of HBF it will be the only drying system used at DCPP. As a result, the vacuum drying option is being deleted from the TS.

SR 3.1.1.2 requires the MPC helium backfill pressure be verified prior to transport operations. DCPP is adding the identification that the specified backfill pressure range is at a reference temperature of 70°F. The reference temperature was previously provided in the TS bases for TS 3.1.1 as part of the initial DCPP licensing submittal and is currently in the TS bases. However, the number was not previously included in the TS SR. To ensure control of that parameter, DCPP is including it in the TS. This change is considered an editorial correction, not a change in a TS requirement.

TS 3.1.2 Spent Fuel Storage Cask (SFSC) Heat Removal System

TS 3.1.2 is being revised to allow continued operability of a storage cask with up to 50 percent of the HI-STORM vents blocked. In HI-2104625 (Attachments 7 and 8), the blockage of 50 percent of the HI-STORM vents was evaluated as an off-normal condition and no SFSC components exceeded the short-term temperature limits. Holtec HI-STORM 100 CoC No. 1014, Amendment 5 (Reference 3), validated this condition for the generic HI-STORM System.

TS 3.1.4 Supplemental Cooling System (SCS)

As shown in Holtec HI-STORM 100 FSAR, Revision 5, (Reference 9), for MPCs containing any HBF, an SCS is required to be operational during the time the loaded and backfilled MPC is in the HI-TRAC transfer cask to ensure fuel cladding temperatures remain within limits. For HBF, the maximum computed fuel cladding temperature of 808°F (Section C.5.7 in the Holtec International Report HI-2104625, Attachments 7 and 8) is significantly greater than the allowed temperature limit of 752°F for HBF. Consequently, it is necessary for DCPP to utilize the SCS during onsite transfer of an MPC containing HBF emplaced in a HI-TRAC transfer cask. The proposed TS change defines that requirement. HI-2104625 (Attachments 7 and 8) limits the maximum allowed short term operation temperature for HBF to 752°F and shows that the SCS only needs to maintain the water in the MPC/HI-TRAC at or below boiling (232°F), and, as such, a keep full system could be used in lieu of a pump driven system.

To use an SCS, PG&E is requesting an exemption to 10 CFR 72.236(f), which requires that a spent fuel storage cask must be designed to provide adequate heat removal capacity without active cooling. This request is consistent with Holtec HI-STORM 100 CoC No. 1014, Amendment 2 (Reference 10).

TS 4.1.2b Design Features Important to Criticality Control

DCPP has discovered an inconsistency between the current DC ISFSI license and Holtec's CoC regarding the B_4C content in METAMIC. TS 4.1.2b currently limits the B_4C content in METAMIC to < 33.0 wt%. That is being revised to limit the B_4C content in METAMIC to $\leq$33.0 wt%, which reflects Holtec's CoC. This change is considered an editorial correction, not a change in a TS requirement.

TS 5.1.3 MPC and SFSC Loading, Unloading, and Preparation Program

DCPP is restoring the unloading requirement for water in the annular gap between the outside wall of the MPC and the inside wall of the transfer cask during MPC reflooding operations (unloading). DCPP Is also removing the requirement for water in the annular gap during vacuum drying due to the deletion of the vacuum drying option in TS 3.1.1.

The modification to TS 5.1.3.b clarifies what conditions need to be maintained in the annular gap. These conditions are contained in the DC ISFSI FSARU Section 10.2.2.1, "Annular Gap Water Requirements." This proposed change supports the required conditions as set forth in DC ISFSI FSARU, Section 10.2.2.1.

Calculations and Methodologies

In support of future loading of the HBF and to enhance the current license and design bases, DCPP has performed the following updates to calculations and methodologies:

- Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8 (Attachments 5 and 6), is the revision to the DCPP dose analyses to allow HBF (up to 68,200 MWD/MTU), and neutron sources. The results of the revision increases the calculated offsite doses from normal operations from approximately 6 mrem for skin surface, whole body, and thyroid, to approximately 18 mrem for each of these doses. Although this is a significant increase in the doses, all of them remain below the 10 CFR 72.104 limits and are considered acceptable.

  DCPP is revising the requirements for the limit on MPC confinement boundary leakage for MPCs to be loaded with HBF fuel to the "leaktight criteria" of ANSI N14.5-1997. The MPC provides for confinement of all radioactive materials for all design basis normal, off-normal, and postulated accident conditions. As discussed in Section 7.1 of the HI-STORM 100 FSAR, Revision 5 (Reference 9), the Holtec MPC design meets the guidance in Interim Staff Guidance 18 (ISG-18) to classify confinement boundary leakage as noncredible. Therefore, a confinement dose analysis is not required. The confinement function of the MPC is verified through pressure testing and helium leak testing on the vent and drains port cover plates and weld examinations performed in accordance with the acceptance test program in Chapter 9 of HI-STORM 100 FSAR, Revision 5 (Reference 9).

As a result of the above, Holtec Report HI-2002513, "Diablo Canyon ISFSI Site Boundary Confinement Analysis," is not being revised to address the source term for the new limits on HBF. This analysis will be maintained for the 16 casks already loaded to the existing DC ISFSI license, but as documented in HI-2002563 Rev. 8, the off-site dose from the assumed loadings with HBF envelope the dose contribution of the fuel under the current DC ISFSI license (which includes a confinement leakage contribution).

- Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3, (Attachments 7 and 8), is the revision to the DCPP thermal evaluation HI-2053376 (Reference 11). This new evaluation and report, utilizes a 3D-CFD model for MPC in HI-STORM as approved in Holtec HI-STORM 100 CoC No. 1014, Amendment 5 (Reference 3) (Reference US NRC Docket # 72-1032). Such a methodology has been adopted (i.e. 3D thermal models for HI-TRAC) in recent applications to the NRC (HI-STORM FW Docket No. 72-1032). The methodologies used in all of the analyses documented in this report are identical to those described in the HI-STORM 100 FSAR, Revision 7, (Reference 8) and in the integral fuel burnable absorber (IFBA) fuel pressure calculations, "Evaluation of IFBA Fuel Storage in the HI-STORM System," Holtec Position Paper DS-265, Revision 1 (Reference 12). The methodology for thermal analyses of an MPC-32 placed in the HI-STORM 100SA is described in Appendix B of this report. All the storage conditions in HI-STORM 100SA Overpack are evaluated using 3D thermal models articulated in Chapter 4 of HI-STORM 100 FSAR, Revision 7 (Reference 8).

  As part of the revision to Holtec International Report HI-2104625, the Temperature Limits during Normal Storage Conditions are being modified as follows:

Component	**Previous Limit (°F)**	**New Limit (°F)**
Fuel Cladding	691 (5 year cooled) 676 (6 year cooled) 635 (7 year cooled) 625 (10 year cooled) 614 (15 year cooled)	752 (ISG-11 Rev. 3 limit) (not cooling time dependant)
Concrete	200	300*

* This change was proposed in a supplement to HI-STORM 100 License Amendment Request 1014-2 (Holtec Letter 5014490, dated August 6, 2003) and approved by the NRC in the Safety Evaluation Report for Amendment #2 to CoC 72-1014 (ML051580522).

The normal long-term storage concrete temperature limit was increased to 300°F in HI-STORM 100 FSAR Revision 2 based on test reports. PG&E will add requirements in their HI-STORM Overpack concrete placement procedures to ensure that the concrete can meet a long term temperature limit of 300°F.

Also as part of the revision to Holtec International Report HI-2104625, the Temperature Limits during Accident Conditions was modified as follows:

Component	**Previous Limit (°F)**	**New Limit (°F)**
HI-STORM Overpack Shell Steel	400	800†
HI-TRAC Holtite in Lid	300	350‡

† - This change was proposed in HI-STORM 100 License Amendment Request 1014-3 (Holtec Letter 5014612, dated December 22, 2006) and approved by the NRC in the Safety Evaluation Report for Amendment #5 to CoC 72-1014 (ML082030122).

‡ - This change was proposed in a supplement to HI-STORM 100 License Amendment Request 1014-2 (Holtec Letter 5014490, dated August 6, 2003) and approved by the NRC in the Safety Evaluation Report for Amendment #2 to CoC 72-1014 (ML051580522). The creation of a short-term temperature limit for Holtite-A which is used only in the HI-TRAC 125 transfer cask, is based on test data summarized in Holtec Report HI-2002396, Revision 3. This report was submitted to the NRC in May, 2003 on Docket 71-9261.

DCPP is eliminating the requirement to assume 100 percent fuel failure occurs simultaneously with 100 percent vent blockage in pressure analysis based on Holtec HI-STORM 100 CoC No. 1014, Amendment 3 (Reference 2). Although based on HI-STORM, DCPP has verified, in calculation HI-2104625 (Attachments 7 and 8), the peak fuel cladding temperatures never exceed the short-term temperature limit, which ensures no significant cladding failures would occur. This is consistent with the latest NRC guidance on fuel cladding in dry storage casks

(ISG-11, Rev. 3), which states "In order to assure integrity of the cladding material ... For off-normal and accident conditions, the maximum cladding temperature should not exceed 570°C (1058°F)." The results of the blocked ducts transient analysis are presented in Table B.5.6 of calculation HI-2104625 (Attachments 7 and 8).

Per HI-2104625 (Attachments 7 and 8), for normal long-term storage, the following results were attained:

- The temperatures of all the components of the MPC and HI-STORM 100SA, including HBF, for the bounding scenario reported in Table B.5.2 of that report, are below their temperature limits.
- The thermal expansion calculation results summarized in Table B.5.3 of that report reveal all the differential expansions are less than the nominal gap.

The MPC boundary pressures are below the design pressure limits specified in Chapter 2 of the HI-STORM 100 FSAR, Revision 7 (Reference 8).

Also in HI-2104625, (Attachments 7 and 8), evaluation of off-normal and accident conditions listed in DC ISFSI FSAR, Chapter 8, which require thermal evaluation, resulted in all limits being met.

The results of the evaluations described above indicate that the thermal-hydraulic performance of the HI-STORM 100SA System components, including HBF assemblies, satisfies all applicable component temperature and MPC internal pressure limits.

<u>FSARU Changes</u>

- FSARU Section 10.2.2.7 will be added to provide the design requirements for the SCS required by TS 3.1.4. As noted in the thermal analysis the SCS only needs to maintain the water in the MPC/HI-TRAC at or below boiling (232°F), and as such a keep full system could be used in lieu of a pump driven system. Per Holtec HI-STORM 100 FSAR, Revision 5, (Reference 9), for MPCs containing any HBF, an SCS is required to be operational during the time the loaded and backfilled MPC is in the HI-TRAC transfer cask to ensure fuel cladding temperatures remain within limits.

  The FSARU change requires that when fuel with a burnup in excess of 45,000 MWD/MTU (HBF) is loaded in an MPC, the MPC water gap shall be maintained through the use of a SCS, following water removal from the MPC, when the MPC helium is not being circulated by the FHD System. The SCS shall meet the following requirements:

- The system shall utilize a contamination free, high purity water to minimize corrosion;

- Heat dissipation capacity of the SCS shall be equal to or greater than the minimum necessary to ensure that the peak cladding temperature is below 400°C (752°F) with an assumed ambient air temperature of 100°F.

- Heat exchangers, if used, shall be assumed to have all heat transfer surfaces fouled to the maximum limits specified in a widely used heat exchange equipment standard, such as the Standard of Tubular Exchanger Manufacturers Association (TEMA);

- All passive components, such as tubular heat exchangers, manually operated valves and fittings shall be designed to applicable standards (TEMA, ANSI);

- All pressure boundaries (as defined in the ASME Boiler and Pressure Vessel Code, Section VIII Division 1) shall have pressure ratings that are greater than the maximum system operating pressure by at least 15 psig;

- All ASME Code components shall comply with Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code;

- All gasketed and packed joints shall have a minimum design pressure rating of the maximum system pressure (e.g., pump shut-off, if a pump is used) plus 15 psig;

- Any electric motors required to operate for adequate cooling shall have a backup power supply for uninterrupted operation;

- The system shall be capable of performing its intended function for 2 hours without operator action.

- FSARU Section 8.2.17 has been added to address the accident created by the loss of the newly added SCS.
- FSARU Table 3.4-2, "Maximum Confinement Boundary Leak Rate," will be revised to add "Leaktight criteria of ANSI N14.5-1997, for MPCs containing high burnup fuel assemblies." This will ensure the assumptions

used in the revised off-site dose analysis (HI-2002563 Revision 8) are met.

- FSARU Section 4.3.2.5 will be revised to specify the torquing requirement for MPC lift cleat attachments as wrench tight. A reference to the supporting Holtec Report HI-992234, Revision 5 (Reference 15) will be added.

  A loaded MPC is lifted using four threaded holes in the top lid during transfer operations. The structural calculation package for MPC (Reference 13) includes an analysis of the lifting holes and assumed lifting stud but does not include an analysis of the lift cleat. The purpose of the calculation HI-992234, Revision 5, demonstrates that the lifting cleat satisfies the requirements of NUREG 0612 and ANSI N14.6. This change was approved for the HI-STORM 100 CoC No. 1014 in Amendment 4 (Reference 14).

Exemption to the requirements of 10 CFR 72.236(f)

An exemption to 10 CFR 72.236(f) for the SCS should be granted in accordance with 10 CFR 72.7, based on it has been determined to be authorized by law as demonstrated by it being granted for the HI-STORM 100 System in CoC No. 1014 Amendment 2 (Reference 10). This exemption request is based on the following features of and operating conditions for the SCS:

- Consistent with its safety function, the SCS is classified as Important to Safety Category B [Attachment 4 - proposed FSARU Table 4.5-1].

- Any required active components (i.e., electric motors) of the SCS must be connected to redundant power sources to ensure uninterrupted operation [Attachment 4 - proposed FSARU section 10.2.2.7].

- Compared with the storage system licensed life of 20 years and design life of 40 years, the operations involving the SCS occur over a relatively short period of 1 to 3 days. Operation of the SCS will be observed at all times, by virtue of the nature of the on-site loading operations involving the HI-TRAC, so that any interruption of operation will be immediately detected and corrected.

- The large thermal capacity of the HI-TRAC transfer cask and its contents will suppress rapid temperature changes, so that any short interruption of SCS operation will not result in large fuel cladding temperature rises.

- Thermal analysis [Attachment 4 – Proposed FSARU Section 4.2.3.3.3] has demonstrated that, were SCS operation to be interrupted for an extended period of time, the fuel cladding temperatures would remain below short-term allowable limits.

Based on these considerations, it is believed that an exemption from the requirements of 10 CFR 72.236(f) is warranted and will not "endanger life property or common defense and security and (is) otherwise in the public interest."

4.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.41, PG&E has reviewed the environmental impact of the proposed amendment. The proposed changes do not significantly change the type or significantly increase in the amounts of any effluents that may be released offsite. In addition, there is no significant increase in individual or cumulative occupational radiation exposure. The proposed changes do not involve construction of any kind. Therefore, there is no significant construction impact. The proposed changes do not involve an increase in the potential for or consequences from radiological accidents. There is an increase in the total offsite dose from normal operations as a result of the use of the new dose analysis supporting loading of HBF. However, the total offsite doses remains below the 10 CFR 72.104 limits and are considered acceptable. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(11). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

5.0 PRECEDENT

The inclusion of NSAs and HBF assemblies and their storage in the MPC is included in the Holtec International HI-STORM 100 CoC No. 1014, Amendment 3 (Reference 2).

The allowance of up to 50 percent vent blockage in the operability of the MPCs is included in the Holtec International HI-STORM 100 CoC No. 1014, Amendment 5 (Reference 3). HI-2104625, (Attachments 7 and 8), analyzed the 50 percent inlet vents blockage scenario as an off-normal condition and determined that temperatures of all the components of the MPC are below their temperature limits, and that cladding temperatures remain below the limits for long term storage.

The addition of ITTRs to the approved contents of the MPC-32 is included in the Holtec International HI-STORM 100 CoC No. 1014, Amendment 6 (Reference 7).

Use of 3D CFD model for the thermal analyses of the MPC in the HI-STORM Overpack was approved by the NRC for the HI-STORM System as part of the evaluation of HI-STORM 100 CoC No. 1014, Amendment 5 (Reference 3).

The increase in temperature limits for the fuel cladding and concrete during normal operation was approved by the NRC for the HI-STORM System as part of the evaluation of HI-STORM 100 CoC No. 1014, Amendment 2 (Reference 10).

The increase in temperature limit for the HI-STORM metal during accident conditions was approved by the NRC for the HI-STORM System as part of the evaluation of HI-STORM 100 CoC No. 1014, Amendment 5 (Reference 3).

The increase in temperature limit of the neutron shielding material in the transfer cask lid during accident conditions was approved by the NRC for the HI-STORM system as part of the evaluation of HI-STORM 100 CoC No. 1014, Amendment 2 (Reference 10).

The change of the tightness requirements for the MPC lift cleats to "wrench tight" is included in the HI-STORM 100 FSAR, Revision 5 (Reference 9), and in the Holtec HI-STORM 100 CoC No. 1014, Amendment 4 (Reference 14).

The exemption from the requirements of 10 CFR 72.236(f) for the nonpassive SCS was included in the Holtec International HI-STORM 100 CoC No. 1014, Amendment 2 (Reference 10).

6.0 REFERENCES

1. Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation (TAC No. L23399) dated March 22, 2004.
2. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 3, dated May 29, 2007.
3. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 5, dated July 14, 2008.
4. Diablo Canyon Independent Spent Fuel Storage Installation Final Safety Analysis Report Update, Revision 3.
5. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 1, dated July 15, 2002.
6. Holtec International Report HI-2002513, "Diablo Canyon ISFSI Site Boundary Confinement Analysis," Revision 7, dated July 21, 2006.
7. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 6, dated August 17, 2009.

8. Final Safety Analysis Report for the HI-STORM 100 Cask System, HI-2002444, Rev. 7, Holtec International (US NRC Docket No. 72-1014).
9. Final Safety Analysis Report for the HI-STORM 100 Cask System, HI-2002444, Rev. 5, Holtec International (US NRC Docket No. 72-1014).
10. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 2, dated June 7, 2005.
11. Holtec International Report HI-2053376, "Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 7, dated January 15, 2010.
12. Evaluation of IFBA Fuel Storage in the HI-STORM System, Holtec Position Paper DS-265, Revision 1.
13. HI-2012787, Structural Calculation Package for MPC, Revision 12.
14. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 4, dated January 8, 2008.
15. Holtec International Report HI-992234, "Stress Analysis of MPC Lift Cleat," Revision 5.
16. Interim Staff Guidance 11 (ISG-11), "Cladding Considerations for the Transportation and Storage of Spent Fuel," U.S. Nuclear Regulatory Commission, Revision 3.

Proposed Technical Specification Changes (markup)

Proposed Technical Specification Changes (retyped)

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Proposed Technical Specification Bases Changes
(Markup for Information Only)

Proposed FSARU Changes

(Markups for Information Only)

Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8

Holtec International Report HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 8 – Proprietary Version

Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3

Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 3 – Proprietary Version, with three discs of proprietary data files on optical storage medium (OSM) DVD-ROM

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I, Kelly Kozink, depose and state as follows:

(1) I am the Holtec International Project Manager for the Diablo Canyon Independent Spent Fuel Storage Installation Project and have reviewed the information described in paragraph (2) which is sought to be withheld, and am authorized to apply for its withholding.

(2) The information sought to be withheld is Revision 8 of Holtec Report HI-2002563, which contains Holtec Proprietary information and is appropriately marked as such.

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

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

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

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

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

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

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

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of

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a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

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

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

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed descriptions of analytical

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approaches and methodologies not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed by Holtec International. A substantial effort has been expended by Holtec International to develop this information. Release of this information would improve a competitor's position because it would enable Holtec's competitor to copy our technology and offer it for sale in competition with our company, causing us financial injury.

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

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

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

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Executed at Marlton, New Jersey, this 8th day of December, 2010.

Kelly Kozink
Holtec International

Holtec Affidavit for Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 2 – Proprietary Version, with three discs of proprietary data files on optical storage medium (OSM) DVD-ROM

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

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

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

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

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Executed at Marlton, New Jersey, this 19th day of January, 2011.

Kelly Kozink
Holtec International

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1.1 Definitions (continued)

INTACT FUEL ASSEMBLY	INTACT FUEL ASSEMBLY is a fuel assembly without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means. A fuel assembly shall not be classified as INTACT FUEL ASSEMBLY unless solid Zircaloy or stainless steel rods are used to replace missing fuel rods and which displace an amount of water equal to that displaced by the original fuel rod(s).
LOADING OPERATIONS	LOADING OPERATIONS include all licensed activities on a TRANSFER CASK while its contained MPC is being loaded with its approved contents. LOADING OPERATIONS begin when the first fuel assembly is placed in the MPC and end when the TRANSFER CASK is suspended from or secured on the transporter. LOADING OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.
MINIMUM ENRICHMENT	*MINIMUM ENRICHMENT is the minimum assembly average enrichment. Natural uranium blankets are not considered in determining minimum enrichment.*
MULTI-PURPOSE CANISTER (MPC)	MPC is a sealed SPENT NUCLEAR FUEL container that consists of a honeycombed fuel basket contained in a cylindrical canister shell which is welded to a baseplate, lid with welded port cover plates, and closure ring. The MPC provides the confinement boundary for the contained radioactive materials.
NONFUEL HARDWARE	NONFUEL HARDWARE is defined as burnable poison rod assemblies (BPRAs), thimble plug devices (TPDs), rod control cluster assemblies (RCCAs), ~~and~~ wet annular burnable absorbers (WABAs)*, neutron source assemblies (NSAs), instrument tube tie rods (ITTRs), and components of these devices such as individual rods*.
OPERABLE/OPERABILITY	A system, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instruments, controls, normal or emergency electrical power, and other auxiliary equipment that are required for the system, component, or device to perform its specific safety function(s) are also capable of performing their related support function(s).

(continued)

1.1 Definitions (continued)

OVERPACK	OVERPACK is a cask that receives and contains a sealed MPC for interim storage in the independent spent fuel storage installation (ISFSI). It provides gamma and neutron shielding, and provides for ventilated air flow to promote heat transfer from the MPC to the environs. The OVERPACK does not include the TRANSFER CASK.
SPENT FUEL STORAGE CASKS (SFSCs)	SFSCs are containers approved for the storage of spent fuel assemblies, FUEL DEBRIS, and associated NONFUEL HARDWARE at the ISFSI. The HI-STORM 100 SFSC System consists of the OVERPACK and its integral MPC loaded with any approved contents.
SPENT NUCLEAR FUEL	SPENT NUCLEAR FUEL means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least one year's decay since being used as a source of energy in a power reactor and has not been chemically separated into its constituent elements by reprocessing. SPENT NUCLEAR FUEL includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.
STORAGE OPERATIONS	STORAGE OPERATIONS include all licensed activities that are performed at the ISFSI while a SFSC containing approved contents is sitting on a storage pad within the ISFSI perimeter. STORAGE OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.
TRANSFER CASK	TRANSFER CASKs are containers designed to contain the MPC during and after loading of its approved contents and to transfer the loaded MPC to or from the OVERPACK.
TRANSPORT OPERATIONS	TRANSPORT OPERATIONS include all licensed activities performed on an OVERPACK or TRANSFER CASK loaded with any approved contents when it is being moved to and from the ISFSI. TRANSPORT OPERATIONS begin when the OVERPACK or TRANSFER CASK is first suspended from or secured on the transporter and end when the OVERPACK or TRANSFER CASK is at its destination and no longer secured on or suspended from the transporter. TRANSPORT OPERATIONS include transfer of the MPC between the OVERPACK and the TRANSFER CASK.

(continued)

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.1 MULTI-PURPOSE CANISTER (MPC)

LCO 3.1.1 The MPC shall be dry and helium filled.

APPLICABILITY: During TRANSPORT OPERATIONS and STORAGE OPERATIONS

ACTIONS

--NOTE--
Separate Condition entry is allowed for each MPC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MPC cavity ~~vacuum~~ drying ~~pressure or~~ demoisturizer exit gas temperature limit not met.	A.1. Perform an engineering evaluation to determine the quantity of moisture left in the MPC.	7 days
	AND	
	A.2 Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	30 days
B. MPC helium backfill pressure limit not met.	B.1 Perform an engineering evaluation to determine the impact of helium pressure differential.	72 hours
	AND	
	B.2 Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	14 days

(continued)

2.3 Alternate MPC-32 Fuel Selection Criteria

The maximum allowable fuel assembly average burnup for a given MINIMUM ENRICHMENT is calculated as described below for minimum cooling times between 5 and 20 years using the maximum permissible decay heat determined in Table 2.1-7 or 2.1-9. Different fuel assembly average burnup limits may be calculated for different minimum enrichments (by individual fuel assembly) for use in choosing the fuel assemblies to be loaded into a given MPC.

a. Choose a fuel assembly minimum enrichment E_{235}.

b. Calculate the maximum allowable fuel assembly average burnup for a minimum cooling time between 5 and 20 years using the following equation below:

$$Bu = (A \times q) + (B \times q^2) + (C \times q^3) + [D \times (E_{235})^2] + (E \times q \times E_{235}) + (F \times q^2 \times E_{235}) + G$$

Where:

Bu = Maximum allowable average burnup per fuel assembly (MWD/MTU)

q = Maximum allowable decay heat per storage location, in kilowatts, determined from Table 2.1-7 or 2.1-9 (e.g. 898 watts, use 0.898)

E_{235} = Minimum fuel assembly average enrichment (wt% ^{235}U) (e.g., for 4.05 wt%, use 4.05)

A through G = Coefficients from Table 2.3-1.

c. Calculated burnup limits shall be rounded down to the nearest integer.

d. Calculated burnup limits greater than 68,200 MWD/MTU must be reduced to be equal to this value.

e. Linear interpolation of calculated burnups between cooling times for a given fuel assembly maximum decay heat and minimum enrichment is permitted. For example, the allowable burnup for a cooling time of 5.5 years may be interpolated between those burnups calculated for 5 year and 6 years.

f. Each ZR-clad fuel assembly to be stored must have a MINIMUM ENRICHMENT greater than or equal to the value used in Step 2.3.a.

g. When complying with the maximum fuel storage location decay heat limits, users must account for the decay heat from both the fuel assembly and any NON-FUEL HARDWARE, as applicable for the particular fuel storage location, to ensure the decay heat emitted by all contents in a storage location does not exceed the limit.

TABLE 2.1-1

MPC-24 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, INTACT FUEL ASSEMBLIES listed in Table 2.1-5, with or without NONFUEL HARDWARE and meeting the following specifications (Note 1):

Cladding type	Zr (Note 2)
Initial enrichment	As specified in Table 2.1-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 2.1-6 or 2.1-8.
NONFUEL HARDWARE	As specified in Table 2.1-10.
Decay heat per assembly	As specified in Tables 2.1-7 or 2.1-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including NONFUEL HARDWARE)

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

C. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading into the MPC-24.

D. One NSA is authorized for loading in an MPC-24.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel cell location. Fuel assemblies containing RCCAs *or NSAs* may only be loaded in fuel storage locations 9, 10, 15, and/or 16 of Figure 2.1-1. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-2 Sheet 2 of 2

A. Quantity per MPC: Up to four (4) DAMAGED FUEL ASSEMBLIES in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 2.1-2. The remaining MPC-24E fuel storage locations may be filled with INTACT FUEL ASSEMBLIES meeting the applicable specifications.

B. FUEL DEBRIS is not authorized for loading in the MPC-24E.

C. One NSA is authorized for loading in an MPC-24E.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs *or NSAs* must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 2.1-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-3 — Sheet 2 of 2

A. Quantity per MPC: Up to four (4) DAMAGED FUEL ASSEMBLIES and/or FUEL DEBRIS in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 2.1-2. The remaining MPC-24EF fuel storage locations may be filled with INTACT FUEL ASSEMBLIES meeting the applicable specifications.

B. One NSA is authorized for loading in an MPC-24EF.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs *or NSAs* must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 2.1-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: The total quantity of FUEL DEBRIS permitted in a single DAMAGED FUEL CONTAINER is limited to the equivalent weight and special nuclear material quantity of one INTACT FUEL ASSEMBLY.

NOTE 3: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-4

MPC-32 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, INTACT FUEL ASSEMBLIES listed in Table 2.1-5, with or without NONFUEL HARDWARE and meeting the following specifications (Note 1):

Cladding type	Zr (Note 2)
Initial enrichment	As specified in Table 2.1-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 2.1-6 or 2.1-8*, or Section 2.3*.
NONFUEL HARDWARE	As specified in Table 2.1-10.
Decay heat per assembly	As specified in Tables 2.1-7 or 2.1-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including NONFUEL HARDWARE)

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

C. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading in the MPC-32.

D. One NSA is authorized for loading in an MPC-32.

NOTE 1: Fuel assemblies*, with or without ITTRs,* containing BPRAs, WABAs, or TPDs*,* may be stored in any fuel storage location. Fuel assemblies*, with or without ITTRs,* containing RCCAs *or NSAs* must be loaded in fuel storage locations 13, 14, 19 and/or 20 of Figure 2.1-3. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-5

FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Type *(Note 6)*	Vantage 5	Standard, or LOPAR
Cladding Material	Zr (Note 5)	Zr (Note 5)
Design Initial U (kg/assy.) (Note 2)	≤ 467	≤ 467
Initial Enrichment (MPC-24, 24E, and 24EF without soluble boron credit) (wt% ^{235}U) (Note 4)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, or 32 with soluble boron credit) (wt% ^{235}U) (Notes 3 and 4)	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	264	264
Fuel Rod Cladding O.D. (in.)	≥ 0.360	≥ 0.372
Fuel Rod Cladding I.D. (in.)	≤ 0.3150	≤ 0.3310
Fuel Pellet Dia. (in.)	≤ 0.3088	≤ 0.3232
Fuel Rod Pitch (in.)	≤ 0.496	≤ 0.496
Active Fuel Length (in.)	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	25	25
Guide/Instrument Tube Thickness (in.)	≥ 0.016	≥ 0.014

NOTE 1: All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies.

NOTE 2: Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or DCPP. For each fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with DCPP fuel records to account for manufacturer's tolerances.

NOTE 3: Soluble boron concentration per Technical Specification LCO 3.2.1.

NOTE 4: For those MPCs loaded with both INTACT FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum initial enrichment of the INTACT FUEL ASSEMBLIES is limited to the maximum initial enrichment of the DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS (i.e., 4.0 wt.% ^{235}U).

NOTE 5: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

NOTE 6: Fuel assemblies meeting the characteristics may be loaded under the requirements for the listed Fuel Assembly Type, even if the name is different.

TABLE 2.1-6

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS) (MWD/MTU)	MPC-32 Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU) *(Note 2)*
≥ 5	40,600	41,100	39,200	32,200
≥ 6	45,000	45,000	43,700	36,500
≥ 7	-	-	44,500	37,500
≥ 8	-	-	45,000	39,900
≥ 9	-	-	-	41,500
≥ 10	-	-	-	42,900
≥ 11	-	-	-	44,100
≥ 12	-	-	-	45,000
≥ 13	-	-	-	-
≥ 14	-	-	-	-
≥ 15	-	-	-	-

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Burnup *limits* for fuel assemblies ~~with cladding made of ZIRLO is limited to 45,000 MWD/MTU or the value in this table, whichever is less~~*in an MPC-32 may alternatively be calculated using Section 2.3*.

TABLE 2.1-7

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)	MPC-24E/24EF Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)	MPC-24E/24EF Assembly Decay Heat (DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS) (Watts)	MPC-32 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)
≥ 5	1157	1173	1115	898
≥ 6	1123	1138	1081	~~873~~*898*
≥ 7	1030	1043	991	~~805~~*898*
≥ 8	1020	1033	981	~~800~~*898*
≥ 9	1010	1023	972	~~794~~*898*
≥ 10	1000	1012	962	~~789~~*898*
≥ 11	996	1008	958	~~785~~*898*
≥ 12	992	1004	954	~~782~~*898*
≥ 13	987	999	949	~~773~~*898*
≥ 14	983	995	945	~~769~~*898*
≥ 15	979	991	941	~~766~~*898*

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Includes all sources of heat (i.e., fuel and NONFUEL HARDWARE).

TABLE 2.1-8

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup for Region 1 (MWD/MTU)	MPC-24 Assembly Burnup for Region 2 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 1 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 2 (MWD/MTU)	MPC-32 Assembly Burnup for Region 1 (MWD/MTU) *(Note 3)*	MPC-32 Assembly Burnup for Region 2 (MWD/MTU) *(Note 3)*
≥ 5	45,000	32,200	45,000	32,200	39,800	22,100
≥ 6	-	37,400	-	37,400	43,400	26,200
≥ 7	-	41,100	-	41,100	44,500	29,100
≥ 8	-	43,800	-	43,800	45,000	31,200
≥ 9	-	45,000	-	45,000	-	32,700
≥ 10	-	-	-	-	-	34,100
≥ 11	-	-	-	-	-	35,200
≥ 12	-	-	-	-	-	36,200
≥ 13	-	-	-	-	-	37,000
≥ 14	-	-	-	-	-	37,800
≥ 15	-	-	-	-	-	38,600
≥ 16	-	-	-	-	-	39,400
≥ 17	-	-	-	-	-	40,200
≥ 18	-	-	-	-	-	40,800
≥ 19	-	-	-	-	-	41,500
≥ 20	-	-	-	-	-	42,200

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: These limits apply to INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS.

NOTE 3: Burnup *limits* for fuel assemblies ~~with cladding made of ZIRLO is limited to 45,000 MWD/MTU or the value in this table, whichever is less~~*in an MPC-32 may alternatively be calculated per Section 2.3*.

TABLE 2.1-9

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Decay Heat for Region 1 (Watts)	MPC-24 Assembly Decay Heat for Region 2 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 1 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 2 (Watts)	MPC-32 Assembly Decay Heat for Region 1 (Watts)	MPC-32 Assembly Decay Heat for Region 2 (Watts)
≥ 5	1470	900	1540	900	1131	600
≥ 6	1470	900	1540	900	*1131*~~1072~~	600
≥ 7	1335	900	1395	900	*1131*~~993~~	600
≥ 8	1301	900	1360	900	*1131*~~978~~	600
≥ 9	1268	900	1325	900	*1131*~~964~~	600
≥ 10	1235	900	1290	900	*1131*~~950~~	600
≥ 11	1221	900	1275	900	*1131*~~943~~	600
≥ 12	1207	900	1260	900	*1131*~~937~~	600
≥ 13	1193	900	1245	900	*1131*~~931~~	600
≥ 14	1179	900	1230	900	*1131*~~924~~	600
≥ 15	1165	900	1215	900	*1131*~~918~~	600
≥ 16	-	-	-	-	-	-
≥ 17	-	-	-	-	-	-
≥ 18	-	-	-	-	-	-
≥ 19	-	-	-	-	-	-
≥ 20	-	-	-	-	-	-

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Includes all sources of decay heat (i.e., fuel and NONFUEL HARDWARE).

NOTE 3: These limits apply to INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS.

TABLE 2.1-10

NONFUEL HARDWARE COOLING AND AVERAGE ACTIVATION

Post-Irradiation Cooling Time (years)	BPRA and WABA Burnup (MWD/MTU)	TPD *and NSA* Burnup (MWD/MTU)	RCCA Burnup (MWD/MTU)
≥3	≤ 20,000	NA	NA
≥4	≤ 25,000	≤ 20,000	NA
≥ 5	≤ 30,000	≤ 25,000	≤ 630,000
≥ 6	≤ 40,000	≤ 30,000	-
≥ 7	≤ 45,000	≤ 40,000	-
≥ 8	≤ 50,000	≤ 45,000	-
≥ 9	≤ 60,000	≤ 50,000	-
≥10	-	≤ 60,000	-
≥ 11	-	≤ 75,000	-
≥ 12	-	≤ 90,000	-
≥ 13	-	≤ 180,000	-
≥ 14	-	≤ 630,000	-

NOTE 1: Linear interpolation between points is permitted, except that TPD *and NSA* burnups > 180,000 MWD/MTU and ≤ 630,000 MWD/MTU must be cooled ≥ 14 years.

NOTE 2: Applicable to uniform loading and regionalized loading.

NOTE 3: NA means not authorized for loading.

NOTE 4: Non-fuel hardware burnup and cooling times are not applicable to ITTRs since they are installed post-irradiation.

NOTE 5: Only one NSA is authorized for loading in any MPC.

Table 2.3-1 (page 1 of 2)

Fuel Assembly Time-Dependent Coefficients

Cooling Time (years)	Vantage 5 fuel						
	A	B	C	D	E	F	G
≥ 5	40315.9	-9724	1622.89	-140.459	3170.28	-547.749	425.136
≥ 6	49378.5	-15653.1	3029.25	-164.712	3532.55	-628.93	842.73
≥ 7	56759.5	-21320.4	4598.78	-190.58	3873.21	-698.143	975.46
≥ 8	63153.4	-26463.8	6102.47	-201.262	4021.84	-685.431	848.497
≥ 9	67874.9	-30519.2	7442.84	-218.184	4287.23	-754.597	723.305
≥ 10	72676.8	-34855.2	8928.27	-222.423	4382.07	-741.243	387.877
≥ 11	75623	-37457.1	9927.65	-232.962	4564.55	-792.051	388.402
≥ 12	80141.8	-41736.5	11509.8	-232.944	4624.72	-787.134	-164.727
≥ 13	83587.5	-45016.4	12800.9	-230.643	4623.2	-745.177	-428.635
≥ 14	86311.3	-47443.4	13815.2	-228.162	4638.89	-729.425	-561.758
≥ 15	87839.2	-48704.1	14500.3	-231.979	4747.67	-775.801	-441.959
≥ 16	91190.5	-51877.4	15813.2	-225.768	4692.45	-719.311	-756.537
≥ 17	94512	-55201.2	17306.1	-224.328	4740.86	-747.11	-1129.15
≥ 18	96959	-57459.9	18403.8	-220.038	4721.02	-726.928	-1272.47
≥ 19	99061.1	-59172.1	19253.1	-214.045	4663.37	-679.362	-1309.88
≥ 20	100305	-59997.5	19841.1	-216.112	4721.71	-705.463	-1148.45

Table 2.3-1 (page 2 of 2)

Fuel Assembly Time-Dependent Coefficients

Cooling Time (years)	Standard, and LOPAR fuel						
	A	B	C	D	E	F	G
≥ 5	36190.4	-7783.2	1186.37	-130.008	2769.53	-438.716	519.95
≥ 6	44159	-12517.5	2209.54	-150.234	3042.25	-489.858	924.151
≥ 7	50399.6	-16780.6	3277.26	-173.223	3336.58	-555.743	1129.66
≥ 8	55453.9	-20420	4259.68	-189.355	3531.65	-581.917	1105.62
≥ 9	59469.3	-23459.8	5176.62	-199.63	3709.99	-626.667	1028.74
≥ 10	63200.5	-26319.6	6047.8	-203.233	3783.02	-619.949	805.311
≥ 11	65636.3	-28258.3	6757.23	-214.247	3972.8	-688.56	843.457
≥ 12	68989.7	-30904.4	7626.53	-212.539	3995.62	-678.037	495.032
≥ 13	71616.6	-32962.2	8360.45	-210.386	4009.11	-666.542	317.009
≥ 14	73923.9	-34748	9037.75	-207.668	4020.13	-662.692	183.086
≥ 15	76131.8	-36422.3	9692.32	-203.428	4014.55	-655.981	47.5234
≥ 16	77376.5	-37224.7	10111.4	-207.581	4110.76	-703.37	161.128
≥ 17	80294.9	-39675.9	11065.9	-201.194	4079.24	-691.636	-173.782
≥ 18	82219.8	-41064.8	11672.1	-195.431	4043.83	-675.432	-286.059
≥ 19	84168.9	-42503.6	12309.4	-190.602	4008.19	-656.192	-372.411
≥ 20	86074.2	-43854.4	12935.9	-185.767	3985.57	-656.72	-475.953

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. MPC helium leak rate limit for vent and drain port cover plate welds not met.	C.1	Perform an engineering evaluation to determine the impact of increased helium leak rate on heat removal capability and offsite dose.	24 hours
	<u>AND</u>		
	C.2	Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	7 days
D. Required Actions and associated Completion Times not met.	D.1	Remove all fuel assemblies from the MPC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	~~Verify MPC cavity vacuum drying pressure is ≤ 3 torr for ≥ 30 min.~~ ~~OR~~While recirculating helium through the MPC cavity, verify that the gas temperature exiting the demoisturizer is ≤ 21°F for ≥ 30 min.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.2	Verify MPC helium backfill pressure is ≥ 29.3 psig and ≤ 33.3 psig *at a reference temperature of 70° F*.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.3	Verify that the total helium leak rate through the MPC vent and drain port confinement welds meets the leaktight criteria of ANSI N14.5-1997.	Once, prior to TRANSPORT OPERATIONS.

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. MPC helium leak rate limit for vent and drain port cover plate welds not met.	C.1	Perform an engineering evaluation to determine the impact of increased helium leak rate on heat removal capability and offsite dose.	24 hours
	AND		
	C.2	Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	7 days
D. Required Actions and associated Completion Times not met.	D.1	Remove all fuel assemblies from the MPC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	~~Verify MPC cavity vacuum drying pressure is ≤ 3 torr for ≥ 30 min.~~ ~~OR~~While recirculating helium through the MPC cavity, verify that the gas temperature exiting the demoisturizer is ≤ 21°F for ≥ 30 min.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.2	Verify MPC helium backfill pressure is ≥ 29.3 psig and ≤ 33.3 psig *at a reference temperature of 70° F*.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.3	Verify that the total helium leak rate through the MPC vent and drain port confinement welds meets the leaktight criteria of ANSI N14.5-1997.	Once, prior to TRANSPORT OPERATIONS.

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.2 Spent Fuel Storage Cask (SFSC) Heat Removal System

LCO 3.1.2 The SFSC Heat Removal System shall be operable.

APPLICABILITY: During STORAGE OPERATIONS

ACTIONS

---NOTE---

Separate Condition entry is allowed for each SFSC.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. ~~LCO not met.~~*SFSC Heat Removal System operable, but partially (< 50%) blocked.*	A.1	*Remove blockage.* ~~Restore SFSC Heat Removal System to operable status.~~	8 hours
	~~OR~~		
	~~A.2.1~~	~~Verify adequate heat removal to prevent exceeding short-term fuel temperature limit;~~	~~Immediately~~
		~~AND~~	
	~~A.2.2~~	~~Restore SFSC Heat Removal System to operable status.~~	~~30 days~~
B. SFSC Heat Removal System inoperable.	*B.1*	*Restore SFSC Heat Removal System to operable status.*	*8 hours*
~~B~~*C*. Required Action~~s~~ *B.1* and associated Completion Time not met.	~~B~~*C*.1	*Measure SFSC dose rates in accordance with the Radiation Protection Program.*	Immediately *and once per 12 hours thereafter.*
	AND		
	C.2.1	*Restore SFSC Heat removal System to operable status.*	*24 hours*
		OR	
	C.2.2	Transfer the MPC into a TRANSFER CASK.	*24 hours*

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.2~~.1~~	Verify all SFSC inlet and outlet air duct screens are free of blockage.	24 hours

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.4 ~~Intentionally left blank~~*Supplemental Cooling System*

LCO 3.1.4 The Supplemental Cooling System (SCS) shall be operable.

--NOTE--

Upon reaching steady state operation, the SCS may be temporarily disabled for a short duration (≤ 7 hours) to facilitate necessary operational evolutions, such as movement of the TRANSFER CASK through a doorway, or other similar operations.

--

APPLICABILITY: This LCO is applicable when the loaded MPC is in the TRANSFER CASK, and:

a.1.a. Bulk water has been removed from the MPC

AND

a.1.b FHD has been secured for greater than 4 hours.

OR

a.2. Within 4 hours of transferring the MPC into the TRANSFER CASK if the MPC is to be unloaded.

AND

b. The MPC contains one or more fuel assemblies with an average burnup of >45,000 MWD/MTU.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. Supplemental Cooling System inoperable	*A.1*	*Restore Supplemental Cooling System to operable status.*	*7 days*
B. Required Action A.1 and associated Completion Time not met.	*B.1*	*Remove all fuel assemblies from the MPC.*	*30 days*

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	*Verify Supplemental Cooling System is operable*	*2 hours*

4.0 DESIGN FEATURES

4.1 Design Features Significant to Safety

4.1.1 Criticality Control

a. MULTI-PURPOSE CANISTER (MPC) MPC-24

1. Flux trap size: $\geq$ 1.09 in.
2. ^{10}B loading in the Boral neutron absorbers: $\geq$ 0.0267 g/cm^2 (Boral) and $\geq$ 0.0223 g/cm^2 (METAMIC)

b MPC-24E and MPC-24EF

1. Flux trap size:
   - Cells 3, 6, 19, and 22: $\geq$ 0.776 in.
   - All Other Cells: $\geq$ 1.076 in.
2. ^{10}B loading in the Boral neutron absorbers: $\geq$ 0.0372 g/cm^2 (Boral) and $\geq$ 0.0310 g/cm^2 (METAMIC)

c. MPC-32

1. Fuel cell pitch: $\geq$ 9.158 in.
2. ^{10}B loading in the Boral neutron absorbers: $\geq$ 0.0372 g/cm^2 (Boral) and $\geq$ 0.0310 g/cm^2 (METAMIC)

4.1.2 Design Features Important to Criticality Control

a. Fuel spacers shall be sized to ensure that the active fuel region of intact fuel assemblies remain within the neutron poison region of the MPC basket with the water in the MPC.

b. The B_4C content in METAMIC shall be $\leq$ 33.0 wt%.

c. Neutron Absorber Test

The minimum ^{10}B for the neutron absorber shall meet the minimum requirements for each MPC model specified in Section 4.1.1 above.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

5.1.3 MPC and SFSC Loading, Unloading, and Preparation Program

This program shall be established and maintained to implement Diablo Canyon ISFSI SAR Section 10.2 requirements for loading fuel and components into MPCs, unloading fuel and components from MPCs, and preparing the MPCs for storage in the SFSCs. The requirements of the program for loading and preparing the MPC shall be complete prior to removing the MPC from the fuel handling building/auxiliary building. The program provides for evaluation and control of the following requirements during the applicable operation:

a. Verify that no transfer cask handling operations are allowed at environmental temperatures below -18 °C [0 °F].

b. Verify that the water is maintained to provide adequate cooling in the annular gap between the loaded MPC and the transfer cask during MPC *reflooding operations (unloading).* ~~moisture removal operations under use of vacuum drying process for low burnup fuel (≤45,000 MWD/MTU). Verify that there is no water present in the annular gap between the loaded MPC and the transfer cask during MPC moisture removal operations under use of forced helium dehydration process.~~

c. The water temperature of a water-filled or partially filled loaded MPC shall be shown by analysis to be less than boiling at all times.

d. Verify that the drying times and pressures assure that fuel cladding temperature limit is not violated and the MPC is adequately dry.

e. Verify that the inerting backfill pressure and purity assure adequate heat transfer and corrosion control.

f. Verify that leak testing assures adequate MPC integrity and consistency with offsite dose analysis.

g. Verify surface dose rates on the TRANSFER CASK are adequate to assure proper loading and consistency with the offsite dose analysis.

h. Verify surface dose rates on the SFSCs are adequate to assure proper storage and consistency with the offsite dose analysis.

i. During MPC re-flooding, verify the helium exit temperature is such that water quenching or flashing does not occur.

j. Verify that combustible gases in the MPC are monitored and controlled to avoid combustion during MPC lid-to-shell welding or MPC cutting activities.

k. For the MPC lid-to-shell weld and the MPC enclosure vessel and lid, the weld must be at minimum of three weld layers. If PT alone is used, it will be tested at least three different weld layers, including the root and final weld layers and each approximately 3/8-inch of weld depth.

l. Very that fuel cladding is not exposed to an oxidizing environment by maintaining the cladding in water or an inert atmosphere.

(continued)

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1.1 Definitions (continued)

INTACT FUEL ASSEMBLY	INTACT FUEL ASSEMBLY is a fuel assembly without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means. A fuel assembly shall not be classified as INTACT FUEL ASSEMBLY unless solid Zircaloy or stainless steel rods are used to replace missing fuel rods and which displace an amount of water equal to that displaced by the original fuel rod(s).
LOADING OPERATIONS	LOADING OPERATIONS include all licensed activities on a TRANSFER CASK while its contained MPC is being loaded with its approved contents. LOADING OPERATIONS begin when the first fuel assembly is placed in the MPC and end when the TRANSFER CASK is suspended from or secured on the transporter. LOADING OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.
MINIMUM ENRICHMENT	MINIMUM ENRICHMENT is the minimum assembly average enrichment. Natural uranium blankets are not considered in determining minimum enrichment.
MULTI-PURPOSE CANISTER (MPC)	MPC is a sealed SPENT NUCLEAR FUEL container that consists of a honeycombed fuel basket contained in a cylindrical canister shell which is welded to a baseplate, lid with welded port cover plates, and closure ring. The MPC provides the confinement boundary for the contained radioactive materials.
NONFUEL HARDWARE	NONFUEL HARDWARE is defined as burnable poison rod assemblies (BPRAs), thimble plug devices (TPDs), rod control cluster assemblies (RCCAs), wet annular burnable absorbers (WABAs), neutron source assemblies (NSAs), instrument tube tie rods (ITTRs), and components of these devices such as individual rods.
OPERABLE/OPERABILITY	A system, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instruments, controls, normal or emergency electrical power, and other auxiliary equipment that are required for the system, component, or device to perform its specific safety function(s) are also capable of performing their related support function(s).

(continued)

1.1 Definitions (continued)

OVERPACK	OVERPACK is a cask that receives and contains a sealed MPC for interim storage in the independent spent fuel storage installation (ISFSI). It provides gamma and neutron shielding, and provides for ventilated air flow to promote heat transfer from the MPC to the environs. The OVERPACK does not include the TRANSFER CASK.
SPENT FUEL STORAGE CASKS (SFSCs)	SFSCs are containers approved for the storage of spent fuel assemblies, FUEL DEBRIS, and associated NONFUEL HARDWARE at the ISFSI. The HI-STORM 100 SFSC System consists of the OVERPACK and its integral MPC loaded with any approved contents.
SPENT NUCLEAR FUEL	SPENT NUCLEAR FUEL means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least one year's decay since being used as a source of energy in a power reactor and has not been chemically separated into its constituent elements by reprocessing. SPENT NUCLEAR FUEL includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.
STORAGE OPERATIONS	STORAGE OPERATIONS include all licensed activities that are performed at the ISFSI while a SFSC containing approved contents is sitting on a storage pad within the ISFSI perimeter. STORAGE OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.
TRANSFER CASK	TRANSFER CASKs are containers designed to contain the MPC during and after loading of its approved contents and to transfer the loaded MPC to or from the OVERPACK.
TRANSPORT OPERATIONS	TRANSPORT OPERATIONS include all licensed activities performed on an OVERPACK or TRANSFER CASK loaded with any approved contents when it is being moved to and from the ISFSI. TRANSPORT OPERATIONS begin when the OVERPACK or TRANSFER CASK is first suspended from or secured on the transporter and end when the OVERPACK or TRANSFER CASK is at its destination and no longer secured on or suspended from the transporter. TRANSPORT OPERATIONS include transfer of the MPC between the OVERPACK and the TRANSFER CASK.

(continued)

2.3 Alternate MPC-32 Fuel Selection Criteria

The maximum allowable fuel assembly average burnup for a given MINIMUM ENRICHMENT is calculated as described below for minimum cooling times between 5 and 20 years using the maximum permissible decay heat determined in Table 2.1-7 or 2.1-9. Different fuel assembly average burnup limits may be calculated for different minimum enrichments (by individual fuel assembly) for use in choosing the fuel assemblies to be loaded into a given MPC.

a. Choose a fuel assembly minimum enrichment E_{235}.

b. Calculate the maximum allowable fuel assembly average burnup for a minimum cooling time between 5 and 20 years using the following equation below:

$$Bu = (A \times q) + (B \times q^2) + (C \times q^3) + [D \times (E_{235})^2] + (E \times q \times E_{235}) + (F \times q^2 \times E_{235}) + G$$

Where:

Bu = Maximum allowable average burnup per fuel assembly (MWD/MTU)

q = Maximum allowable decay heat per storage location, in kilowatts, determined from Table 2.1-7 or 2.1-9 (e.g. 898 watts, use 0.898)

E_{235} = Minimum fuel assembly average enrichment (wt% ^{235}U) (e.g., for 4.05 wt%, use 4.05)

A through G = Coefficients from Table 2.3-1.

c. Calculated burnup limits shall be rounded down to the nearest integer.

d. Calculated burnup limits greater than 68,200 MWD/MTU must be reduced to be equal to this value.

e. Linear interpolation of calculated burnups between cooling times for a given fuel assembly maximum decay heat and minimum enrichment is permitted. For example, the allowable burnup for a cooling time of 5.5 years may be interpolated between those burnups calculated for 5 year and 6 years.

f. Each ZR-clad fuel assembly to be stored must have a MINIMUM ENRICHMENT greater than or equal to the value used in Step 2.3.a.

g. When complying with the maximum fuel storage location decay heat limits, users must account for the decay heat from both the fuel assembly and any NON-FUEL HARDWARE, as applicable for the particular fuel storage location, to ensure the decay heat emitted by all contents in a storage location does not exceed the limit.

TABLE 2.1-1

MPC-24 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, INTACT FUEL ASSEMBLIES listed in Table 2.1-5, with or without NONFUEL HARDWARE and meeting the following specifications (Note 1):

Cladding type	Zr (Note 2)
Initial enrichment	As specified in Table 2.1-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 2.1-6 or 2.1-8.
NONFUEL HARDWARE	As specified in Table 2.1-10.
Decay heat per assembly	As specified in Tables 2.1-7 or 2.1-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including NONFUEL HARDWARE)

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

C. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading into the MPC-24.

D. One NSA is authorized for loading in an MPC-24.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel cell location. Fuel assemblies containing RCCAs or NSAs may only be loaded in fuel storage locations 9, 10, 15, and/or 16 of Figure 2.1-1. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-2 Sheet 2 of 2

A. Quantity per MPC: Up to four (4) DAMAGED FUEL ASSEMBLIES in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 2.1-2. The remaining MPC-24E fuel storage locations may be filled with INTACT FUEL ASSEMBLIES meeting the applicable specifications.

B. FUEL DEBRIS is not authorized for loading in the MPC-24E.

C. One NSA is authorized for loading in an MPC-24E.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs or NSAs must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 2.1-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-3

A. Quantity per MPC: Up to four (4) DAMAGED FUEL ASSEMBLIES and/or FUEL DEBRIS in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 2.1-2. The remaining MPC-24EF fuel storage locations may be filled with INTACT FUEL ASSEMBLIES meeting the applicable specifications.

B. One NSA is authorized for loading in an MPC-24EF.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs or NSAs must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 2.1-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: The total quantity of FUEL DEBRIS permitted in a single DAMAGED FUEL CONTAINER is limited to the equivalent weight and special nuclear material quantity of one INTACT FUEL ASSEMBLY.

NOTE 3: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-4

MPC-32 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, INTACT FUEL ASSEMBLIES listed in Table 2.1-5, with or without NONFUEL HARDWARE and meeting the following specifications (Note 1):

Cladding type	Zr (Note 2)
Initial enrichment	As specified in Table 2.1-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 2.1-6 or 2.1-8, or Section 2.3.
NONFUEL HARDWARE	As specified in Table 2.1-10.
Decay heat per assembly	As specified in Tables 2.1-7 or 2.1-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including NONFUEL HARDWARE)

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

C. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading in the MPC-32.

D. One NSA is authorized for loading in an MPC-32.

NOTE 1: Fuel assemblies, with or without ITTRs, containing BPRAs, WABAs, or TPDs, may be stored in any fuel storage location. Fuel assemblies, with or without ITTRs, containing RCCAs or NSAs must be loaded in fuel storage locations 13, 14, 19 and/or 20 of Figure 2.1-3. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

TABLE 2.1-5

FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Type (Note 6)	Vantage 5	Standard, or LOPAR
Cladding Material	Zr (Note 5)	Zr (Note 5)
Design Initial U (kg/assy.) (Note 2)	≤ 467	≤ 467
Initial Enrichment (MPC-24, 24E, and 24EF without soluble boron credit) (wt% ^{235}U) (Note 4)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, or 32 with soluble boron credit) (wt% ^{235}U) (Notes 3 and 4)	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	264	264
Fuel Rod Cladding O.D. (in.)	≥ 0.360	≥ 0.372
Fuel Rod Cladding I.D. (in.)	≤ 0.3150	≤ 0.3310
Fuel Pellet Dia. (in.)	≤ 0.3088	≤ 0.3232
Fuel Rod Pitch (in.)	≤ 0.496	≤ 0.496
Active Fuel Length (in.)	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	25	25
Guide/Instrument Tube Thickness (in.)	≥ 0.016	≥ 0.014

NOTE 1: All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies.

NOTE 2: Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or DCPP. For each fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with DCPP fuel records to account for manufacturer's tolerances.

NOTE 3: Soluble boron concentration per Technical Specification LCO 3.2.1.

NOTE 4: For those MPCs loaded with both INTACT FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum initial enrichment of the INTACT FUEL ASSEMBLIES is limited to the maximum initial enrichment of the DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS (i.e., 4.0 wt.% ^{235}U).

NOTE 5: Zr designates fuel-cladding material, which is made of Zircaloy-2, Zircaloy-4 and ZIRLO.

NOTE 6: Fuel assemblies meeting the characteristics may be loaded under the requirements for the listed Fuel Assembly Type, even if the name is different.

TABLE 2.1-6

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS) (MWD/MTU)	MPC-32 Assembly Burnup (INTACT FUEL ASSEMBLIES) (MWD/MTU) (Note 2)
≥ 5	40,600	41,100	39,200	32,200
≥ 6	45,000	45,000	43,700	36,500
≥ 7	-	-	44,500	37,500
≥ 8	-	-	45,000	39,900
≥ 9	-	-	-	41,500
≥ 10	-	-	-	42,900
≥ 11	-	-	-	44,100
≥ 12	-	-	-	45,000
≥ 13	-	-	-	-
≥ 14	-	-	-	-
≥ 15	-	-	-	-

NOTE 1: Linear interpolation between points is permitted.
NOTE 2: Burnup limits for fuel assemblies in an MPC-32 may alternatively be calculated using Section 2.3.

TABLE 2.1-7

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)	MPC-24E/24EF Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)	MPC-24E/24EF Assembly Decay Heat (DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS) (Watts)	MPC-32 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts)
≥ 5	1157	1173	1115	898
≥ 6	1123	1138	1081	898
≥ 7	1030	1043	991	898
≥ 8	1020	1033	981	898
≥ 9	1010	1023	972	898
≥ 10	1000	1012	962	898
≥ 11	996	1008	958	898
≥ 12	992	1004	954	898
≥ 13	987	999	949	898
≥ 14	983	995	945	898
≥ 15	979	991	941	898

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Includes all sources of heat (i.e., fuel and NONFUEL HARDWARE).

TABLE 2.1-8

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup for Region 1 (MWD/MTU)	MPC-24 Assembly Burnup for Region 2 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 1 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 2 (MWD/MTU)	MPC-32 Assembly Burnup for Region 1 (MWD/MTU) (Note 3)	MPC-32 Assembly Burnup for Region 2 (MWD/MTU) (Note 3)
≥ 5	45,000	32,200	45,000	32,200	39,800	22,100
≥ 6	-	37,400	-	37,400	43,400	26,200
≥ 7	-	41,100	-	41,100	44,500	29,100
≥ 8	-	43,800	-	43,800	45,000	31,200
≥ 9	-	45,000	-	45,000	-	32,700
≥ 10	-	-	-	-	-	34,100
≥ 11	-	-	-	-	-	35,200
≥ 12	-	-	-	-	-	36,200
≥ 13	-	-	-	-	-	37,000
≥ 14	-	-	-	-	-	37,800
≥ 15	-	-	-	-	-	38,600
≥ 16	-	-	-	-	-	39,400
≥ 17	-	-	-	-	-	40,200
≥ 18	-	-	-	-	-	40,800
≥ 19	-	-	-	-	-	41,500
≥ 20	-	-	-	-	-	42,200

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: These limits apply to INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS.

NOTE 3: Burnup limits for fuel assemblies in an MPC-32 may alternatively be calculated per Section 2.3.

TABLE 2.1-9

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Decay Heat for Region 1 (Watts)	MPC-24 Assembly Decay Heat for Region 2 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 1 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 2 (Watts)	MPC-32 Assembly Decay Heat for Region 1 (Watts)	MPC-32 Assembly Decay Heat for Region 2 (Watts)
≥ 5	1470	900	1540	900	1131	600
≥ 6	1470	900	1540	900	1131	600
≥ 7	1335	900	1395	900	1131	600
≥ 8	1301	900	1360	900	1131	600
≥ 9	1268	900	1325	900	1131	600
≥ 10	1235	900	1290	900	1131	600
≥ 11	1221	900	1275	900	1131	600
≥ 12	1207	900	1260	900	1131	600
≥ 13	1193	900	1245	900	1131	600
≥ 14	1179	900	1230	900	1131	600
≥ 15	1165	900	1215	900	1131	600
≥ 16	-	-	-	-	-	-
≥ 17	-	-	-	-	-	-
≥ 18	-	-	-	-	-	-
≥ 19	-	-	-	-	-	-
≥ 20	-	-	-	-	-	-

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Includes all sources of decay heat (i.e., fuel and NONFUEL HARDWARE).

NOTE 3: These limits apply to INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS.

TABLE 2.1-10

NONFUEL HARDWARE COOLING AND AVERAGE ACTIVATION

Post-Irradiation Cooling Time (years)	BPRA and WABA Burnup (MWD/MTU)	TPD and NSA Burnup (MWD/MTU)	RCCA Burnup (MWD/MTU)
≥3	≤ 20,000	NA	NA
≥4	≤ 25,000	≤ 20,000	NA
≥ 5	≤ 30,000	≤ 25,000	≤ 630,000
≥ 6	≤ 40,000	≤ 30,000	-
≥ 7	≤ 45,000	≤ 40,000	-
≥ 8	≤ 50,000	≤ 45,000	-
≥ 9	≤ 60,000	≤ 50,000	-
≥10	-	≤ 60,000	-
≥ 11	-	≤ 75,000	-
≥ 12	-	≤ 90,000	-
≥ 13	-	≤ 180,000	-
≥ 14	-	≤ 630,000	-

NOTE 1: Linear interpolation between points is permitted, except that TPD and NSA burnups > 180,000 MWD/MTU and ≤ 630,000 MWD/MTU must be cooled ≥ 14 years.

NOTE 2: Applicable to uniform loading and regionalized loading.

NOTE 3: NA means not authorized for loading.

NOTE 4: Non-fuel hardware burnup and cooling times are not applicable to ITTRs since they are installed post-irradiation.

NOTE 5: Only one NSA is authorized for loading in any MPC.

Table 2.3-1 (page 1 of 2)

Fuel Assembly Time-Dependent Coefficients

Cooling Time (years)	Vantage 5 fuel						
	A	B	C	D	E	F	G
≥ 5	40315.9	-9724	1622.89	-140.459	3170.28	-547.749	425.136
≥ 6	49378.5	-15653.1	3029.25	-164.712	3532.55	-628.93	842.73
≥ 7	56759.5	-21320.4	4598.78	-190.58	3873.21	-698.143	975.46
≥ 8	63153.4	-26463.8	6102.47	-201.262	4021.84	-685.431	848.497
≥ 9	67874.9	-30519.2	7442.84	-218.184	4287.23	-754.597	723.305
≥ 10	72676.8	-34855.2	8928.27	-222.423	4382.07	-741.243	387.877
≥ 11	75623	-37457.1	9927.65	-232.962	4564.55	-792.051	388.402
≥ 12	80141.8	-41736.5	11509.8	-232.944	4624.72	-787.134	-164.727
≥ 13	83587.5	-45016.4	12800.9	-230.643	4623.2	-745.177	-428.635
≥ 14	86311.3	-47443.4	13815.2	-228.162	4638.89	-729.425	-561.758
≥ 15	87839.2	-48704.1	14500.3	-231.979	4747.67	-775.801	-441.959
≥ 16	91190.5	-51877.4	15813.2	-225.768	4692.45	-719.311	-756.537
≥ 17	94512	-55201.2	17306.1	-224.328	4740.86	-747.11	-1129.15
≥ 18	96959	-57459.9	18403.8	-220.038	4721.02	-726.928	-1272.47
≥ 19	99061.1	-59172.1	19253.1	-214.045	4663.37	-679.362	-1309.88
≥ 20	100305	-59997.5	19841.1	-216.112	4721.71	-705.463	-1148.45

Table 2.3-1 (page 2 of 2)

Fuel Assembly Time-Dependent Coefficients

Cooling Time (years)	Standard, and LOPAR fuel						
	A	B	C	D	E	F	G
≥ 5	36190.4	-7783.2	1186.37	-130.008	2769.53	-438.716	519.95
≥ 6	44159	-12517.5	2209.54	-150.234	3042.25	-489.858	924.151
≥ 7	50399.6	-16780.6	3277.26	-173.223	3336.58	-555.743	1129.66
≥ 8	55453.9	-20420	4259.68	-189.355	3531.65	-581.917	1105.62
≥ 9	59469.3	-23459.8	5176.62	-199.63	3709.99	-626.667	1028.74
≥ 10	63200.5	-26319.6	6047.8	-203.233	3783.02	-619.949	805.311
≥ 11	65636.3	-28258.3	6757.23	-214.247	3972.8	-688.56	843.457
≥ 12	68989.7	-30904.4	7626.53	-212.539	3995.62	-678.037	495.032
≥ 13	71616.6	-32962.2	8360.45	-210.386	4009.11	-666.542	317.009
≥ 14	73923.9	-34748	9037.75	-207.668	4020.13	-662.692	183.086
≥ 15	76131.8	-36422.3	9692.32	-203.428	4014.55	-655.981	47.5234
≥ 16	77376.5	-37224.7	10111.4	-207.581	4110.76	-703.37	161.128
≥ 17	80294.9	-39675.9	11065.9	-201.194	4079.24	-691.636	-173.782
≥ 18	82219.8	-41064.8	11672.1	-195.431	4043.83	-675.432	-286.059
≥ 19	84168.9	-42503.6	12309.4	-190.602	4008.19	-656.192	-372.411
≥ 20	86074.2	-43854.4	12935.9	-185.767	3985.57	-656.72	-475.953

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.1 MULTI-PURPOSE CANISTER (MPC)

LCO 3.1.1 The MPC shall be dry and helium filled.

APPLICABILITY: During TRANSPORT OPERATIONS and STORAGE OPERATIONS

ACTIONS

---NOTE---

Separate Condition entry is allowed for each MPC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MPC cavity drying demoisturizer exit gas temperature limit not met.	A.1. Perform an engineering evaluation to determine the quantity of moisture left in the MPC.	7 days
	<u>AND</u>	
	A.2 Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	30 days
B. MPC helium backfill pressure limit not met.	B.1 Perform an engineering evaluation to determine the impact of helium pressure differential.	72 hours
	<u>AND</u>	
	B.2 Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	14 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. MPC helium leak rate limit for vent and drain port cover plate welds not met.	C.1	Perform an engineering evaluation to determine the impact of increased helium leak rate on heat removal capability and offsite dose.	24 hours
	<u>AND</u>		
	C.2	Develop and initiate corrective actions necessary to return the MPC to an analyzed condition.	7 days
D. Required Actions and associated Completion Times not met.	D.1	Remove all fuel assemblies from the MPC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	While recirculating helium through the MPC cavity, verify that the gas temperature exiting the demoisturizer is ≤ 21°F for ≥ 30 min.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.2	Verify MPC helium backfill pressure is ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70° F.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.3	Verify that the total helium leak rate through the MPC vent and drain port confinement welds meets the leaktight criteria of ANSI N14.5-1997.	Once, prior to TRANSPORT OPERATIONS.

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.2 Spent Fuel Storage Cask (SFSC) Heat Removal System

LCO 3.1.2 The SFSC Heat Removal System shall be operable.

APPLICABILITY: During STORAGE OPERATIONS

ACTIONS

---NOTE---

Separate Condition entry is allowed for each SFSC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. SFSC Heat Removal System operable, but partially (< 50%) blocked.	A.1 Remove blockage.	8 hours
B. SFSC Heat Removal System inoperable.	B.1 Restore SFSC Heat Removal System to operable status.	8 hours
C. Required Action B.1 and associated Completion Time not met.	C.1 Measure SFSC dose rates in accordance with the Radiation Protection Program.	Immediately and once per 12 hours thereafter.
	AND	
	C.2.1 Restore SFSC Heat removal System to operable status.	24 hours
	OR	
	C.2.2 Transfer the MPC into a TRANSFER CASK.	24 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.2	Verify all SFSC inlet and outlet air duct screens are free of blockage.	24 hours

3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

3.1.4 Supplemental Cooling System

LCO 3.1.4 The Supplemental Cooling System (SCS) shall be operable.

---NOTE---

Upon reaching steady state operation, the SCS may be temporarily disabled for a short duration ($\leq$ 7 hours) to facilitate necessary operational evolutions, such as movement of the TRANSFER CASK through a doorway, or other similar operations.

APPLICABILITY: This LCO is applicable when the loaded MPC is in the TRANSFER CASK, and:

a.1.a. Bulk water has been removed from the MPC

AND

a.1.b FHD has been secured for greater than 4 hours.

OR

a.2. Within 4 hours of transferring the MPC into the TRANSFER CASK if the MPC is to be unloaded.

AND

b. The MPC contains one or more fuel assemblies with an average burnup of >45,000 MWD/MTU.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Supplemental Cooling System inoperable	A.1 Restore Supplemental Cooling System to operable status.	7 days
B. Required Action A.1 and associated Completion Time not met.	B.1 Remove all fuel assemblies from the MPC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.1.4.1 Verify Supplemental Cooling System is operable	2 hours

4.0 DESIGN FEATURES

4.1 Design Features Significant to Safety

4.1.1 Criticality Control

a. MULTI-PURPOSE CANISTER (MPC) MPC-24

1. Flux trap size: ≥ 1.09 in.
2. ^{10}B loading in the Boral neutron absorbers: ≥ 0.0267 g/cm^2 (Boral) and ≥ 0.0223 g/cm^2 (METAMIC)

b MPC-24E and MPC-24EF

1. Flux trap size:
   - Cells 3, 6, 19, and 22: ≥ 0.776 in.
   - All Other Cells: ≥ 1.076 in.
2. ^{10}B loading in the Boral neutron absorbers: ≥ 0.0372 g/cm^2 (Boral) and ≥ 0.0310 g/cm^2 (METAMIC)

c. MPC-32

1. Fuel cell pitch: ≥ 9.158 in.
2. ^{10}B loading in the Boral neutron absorbers: ≥ 0.0372 g/cm^2 (Boral) and ≥ 0.0310 g/cm^2 (METAMIC)

4.1.2 Design Features Important to Criticality Control

a. Fuel spacers shall be sized to ensure that the active fuel region of intact fuel assemblies remain within the neutron poison region of the MPC basket with the water in the MPC.

b. The B_4C content in METAMIC shall be ≤33.0 wt%.

c. Neutron Absorber Test

The minimum ^{10}B for the neutron absorber shall meet the minimum requirements for each MPC model specified in Section 4.1.1 above.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

5.1.3 MPC and SFSC Loading, Unloading, and Preparation Program

This program shall be established and maintained to implement Diablo Canyon ISFSI SAR Section 10.2 requirements for loading fuel and components into MPCs, unloading fuel and components from MPCs, and preparing the MPCs for storage in the SFSCs. The requirements of the program for loading and preparing the MPC shall be complete prior to removing the MPC from the fuel handling building/auxiliary building. The program provides for evaluation and control of the following requirements during the applicable operation:

a. Verify that no transfer cask handling operations are allowed at environmental temperatures below -18 °C [0 °F].

b. Verify that the water is maintained to provide adequate cooling in the annular gap between the loaded MPC and the transfer cask during MPC reflooding operations (unloading).

c. The water temperature of a water-filled or partially filled loaded MPC shall be shown by analysis to be less than boiling at all times.

d. Verify that the drying times and pressures assure that fuel cladding temperature limit is not violated and the MPC is adequately dry.

e. Verify that the inerting backfill pressure and purity assure adequate heat transfer and corrosion control.

f. Verify that leak testing assures adequate MPC integrity and consistency with offsite dose analysis.

g. Verify surface dose rates on the TRANSFER CASK are adequate to assure proper loading and consistency with the offsite dose analysis.

h. Verify surface dose rates on the SFSCs are adequate to assure proper storage and consistency with the offsite dose analysis.

i. During MPC re-flooding, verify the helium exit temperature is such that water quenching or flashing does not occur.

j. Verify that combustible gases in the MPC are monitored and controlled to avoid combustion during MPC lid-to-shell welding or MPC cutting activities.

k. For the MPC lid-to-shell weld and the MPC enclosure vessel and lid, the weld must be at minimum of three weld layers. If PT alone is used, it will be tested at least three different weld layers, including the root and final weld layers and each approximately 3/8-inch of weld depth.

l. Very that fuel cladding is not exposed to an oxidizing environment by maintaining the cladding in water or an inert atmosphere.

(continued)

TECHNICAL SPECIFICATIONS BASES

FOR THE

DIABLO CANYON

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

Docket No. 72-26

Materials License No. SNM-2511

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B 3.0 LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY

BASES

LCO	LCO 3.0.1, 3.0.2, and 3.0.4 establish the general requirements applicable to all Specifications and apply at all times, unless otherwise stated.
LCO 3.0.1	LCO 3.0.1 establishes the Applicability statement within each individual Specification as the requirement for when the LCO is required to be met (i.e., when the facility is in the specified conditions of the Applicability statement of each Specification.)
LCO 3.0.2	LCO 3.0.2 establishes that upon discovery of a failure to meet an LCO, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS condition is applicable from the point in time that an ACTIONS condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of an LCO are not met. This Specification establishes that: a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a Specification; and b. Completion of the Required Actions is not required when an LCO is met within the specified Completion Time, unless otherwise specified. There are two basic types of Required Actions. The first type of Required Action specifies a time limit in which the LCO must be met. This time limit is the Completion Time to restore a system or component or to restore variables to within specified limits. Whether stated as a Required Action or not, correction of the entered condition is an action that may always be considered upon entering ACTIONS. The second type of Required Action specifies the remedial measures that permit continued operation that is not further restricted by the Completion Time. In this case, compliance with the Required Actions provides an acceptable level of safety for continued operation. Completing the Required Actions is not required when an LCO is met or is no longer applicable, unless otherwise stated in the individual Specifications. The Completion Times of the Required Actions are also applicable when a system or component is removed from service intentionally. The reasons for intentionally relying on the ACTIONS include, but are not limited to, performance of Surveillances, preventive maintenance, corrective maintenance, or investigation of operational problems. Entering ACTIONS for these reasons must be done in a manner that does not compromise safety. Intentional entry into ACTIONS should not be made for operational convenience.

(continued)

BASES (continued)

LCO 3.0.3	This specification is not applicable to the Diablo Canyon ISFSI because it describes conditions under which a power reactor must be shut down when an LCO is not met and an associated ACTION is not met or provided. The placeholder is retained for consistency with the power reactor technical specifications.
LCO 3.0.4	LCO 3.0.4 establishes limitations on changes in specified conditions in the Applicability when an LCO is not met. It precludes placing the facility in a specified condition stated in that Applicability (e.g., Applicability desired to be entered) when the following exist: a. Facility conditions are such that the requirements of the LCO would not be met in the Applicability desired to be entered; and b. Continued noncompliance with the LCO requirements, if the Applicability were entered, would result in being required to exit the Applicability desired to be entered to comply with the Required Actions. Compliance with Required Actions that permit continued operation of the facility for an unlimited period of time in a specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the facility. Therefore, in such cases, entry into a specified condition in the Applicability may be made in accordance with the provisions of the Required Actions. The provisions of this Specification should not be interpreted as endorsing the failure to exercise the good practice of restoring systems or components before entering an associated specified condition in the Applicability. The provisions of LCO 3.0.4 shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS, or that are related to the unloading of an SFSC Exceptions to LCO 3.0.4 are stated in the individual Specifications. Exceptions may apply to all the ACTIONS or to a specific Required Action of a Specification.

(continued)

BASES (continued)

LCO 3.0.5	This specification is not applicable to the Diablo Canyon ISFSI because it describes conditions under which a power reactor must be shut down when an LCO is not met and an associated ACTION is not met or provided. The placeholder is retained for consistency with the power reactor technical specifications.

B 3.0 SURVEILLANCE REQUIREMENT (SR) APPLICABILITY

BASES

SRs	SR 3.0.1 through SR 3.0.4 establish the general requirements applicable to all Specifications and apply at all times, unless otherwise stated.

SR 3.0.1

SR 3.0.1 establishes the requirement that SRs must be met during the specified conditions in the Applicability for which the requirements of the LCO apply, unless otherwise specified in the individual SRs. This Specification is to ensure that Surveillances are performed to verify that systems and components meet the LCO and variables are within specified limits. Failure to complete a Surveillance within the specified Frequency, in accordance with SR 3.0.2, constitutes a failure to meet an LCO.

Systems and components are assumed to meet the LCO when the associated SRs have been met. Nothing in this Specification, however, is to be construed as implying that systems or components meet the associated LCO when:

a. The systems or components are known to not meet the LCO, although still meeting the SRs; or

b. The requirements of the Surveillance(s) are known to be not met between required Surveillance performances.

Surveillances do not have to be performed when the facility is in a specified condition for which the requirements of the associated LCO are not applicable, unless otherwise specified.

Surveillances including Surveillances invoked by Required Actions, do not have to be performed on equipment that has been determined to not meet the LCO because the ACTIONS define the remedial measures that apply. Surveillances have to be met and performed in accordance with SR 3.0.2, prior to returning equipment to service. Upon completion of maintenance, appropriate post-maintenance testing is required. This includes ensuring applicable Surveillances are not failed and their most recent performance is in accordance with SR 3.0.2.

Post-maintenance testing may not be possible in the current specified conditions in the Applicability due to the necessary facility parameters not having been established. In these situations, the equipment may be considered to meet the LCO provided testing has been satisfactorily completed to the extent possible and the equipment is not otherwise believed to be incapable of performing its function. This will allow operation to proceed to a specified condition where other necessary post-maintenance tests can be completed.

(continued)

BASES (continued)

SR 3.0.2

SR 3.0.2 establishes the requirements for meeting the specified Frequency for Surveillances and any Required Action with a Completion Time that requires the periodic performance of the Required Action on a "once per....." interval.

SR 3.0.2 permits a 25% extension of the interval specified in the Frequency. This extension facilitates Surveillance scheduling and considers facility conditions that may be suitable for conducting the Surveillance (e.g., transient conditions or other ongoing Surveillance or maintenance activities).

The 25% extension does not significantly degrade the reliability that results from performing the Surveillance at its specified Frequency. This is based on the recognition that the most probable result of any particular Surveillance being performed is the verification of conformance with SRs. The exceptions to SR 3.0.2 are those Surveillances for which the 25% extension of the interval specified in the Frequency does not apply. These exceptions are stated in the individual Specifications as a Note in the Frequency stating, "SR 3.0.2 is not applicable."

As stated in SR 3.0.2, the 25% extension also does not apply to the initial portion of a periodic Completion Time that requires performance on a "once per ...." basis. The 25% extension applies to each performance after the initial performance. The initial performance of the Required Action, whether it is a particular Surveillance or some other remedial action, is considered a single action with a single Completion Time. One reason for not allowing the 25% extension to this Completion Time is that such an action usually verifies that no loss of function has occurred by checking the status of redundant or diverse components or accomplishes the function of the affected equipment in an alternative manner.

The provisions of SR 3.0.2 are not intended to be used repeatedly merely as an operational convenience to extend Surveillance intervals or periodic Completion Time intervals beyond those specified.

(continued)

BASES (continued)

SR 3.0.3

SR 3.0.3 establishes the flexibility to defer declaring affected equipment as not meeting the LCO or an affected variable outside the specified limits when a Surveillance has not been completed within the specified Frequency. A delay period of up to 24 hours or up to the limit of the specified Frequency, whichever is less, applies from the point in time that it is discovered that the Surveillance has not been performed in accordance with SR 3.0.2, and not at the time that the specified frequency was not met.

This delay period provides adequate time to complete Surveillances that have been missed. This delay period permits the completion of a Surveillance before complying with Required Actions or other remedial measures that might preclude completion of the Surveillance.

The basis for this delay period includes consideration of facility conditions, adequate planning, availability of personnel, the time required to perform the Surveillance, the safety significance of the delay in completing the required Surveillance, and the recognition that the most probable result of any particular Surveillance being performed is the verification of conformance with the requirements. When a Surveillance with a Frequency based not on time intervals, but upon specified facility conditions, is discovered not to have been performed when specified, SR 3.0.3 allows the full delay period of 24 hours to perform the Surveillance.

SR 3.0.3 also provides a time limit for completion of Surveillances that become applicable as a consequence of changes in the specified conditions in the Applicability imposed by the Required Actions.

Failure to comply with specified Frequencies for SRs is expected to be an infrequent occurrence. Use of the delay period established by SR 3.0.3 is a flexibility, which is not intended to be used as an operational convenience to extend Surveillance intervals.

If a Surveillance is not complete within the allowed delay period, then the equipment is considered to not meet the LCO or the variable is considered outside the specified limits and the Completion Times of the Required Actions for the applicable LCO Conditions begin immediately upon expiration of the delay period. If a Surveillance is failed within the delay period, then the equipment does not meet the LCO, or the variable is outside the specified limits and the Completion Times of the Required Actions for the applicable LCO Conditions begin immediately upon the failure of the Surveillance.

Completion of the Surveillance within the delay period allowed by this Specification, or within the Completion Time of the ACTIONS, restores compliance with SR 3.0.1.

(continued)

BASES (continued)

SR 3.0.4

SR 3.0.4 establishes the requirement that all applicable SRs must be met before entry into a specified condition in the Applicability.

This Specification ensures that system and component requirements and variable limits are met before entry into specified conditions in the Applicability for which these systems and components ensure safe operation of the facility.

The provisions of this Specification should not be interpreted as endorsing the failure to exercise the good practice of restoring systems or components before entering an associated specified condition in the Applicability.

However, in certain circumstances, failing to meet an SR will not result in SR 3.0.4 restricting a change in specified condition. When a system, subsystem, division, component, device, or variable is outside the specified limits, the associated SR(s) are not required to be performed per SR 3.0.1, which states that Surveillances do not have to be performed on equipment that has been determined to not meet the LCO. When equipment does not meet the LCO, SR 3.0.4 does not apply to the associated SR(s) since the requirement for the SR(s) to be performed is removed. Therefore, failing to perform the Surveillance(s) within the specified Frequency does not result in an SR 3.0.4 restriction to changing specified conditions of the Applicability. However, since the LCO is not met in this instance, LCO 3.0.4 will govern any restrictions that may (or may not) apply to specified condition changes.

The provisions of SR 3.0.4 shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS.

The precise requirements of performance of SRs are specified such that exceptions to SR 3.0.4 are not necessary. The specific time frames and conditions necessary for meeting the SRs are specified in the Frequency, in the Surveillance, or both. This allows performance of Surveillances when the prerequisite condition(s) specified in a Surveillance procedure require entry into the specified condition in the Applicability of the associated LCO prior to the performance or completion of a Surveillance. A Surveillance that could not be performed until after entering the LCO Applicability would have its Frequency specified such that it is not "due" until the specific conditions needed are met. Alternately, the Surveillance may be stated in the form of a Note as not required (to be met or performed) until a particular event, condition, or time has been reached. Further discussion of the specific formats of SRs annotation is found in Diablo Canyon ISFSI Technical Specification Section 1.4, Frequency.

B 3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

B 3.1.1 Multi-Purpose Canister (MPC)

BASES

BACKGROUND

A TRANSFER CASK with an empty MPC is placed in the spent fuel pool and loaded with fuel assemblies meeting the requirements TS Section 2.0 Approved Contents. A lid is then placed on the MPC. An MPC lid retention device is placed over the lid and attached to the TRANSFER CASK. The TRANSFER CASK and MPC are raised to the top of the spent fuel pool surface. The TRANSFER CASK and MPC are then moved into the cask washdown area where dose rates are measured and the MPC lid is welded to the MPC shell and the welds are inspected and tested. The water is drained from the MPC cavity and moisture removal performed. The MPC cavity is backfilled with helium. Additional dose rates are measured and the MPC vent and drain cover plates and closure ring are installed and welded. Inspections are performed on the welds.
MPC cavity moisture removal using forced helium recirculation is performed to remove residual moisture from the MPC fuel cavity after the MPC has been drained of water. Dry gas introduced to the MPC cavity through the vent and drain port absorbs the residual moisture in the MPC. This humidified gas exits the MPC via the other port and the absorbed water is removed through condensation and/or mechanical drying. The dried helium is then forced back though the MPC until the temperature acceptance limit is met.

After the completion of moisture removal, the MPC cavity is backfilled with helium meeting the backfill pressure requirements of the LCO.

Backfilling of the MPC fuel cavity with helium promotes gaseous heat dissipation and the inert atmosphere protects the fuel cladding. Providing a helium pressure in the required range at room temperature (70° F), eliminates air in-leakage over the life of the MPC because the cavity pressure rises due to heat up of the confined gas by the fuel decay heat during storage.

In-leakage of air could be harmful to the fuel. Prior to moving the SFSC to the storage pad, the MPC helium leak rate is determined to ensure that the fuel is confined.

(continued)

BASES (continued)

APPLICABLE SAFETY ANALYSIS	The confinement of radioactivity during the storage of spent fuel in the MPC is ensured by the multiple confinement boundaries and systems. The barriers relied on are the fuel pellet matrix, the metallic fuel cladding tubes in which the fuel pellets are contained, and the MPC in which the fuel assemblies are stored. Long-term integrity of the fuel and cladding depend on storage in an inert atmosphere. This is accomplished by removing water from the MPC and backfilling the cavity with an inert gas. The thermal analyses of the MPC assume that the MPC cavity is filled with dry helium of a minimum quality to ensure the assumptions used for convection heat transfer are preserved. Keeping the backfill pressure below the maximum value preserves the initial condition assumptions made in the MPC over-pressurization evaluation.
LCO	A dry, helium filled and sealed MPC establishes an inert heat removal environment necessary to ensure the integrity of the multiple confinement boundaries. Moreover, it also ensures that there will be no air in-leakage into the MPC cavity that could damage the fuel cladding over the storage period.
APPLICABILITY	The dry, sealed and inert atmosphere is required to be in place during TRANSPORT OPERATIONS and STORAGE OPERATIONS to ensure both the confinement barriers and heat removal mechanisms are in place during these operating periods. These conditions are not required during LOADING OPERATIONS or UNLOADING OPERATIONS as these conditions are being established or removed, respectively during these periods in support of other activities being performed with the stored fuel.
ACTIONS	A note has been added to the ACTIONS, which states that, for this LCO, separate Condition entry is allowed for each MPC. This is acceptable since the Required Actions for each Condition provide appropriate compensatory measures for each MPC not meeting the LCO. Subsequent MPCs that do not meet the LCO are governed by subsequent Condition entry and application of associated Required Actions. <u>A.1</u> If the demoisturizer exit gas temperature limit has been determined not to be met during TRANSPORT OPERATIONS or STORAGE OPERATIONS, an engineering evaluation is necessary to determine the potential quantity of moisture left within the MPC cavity. Since moisture remaining in the cavity during these modes of operation may represent a long-term degradation concern, immediate action is not necessary. The Completion Time is sufficient to complete the engineering evaluation commensurate with the safety significance of the CONDITION.

(continued)

BASES (continued)

A.2

Once the quantity of moisture potentially left in the MPC cavity is determined, a corrective action plan shall be developed and actions initiated to the extent necessary to return the MPC to an analyzed condition. Since the quantity of moisture estimated under Required Action A.1 can range over a broad scale, different recovery strategies may be necessary. Since moisture remaining in the cavity during these modes of operation may represent a long-term degradation concern, immediate action is not necessary. The Completion Time is sufficient to develop and initiate the corrective actions commensurate with the safety significance of the CONDITION.

B.1

If the helium backfill pressure limit has been determined not to be met during TRANSPORT OPERATIONS or STORAGE OPERATIONS, an engineering evaluation is necessary to determine the quantity of helium within the MPC cavity. Since too much or too little helium in the MPC during these modes represents a potential overpressure or heat removal degradation concern, an engineering evaluation shall be performed in a timely manner. The Completion Time is sufficient to complete the engineering evaluation commensurate with the safety significance of the CONDITION.

B.2

Once the quantity of helium in the MPC cavity is determined, a corrective action plan shall be developed and initiated to the extent necessary to return the MPC to an analyzed condition. Since the quantity of helium estimated under Required Action B.1 can range over a broad scale, different recovery strategies may be necessary. Since elevated or reduced helium quantities existing in the MPC cavity represent a potential overpressure or heat removal degradation concern, corrective actions should be developed and implemented in a timely manner. The Completion Time is sufficient to develop and initiate the corrective actions commensurate with the safety significance of the CONDITION.

(continued)

BASES (continued)

C.1

If the helium leakrate limit for vent and drain port cover plate welds have been determined not to be met during TRANSPORT OPERATIONS or STORAGE OPERATIONS, an engineering evaluation is necessary to determine the impact of increased helium leak rate on heat removal and off-site dose. Since the HI-STORM OVERPACK is a ventilated system, any leakage from the MPC is transported directly to the environment. Since an increased helium leak rate represents a potential challenge to MPC heat removal and the off-site doses calculated in the SAR confinement analyses, reasonably rapid action is warranted. The Completion Time is sufficient to complete the engineering evaluation commensurate with the safety significance of the CONDITION.

C.2

Once the cause and consequences of the elevated leak rate from the MPC vent and drain port cover plate welds are determined, a corrective action plan shall be developed and initiated to the extent necessary to return the MPC vent and drain port cover plate welds to an analyzed condition. Since the recovery mechanisms can range over a broad scale based on the evaluation performed under Required Action C.1, different recovery strategies may be necessary. Since an elevated helium leak rate represents a challenge to heat removal rates and off-site doses, reasonably rapid action is required. The Completion Time is sufficient to develop and initiate the corrective actions commensurate with the safety significance of the CONDITION.

D.1

If the MPC fuel cavity cannot be successfully returned to a safe, analyzed condition, the fuel must be placed in a safe condition in the spent fuel pool. The Completion Time is reasonable based on the time required to perform fuel cooldown operations, re-flood the MPC, cut the MPC lid welds, move the TRANSFER CASK into the spent fuel pool, remove the MPC lid, and remove the spent fuel assemblies in an orderly manner and without challenging personnel.

(continued)

SURVEILLANCE REQUIREMENTS	SR 3.1.1.1, SR 3.1.1.2, and SR 3.1.1.3

SURVEILLANCE REQUIREMENTS

SR 3.1.1.1, SR 3.1.1.2, and SR 3.1.1.3

The long-term integrity of the stored fuel is dependent on storage in a dry, inert environment. Fuel cavity dryness is demonstrated by recirculating dry helium through the MPC cavity to absorb moisture until the demoisturizer exit temperature reaches and remains below the acceptance limit for the specified time period. A low demoisturizer exit temperature meeting the acceptance limit is an indication that the cavity is dry.

Having the proper helium backfill pressure ensures adequate heat transfer from the fuel to the fuel basket and surrounding structure of the MPC. Meeting the helium leak rate limit ensures there is adequate helium in the MPC for long term storage and the leak rate assumed in the confinement analyses remains bounding for off-site dose.

The leakage rate acceptance limit is a mass-like leakage rate as specified in ANSI N14.5 (1997). This is defined as the rate of change of the pressure-volume product of the leaking fluid at test conditions. This allows the leakage rate as measured by a mass spectrometer leak detector (MSLD) to be compared directly to the acceptance limit without the need for unit conversion from test conditions to standard, or reference conditions.

All three of these surveillances must be successfully performed once, prior to TRANSPORT OPERATIONS to ensure that the conditions are established for SFSC storage, which preserve the analysis basis supporting the cask design.

(continued)

REFERENCES

1. Diablo Canyon ISFSI SAR Sections 3.1.2, and 3.3.1.7
2. Diablo Canyon ISFSI SAR Section 4.2.3.3 and Table 4.5-1
3. Diablo Canyon ISFSI SAR Section 5.1.1.2 and Table 5.1-1
4. Diablo Canyon ISFSI SAR Sections 7.5.2.1 and Table 7.4-1
5. Diablo Canyon ISFSI SAR Section 8.2.7.2.2
6. Diablo Canyon ISFSI SAR Sections 10.2.2.3, 10.2.2.4, 10.2.2.5 and Figure 10.2-4.

(continued)

B 3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

B 3.1.2 Spent Fuel Storage Cask (SFSC) Heat Removal System

BASES

BACKGROUND	The SFSC heat removal system is a passive, air-cooled, convective heat transfer system that ensures heat from the MULTI-PURPOSE CANISTER (MPC) is transferred to the environs by the chimney effect. Relatively cool air is drawn into the annulus between the OVERPACK and the MPC through the four inlet air ducts at the bottom of the OVERPACK. The MPC transfers its heat from the canister surface to the air via natural convection. The buoyancy created by the heating of the air creates a chimney effect and the air is forced back into the environs through the four outlet air ducts at the top of the OVERPACK.
APPLICABLE SAFETY ANALYSIS	The thermal analyses of the SFSC take credit for the decay heat from the spent fuel assemblies being ultimately transferred to the ambient environment surrounding the SFSC. Transfer of heat away from the fuel assemblies ensures that the fuel cladding and other SFSC component temperatures do not exceed applicable limits. Under normal storage conditions, the four inlet and four outlet air ducts are unobstructed and full air flow (i.e., maximum heat transfer for the given ambient temperature) occurs. Analyses have been performed for the complete obstruction of two, three, and four inlet air ducts. Blockage of two inlet air ducts reduces airflow through the OVERPACK annulus and decreases heat transfer from the MPC. Under this off-normal condition, no SFSC components exceed the short-term temperature limits. Blockage of three inlet air ducts further reduces airflow through the OVERPACK annulus and decreases heat transfer from the MPC. Under this accident condition, no SFSC components exceed the short-term temperature limits. The complete blockage of all four inlet air ducts stops air-cooling of the MPC. The MPC will continue to radiate heat to the relatively cooler inner shell of the OVERPACK. With the loss of air-cooling, the SFSC component temperatures will increase toward their respective short-term temperature limits. None of the components reach their temperature limits over the 32-hour duration of the analyzed event. Therefore, the limiting component is assumed to be the fuel cladding.

(continued)

BASES (continued)

LCO	The SFSC heat removal system must be verified to be operable to preserve the assumptions of the thermal analyses. Operability is defined as at least 50% of the inlet air ducts available for air flow (i.e., unblocked).The operability of the heat removal system ensures that the decay heat generated by the stored fuel assemblies is transferred to the environs at a sufficient rate to maintain fuel cladding and other SFSC component temperatures within design limits.
APPLICABILITY	The LCO is applicable during STORAGE OPERATIONS. Once an OVERPACK containing an MPC loaded with approved contents has been placed in storage, the heat removal system must be operable to ensure adequate heat transfer of the decay heat away from the fuel assemblies.
ACTIONS	A note has been added to the ACTIONS, which states that for this LCO, separate condition entry is allowed for each SFSC. This is acceptable since the Required Actions for each condition provide appropriate compensatory measures for each SFSC not meeting the LCO. Subsequent SFSCs that don't meet the LCO are governed by subsequent condition entry and application of associated Required Actions. <u>A.1</u> Although the heat removal system remains operable, the blockage should be cleared expeditiously. <u>B.1</u> If the heat removal system has been determined to be inoperable, it must be restored to operable status within 8 hours. Eight hours is reasonable period of time (typically, one operating shift) to take action to remove the obstructions in the air flow path.

(continued)

BASES

ACTIONS
(continued)

C.1

If the heat removal system cannot be restored to operable status within eight hours, the innermost portion of the OVERPACK concrete may experience elevated temperatures. Therefore, dose rates are required to be measured to verify the effectiveness of the radiation shielding provided by the concrete. This Action must be performed immediately and repeated every twelve hours thereafter to provide timely and continued evaluation of the effectiveness of the concrete shielding. As necessary, the cask user shall provide additional radiation protection measures such as temporary shielding. The Completion Time is reasonable considering the expected slow rate of deterioration, if any, of the concrete under elevated temperatures.

C.2.1

In addition to Required Action C.1, efforts must continue to restore cooling to the SFSC. Efforts must continue to restore the heat removal system to operable status by removing the air flow obstruction(s) unless optional Required Action C.2.2 is being implemented. This Required Action must be complete in 24 hours. These Completion Times are consistent with the thermal analyses of this event, which show that all component temperatures remain below their short-term temperature limits up to 32 hours after event initiation.

The Completion Time reflects the 8 hours to complete Required Action B.1 and the appropriate balance of time consistent with the applicable analysis results. The event is assumed to begin at the time the SFSC heat removal system is declared inoperable. This is reasonable considering the low probability of all inlet ducts becoming simultaneously blocked by trash or debris.

C.2.2

In lieu of implementing Required Action C.2.1, transfer of the MPC into a TRANSFER CASK will place the MPC in an analyzed condition and ensure adequate fuel cooling until actions to correct the heat removal system inoperability can be completed. Transferring the affected MPC from the inoperable SFSC to the TRANSFER CASK will place the MPC in an analyzed condition. The TRANSFER CASK has adequate heat removal capability to ensure that the short-term fuel cladding temperature limit is not exceeded.

Transfer of the MPC into a TRANSFER CASK removes the SFSC from the LCO applicability. STORAGE OPERATIONS does not include time restrictions when the MPC resides in the TRANSFER CASK because of adequate heat transfer in this configuration to maintain peak fuel cladding temperature well below the short term limit. In this case, the requirements of LCO 3.1.4 apply.

An engineering evaluation must be performed to determine if any concrete deterioration has occurred which prevents it from performing its design function. If the evaluation is successful and the air flow obstructions have been cleared, the OVERPACK heat removal system may be considered operable and the MPC transferred back into the OVERPACK. Compliance with LCO 3.1.2 is then restored. If the evaluation is unsuccessful, the user must transfer the MPC into a different, fully qualified OVERPACK to resume STORAGE OPERATIONS and restore compliance with LCO 3.1.2

In lieu of performing the engineering evaluation, the user may opt to proceed directly to transferring the MPC into a different, fully qualified OVERPACK or place the TRANSFER CASK in the spent fuel pool and unload the MPC. The Completion Time of 24 hours reflect the Completion Times from Required Action C.2.1 to ensure component temperatures remain below their short-term temperature limits for the respective decay heat loads.

(continued)

BASES

SURVEILLANCE REQUIREMENTS	SR 3.1.2 The long-term integrity of the stored fuel is dependent on the ability of the SFSC to reject heat from the MPC to the environment. Visual observation that all four inlet and outlet air ducts are unobstructed and intact ensures that airflow past the MPC is occurring and heat transfer is taking place. Blockage of 50% or greater of the total inlet or outlet air duct area renders the heat removal system inoperable and this LCO not met. Less than 50% blockage of the total inlet or outlet air duct area does not constitute inoperability of the heat removal system. However, corrective actions should be taken promptly to remove the obstruction and restore full flow through the affected duct(s). The Frequency of 24 hours is reasonable based on the time necessary for SFSC components to heat up to unacceptable temperatures assuming design basis heat loads, and allowing for corrective actions to take place upon discovery of blockage of air ducts.
REFERENCES	7. Diablo Canyon ISFSI SAR Section 3.4, Table 3.4-2 8. Diablo Canyon ISFSI SAR Section 4.4 9. Diablo Canyon ISFSI SAR Sections 7.1, 7.2, and 7.3 10. Diablo Canyon ISFSI SAR Section 8.1 11. Diablo Canyon ISFSI SAR Sections 8.2.11, 8.2.12, and 8.2.15

B 3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

B 3.1.3 Fuel Cool-Down

BASES

BACKGROUND	In the event that an MPC must be unloaded, the TRANSFER CASK with its enclosed MPC is returned to the cask preparation area to begin the process of fuel unloading. The MPC closure ring, and vent and drain port cover plates are removed. The MPC gas is sampled to determine the integrity of the spent fuel cladding. The MPC is attached to the Cool-Down System. The Cool-Down System is a closed-loop forced ventilation gas cooling system that cools the fuel assemblies by cooling the surrounding helium gas. Following fuel cool-down, the MPC is then re-flooded with water and the MPC lid weld is removed leaving the MPC lid in place. The transfer cask and MPC are placed in the spent fuel pool and the MPC lid is removed. The fuel assemblies are removed from the MPC and the MPC and transfer cask are removed from the spent fuel pool and decontaminated. Reducing the fuel cladding temperatures significantly reduces the temperature gradients across the cladding thus minimizing thermally-induced stresses on the cladding during MPC re-flooding. Reducing the MPC internal temperatures eliminates the risk of high MPC pressure due to sudden generation of steam during re-flooding.
APPLICABLE SAFETY ANALYSIS	The confinement of radioactivity during the storage of spent fuel in the MPC is ensured by the multiple confinement boundaries and systems. The barriers relied on are the fuel pellet matrix, the metallic fuel cladding tubes in which the fuel pellets are contained, and the MPC in which the fuel assemblies are stored. Long-term integrity of the fuel and cladding depend on minimizing thermally induced stresses to the cladding. This is accomplished during the unloading operations by lowering the MPC internal temperatures prior to MPC re-flooding. The Integrity of the MPC depends on maintaining the internal cavity pressures within design limits. This is accomplished by reducing the MPC internal temperatures such that there is no sudden formation of steam during MPC re-flooding.

(continued)

BASES (continued)

LCO	Monitoring the circulating MPC gas exit temperature ensures that there will be no large thermal gradient across the fuel assembly cladding during re-flooding which could be potentially harmful to the cladding. The temperature limit specified in the LCO was selected to ensure that the MPC gas exit temperature will closely match the desired fuel cladding temperature prior to re-flooding the MPC. The temperature was selected to be lower than the boiling temperature of water with an additional margin.
APPLICABILITY	The MPC helium gas exit temperature is measured during UNLOADING OPERATIONS after the transfer cask and integral MPC are back in the fuel building and are no longer suspended from, or secured in, the transporter. Therefore, the Fuel Cool-Down LCO does not apply during TRANSPORT OPERATIONS and STORAGE OPERATIONS. A note has been added to the APPLICABILITY for LCO 3.1.3 which states that the Applicability is only applicable during wet UNLOADING OPERATIONS. This is acceptable since the intent of the LCO is to avoid uncontrolled MPC pressurization due to water flashing during re-flooding operations. This is not a concern for dry UNLOADING OPERATIONS.
ACTIONS	A note has been added to the ACTIONS which states that, for this LCO, separate Condition entry is allowed for each MPC. This is acceptable since the Required Actions for each Condition provide appropriate compensatory measures for each MPC not meeting the LCO. Subsequent MPCs that do not meet the LCO are governed by subsequent Condition entry and application of associated Required Actions. <u>A.1</u> If the MPC helium gas exit temperature limit is not met, actions must be taken to restore the parameters to within the limits before re-flooding the MPC. Failure to successfully complete fuel cool-down could have several causes, such as failure of the cool down system, inadequate cool down, or clogging of the piping lines. The Completion Time is sufficient to determine and correct most failure mechanisms and proceeding with activities to flood the MPC cavity with water are prohibited.

(continued)

BASES (continued)

A.2

If the LCO is not met, in addition to performing Required Action A.1 to restore the gas temperature to within the limit, the user must ensure that the proper conditions exist for the transfer of heat from the MPC to the surrounding environs to ensure the fuel cladding remains below the short term temperature limit.

Ensure the annulus between the MPC and the TRANSFER CASK is filled with water. This places the system in a heat removal configuration which is bounded by the FSAR thermal evaluation of the system considering a vacuum in the MPC. The system is open to the ambient environment which limits the temperature of the ultimate heat sink (the water in the annulus) and, therefore, the MPC shell to 212°F.

Twenty-two (22) hours is an acceptable time frame to allow for completion of Required Action A.2 and is conservatively based on a thermal evaluation of a TRANSFER CASK located in a pit or vault. In such a configuration, passive cooling mechanisms will be largely diminished. Eliminating 90 percent of the passive cooling mechanisms with the cask emplaced in the vault, the thermal inertia of the cask (approximately 20,000 Btu/°F) will limit the rate of temperature rise with design basis maximum heat load to approximately 4.5°F per hour. Thus, the fuel cladding temperature rise in 22 hours will be less than 100°F. Large short term temperature margins exist to preclude any cladding integrity concerns under this temperature rise.

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1

The long-term integrity of the stored fuel is dependent on the material condition of the fuel assembly cladding. By minimizing thermally-induced stresses across the cladding the integrity of the fuel assembly cladding is maintained. The integrity of the MPC is dependent on controlling the internal MPC pressure. By controlling the MPC internal temperature prior to re-flooding the MPC there is no formation of steam during MPC re-flooding.

The MPC helium exit gas temperature limit ensures that there will be no large thermal gradients across the fuel assembly cladding during MPC re-flooding and no formation of steam which could potentially overpressurize the MPC.

Fuel cool down must be performed successfully on each SFSC before the initiation of MPC re-flooding operations to ensure the design and analysis basis are preserved.

(continued)

BASES (continued)

REFERENCES	12. Diablo Canyon ISFSI SAR Sections 4.2.3.3.3, 4.4.1, and 4.4.1.2.6
	13. Diablo Canyon ISFSI SAR Table 5.1-1
	14. Diablo Canyon ISFSI Sections 9.4.1.1.2 and 9.4.1.1.4
	15. Diablo Canyon ISFSI SAR Sections 10.2.3, 10.2.3.1 and 10.2.3.6

B 3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

B 3.1.4 Supplemental Cooling System

BACKGROUND	The Supplemental Cooling System (SCS) is an active cooling system that provides augmented heat removal from the MPC to ensure high burnup fuel cladding temperatures remain below the applicable ISG-11, Rev. 3 limit during onsite transport operations in the TRANSFER CASK. The system is required for all MPCs meeting the burnup, and TRANSFER CASK orientation combinations specified in the Applicability of the LCO.
APPLICABLE SAFETY ANALYSIS	The thermal analyses of the MPC inside the TRANSFER CASK take credit for the operation of the SCS under certain conditions to ensure that the spent fuel cladding temperature remains below the applicable limit. For MPCs containing all moderate burnup fuel ($\leq$ 45,000 MWD/MTU), SCS operation is not required, because the fuel cladding temperature cannot exceed the limit of 1058°F for moderate burnup fuel. For high burnup fuel, the fuel cladding temperature limit is 400°C (752°F) during onsite transportation. For helium filled MPCs containing one or more high burnup fuel assemblies, the SCS has been credited in the thermal analysis in order to meet the lower fuel cladding temperature limit.
LCO	The Supplemental Cooling System must be operable if the MPC/TRANSFER cask assemblage meets one of the following conditions in the Applicability portion of the LCO in order to preserve the assumptions made in the thermal analysis.
APPLICABILITY	When an MPC containing at least one high burnup (greater than 45,000 MWD/MTU) fuel assembly is in the TRANSFER CASK, the SCS needs to be put in service within 4 hours when another mechanism for maintaining the fuel cladding less than 400°C is not available. During LOADING OPERATIONS this would be 4 hours after securing the FHD system, following blowdown of the bulk water from the MPC. During UNLOADING OPERATIONS the SCS needs to be placed in service within 4 hours of transferring the MPC into the Transfer Cask. A Note has been added allowing the SCS to be interrupted for up to 7 hours to allow for normal operational evolutions, such as placing the MPC on the Mating device for download or transport on the LPT, provided steady state operation of the supplemental cooling system had been established.

(continued)

BASES (continued)

ACTIONS

A.1

If the SCS has been determined to be inoperable, the thermal analysis shows that the fuel cladding temperature would not exceed the short term temperature limit applicable to an offnormal condition, even with no water in the TRANSFER CASK-to-MPC annulus. Actions should be taken to restore the SCS to operable status in a timely manner. Because the thermal analysis is a steady-state analysis, there is an indefinite period of time available to make repairs to the SCS. However, it is prudent to require the actions to be completed in a reasonably short period of time. A Completion Time of 7 days is considered appropriate and a reasonable amount of time to plan the work, obtain needed parts, and execute the work in a controlled manner.

B.1

If, after 7 days, the SCS cannot be restored to operable status, actions should be taken to remove the fuel assemblies from the MPC and place them back into the spent fuel pool storage racks. Thirty days is considered a reasonable time frame given that the MPC will be adequately cooled while this action is being planned and implemented, and certain equipment for this infrequent evolution (e.g., weld cutting machine) may take some time to acquire.

SURVEILLANCE REQUIREMENTS

SR 3.1.4

The long-term integrity of the stored fuel is dependent on the ability of the SFSC to reject heat from the MPC to the environment, including during short-term evolutions such as on-site transportation in the TRANSFER CASK. The SCS is required to ensure adequate fuel cooling in certain cases. The SCS should be verified to be operable every two hours. This is a reasonable Frequency given the typical oversight occurring during the onsite transportation evolution, the duration of the evolution, and the simple equipment involved.

REFERENCES

16. Diablo Canyon ISFSI FSAR Section 4.3
17. Diablo Canyon ISFSI SAR Section 4.5
18. Diablo Canyon ISFSI SAR Sections 5.1
19. Diablo Canyon ISFSI SAR Section 8.2.17
20. Diablo Canyon ISFSI FSAR Section 10.2.2.7

B 3.2 SPENT FUEL STORAGE CASK (SFSC) CRITICALITY CONTROL

B 3.2.1 Dissolved Boron Concentration

BASES

BACKGROUND

A TRANSFER CASK with an empty MULTI-PURPOSE CANISTER (MPC) is placed in the spent fuel pool (SFP) and loaded with fuel assemblies and associated NONFUEL HARDWARE meeting the requirements of Section 2.0, Approved Contents.

After loading the MPC, an MPC lid is placed on the MPC along with a lid retention device attached to the TRANSFER CASK. The TRANSFER CASK with the MPC inside is removed from the SFP to a washdown area. In the washdown area, the MPC lid is welded in place and the MPC is leak tested, drained, dried, and backfilled with helium. The TRANSFER CASK and accessible portions of the contained MPC are also surveyed to ensure that any radioactive contamination is within administrative limits.

For those MPCs containing fuel assemblies of relatively high initial enrichment, credit is taken in the criticality analyses for boron in the water within the MPC. To preserve the analysis basis, the dissolved boron concentration of the water in the MPC must be verified to meet specified limits when there is fuel and water in the MPC. This may occur during LOADING OPERATIONS and UNLOADING OPERATIONS.

A boron dilution analysis has been performed and submitted to the NRC in PG&E Letters DCL-03-150 and DIL-03-014 to determine the time available for operator action to ensure criticality does not occur in an MPC-32 during LOADING OPERATIONS and UNLOADING OPERATIONS. The analysis results show that operators have approximately 5 hours available to identify and terminate the source of unborated water flow from the limiting boron dilution event to ensure criticality in the MPC-32 does not occur. To minimize the possibility of a dilution event, a temporary administrative control will be implemented while the MPC is in the SFP that will require, with the exception of the 1-inch line used to rinse the cask as it is removed from the SFP, at least one valve in each potential flow path of unborated water to the SFP to be closed and tagged out. During the cask rinsing process, the MPC will have a lid in place that will minimize entry of any unborated water into the MPC. The flow path with the highest potential flow rate of 494 gpm will be doubly isolated by having two valves closed and tagged out while the MPC is in the SFP.

APPLICABLE SAFETY ANALYSIS

The spent nuclear fuel stored in the SFSC is required to remain subcritical ($k_{eff} \leq 0.95$) under all conditions of storage. The SFSC is analyzed to store a wide variety of spent nuclear fuel assembly types with differing initial enrichments and associated NONFUEL HARDWARE. For all allowed fuel loaded in the MPCs credit was taken in the criticality analyses for neutron poison in the form of soluble boron in the water within the MPC. Compliance with this LCO preserves the assumptions made in the criticality analyses regarding credit for soluble boron.

(continued)

BASES

LCO

Compliance with this LCO ensures that the stored fuel will remain subcritical with a $k_{eff} \leq 0.95$ while water is in the MPC. The LCO provides the minimum concentration of soluble boron required in the MPC water based on type of MPC and the initial enrichment of the fuel.

LCO 3.2.1.a provides the minimum concentration of soluble boron required in any of the MPCs if one or more fuel assemblies are loaded with an initial enrichment of ≤ 4.1 wt% U-235. LCO 3.2.1.b provides the minimum concentration of soluble boron required in MPC-24/24E/24EF if one or more fuel assemblies are loaded with an initial enrichment of > 4.1 wt% and ≤ 5.0 wt% U-235. LCO 3.2.1.c provides the minimum concentration of soluble boron required in MPC-32 if one or more fuel assemblies are loaded with a maximum initial enrichment of 5.0 wt% U-235.

A note has been added to the LCOs, which states that, "For MPC-32, with maximum initial enrichments between 4.1 wt% and 5.0 wt% ^{235}U, the minimum dissolved boron concentration may be determined by linear interpolation between 2000 ppmb at 4.1wt% and 2600 ppmb at 5.0 wt% ^{235}U, based on the assembly with the highest initial enrichment to be loaded." This linear interpolation is acceptable because the maximum multiplication factor is a near linear function of both enrichment and soluble boron concentration. This function demonstrates a saturation effect in which the reduction in reactivity for the same increase in the soluble boron concentration is reduced for higher soluble boron concentrations and that a linear interpolation results in a slight overestimation of the minimum soluble boron concentration required for the analyzed enrichments. This was accepted by the NRC with the approval of the Holtec HI-STORM 100 Cask System Certificate of Compliance, Amendment 3 and the associated safety evaluation report.

All INTACT FUEL ASSEMBLIES loaded into the MPC-24, MPC-24E, MPC-24EF, and MPC-32 are limited by analysis to maximum enrichments of 5.0 wt% U-235.

For all INTACT FUEL ASSEMBLIES loaded into an MPC that contains DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum initial enrichment of the INTACT FUEL ASSEMBLES is limited to the maximum initial enrichment of the DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS (i.e., 4.0 wt% U-235).

BASES (continued)

APPLICABILITY

The dissolved boron concentration LCO is applicable whenever an MPC-24, MPC-24E, MPC-24EF, or MPC-32 has at least one fuel assembly in a storage location and water in the MPC.

During LOADING OPERATIONS, the LCO is applicable immediately upon the loading of the first fuel assembly in the MPC. It remains applicable until the MPC is drained of water.

During UNLOADING OPERATIONS, the LCO is applicable when the MPC is reflooded with water after helium cool-down operations. Note that compliance with SR 3.0.4 ensures that the water to be used to flood the MPC is of the correct dissolved boron concentration to ensure the LCO is met upon entering the Applicability.

ACTIONS

A note has been added to the ACTIONS, which states that, for this LCO, separate condition entry is allowed for each MPC. This is acceptable since the Required Actions for each condition provide appropriate compensatory measures for each MPC not meeting the LCO. Subsequent MPCs that do not meet the LCO are governed by subsequent condition entry and application of associated Required Actions.

A.1 and A2

Continuation of LOADING OPERATIONS, UNLOADING OPERATIONS or positive reactivity additions (including ACTIONS to reduce dissolved boron concentration) is contingent upon maintaining the MPC in compliance with the LCO. If the dissolved boron concentration of water in the MPC is less than its limit, LOADING OPERATIONS or UNLOADING OPERATIONS, and any positive reactivity additions must be suspended immediately. Inherent in the required action to stop these activities is the requirement to place any in progress activity, such as the movement of a fuel assembly, in a safe condition.

A.3

In addition to immediately suspending LOADING OPERATIONS or UNLOADING OPERATIONS, and any positive reactivity additions, action to restore the concentration to within the limit specified in the LCO must be initiated immediately.

One means of complying with this action is to initiate boration of the affected MPC. In determining the required combination of boration flow rate and concentration, there is no unique design bases event that must be satisfied; only that boration be initiated without delay. In order to raise the boron concentration as quickly as possible, the operator should begin boration with the best source available for existing plant conditions. The methods available for boration should include, but not be limited to, direct boration of the MPC or boration of the SFP if the MPC is located in the pool at the time.

Once boration is initiated, it must be continued until the boron concentration is restored. The restoration time depends on the amount of boron that must be injected to reach the required concentration.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.2.1.1

When the MPC is placed in the SFP the dissolved boron concentration in the MPC water must be verified by two independent measurements to be within the applicable limit within 4 hours prior to entering the applicability of the LCO. For LOADING OPERATIONS, this means within 4 hours prior to loading any approved content into the cask.

The use of two independent measurements provides reasonable assurance that the dissolved boron LCO limit is met and maintained. The 4 hours limitation is considered a reasonably short time period which minimizes any potential for changes in the critical dissolved boron concentration prior to loading and still allows flexibility in the operation. Once the dissolved boron concentration has been verified a change in this concentration is not credible unless there is some action specifically taken to modify it. During the period between verification and loading all changes in water volume including additions or subtractions in the SFP or MPC; recirculation of water through the MPC; or the addition or dilution of the dissolved boron concentration in the SFP or MPC to be loaded, will be administratively controlled. If any of these actions or operations takes place during the 4-hour period, the dissolved boron concentration will be re-verified to be within limits prior to loading any authorized contents in the MPC.

In addition, while the MPC is in the SFP the boron concentration will continue to be verified to be within the applicable limits every 48 hours. This reflects the premise that normally there is no real need to re-verify the boron concentration of the water in the MPC after it is removed from the SFP unless water is to be added to, or recirculated through the MPC, because these are the only credible activities that could potentially change the dissolved boron concentration during this time. The 48-hour Completion Time for the re-verification is infrequent enough to prevent the interference of unnecessary sampling activities. However, it is often enough to ensure that any change in the concentration for any reason is detected in a reasonable time to take proper action. Plant procedures shall specifically ensure that any water to be added to, or recirculated through the MPC is at a dissolved boron concentration greater than or equal to the minimum boron concentration specified in the LCO.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.2.1.1 (continued)

SR 3.2.1.1 is modified by a note which states that SR 3.2.1.1 is only required to be performed if the MPC is submerged in water or if water is to be added or recirculated through the MPC. This reflects the premise of this SR which is to ensure, once the correct boron concentration is established, it need only be verified thereafter if the MPC is in a state where the concentration could be changed. Once the MPC is removed from the spent fuel pool, adding water to the MPC or recirculating water through the MPC are the only credible activities that could potentially change the boron concentration. This note prevents unnecessary sampling activities during lid closure welding and other MPC storage preparation activities in an elevated radiation area atop the MPC.

Plant procedures shall ensure that any water to be added to or recirculated through the MPC is at a boron concentration greater than or equal to the minimum boron concentration specified in the LCO for the approved content of the MPC.

SR 3.2.1.2

For UNLOADING OPERATIONS, this means verifying the source of borated water to be used to reflood the MPC within 4 hours prior to commencing reflooding operations. This ensures that when the LCO is applicable (upon introducing water into the MPC), the LCO will be met.

The use of two independent measurements provides reasonable assurance that the dissolved boron LCO limit is met and maintained in the source of water. The 4 hours limitation is considered a reasonably short time period which minimizes any potential for changes in the critical dissolved boron concentration in the source of water prior to introduction into the MPC and still allows flexibility in the operation. Once the dissolved boron concentration has been verified a change in this concentration is not credible unless there is some action specifically taken to modify it. During the period between verification and introducing the water into the MPC all changes in water source or volume including additions or subtractions in the source; or the addition or dilution of the dissolved boron concentration in the source will be administratively controlled. If any of these actions or operations takes place during the 4-hour period, the dissolved boron concentration in the source water will be re-verified prior to introducing any water into the MPC to be unloaded.

In addition, while the MPC to be unloaded is in the SFP the dissolved boron concentration will continue to be verified to be within the applicable limits every 48 hours. This reflects the premise that normally there is no real need to re-verify the dissolved boron concentration of the water in the MPC unless water is to be added to, or recirculated through the MPC, because these are the only credible activities that could potentially change the dissolved boron concentration during this time.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.2.1.2 (continued)

The 48-hour Completion Time for the re-verification is infrequent enough to prevent the interference of unnecessary sampling activities while MPC UNLOADING OPERATIONS are taking place in an elevated radiation area atop the MPC. However, it is often enough to ensure that any change in the concentration for any reason is detected in a reasonable time to take proper action. Plant procedures shall specifically ensure that any water to be added to, or recirculated through the MPC is at a dissolved boron concentration is greater than or equal to the minimum dissolved boron concentration specified in the LCO.

SR 3.2.1.2 is modified by a note which states that SR 3.2.1.2 is only required to be performed if the MPC is submerged in water or if water is to be added or recirculated through the MPC. This reflects the premise of this SR which is to ensure, once the correct boron concentration is established, it need only be verified thereafter if the MPC is in a state where the concentration could be changed. During the unloading process the MPC is refilled with borated water while it is outside of the spent fuel pool. During this process the boron concentration will be verified to meet the TS limits. Once the boron concentration is verified the addition of water to the MPC, or the recirculation of the water through the MPC are the only credible activites that could potentially change the boron concentration. As a result, continued surveillance per SR 3.2.1.2 is unnecessary. Once the MPC is placed back into the spent fuel pool verification will continue under SR 3.2.1.2.

Plant procedures shall ensure that any water to be added to, or recirculated through the MPC is at a boron concentration greater than or equal to the minimum boron concentration specified in the LCO for the approved content of the MPC.

REFERENCES

1. Diablo Canyon ISFSI SAR Section 4.2

CHAPTER 1

INTRODUCTION AND GENERAL DESCRIPTION

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CHAPTER 1

INTRODUCTION AND GENERAL DESCRIPTION

Pursuant to 10 CFR 72, the Nuclear Regulatory Commission (NRC) issued Materials License SNM-2511 to PG&E on March 22, 2004, authorizing PG&E to build and operate the Diablo Canyon Independent Spent Fuel Storage Installation (ISFSI). The license was issued for a period of 20 years in accordance with 10 CFR 72.42. This Final Safety Analysis Report (FSAR) Update is issued by PG&E and will be updated periodically in accordance with the provisions of 10 CFR 72.70.

This FSAR chapter explains the need for the Diablo Canyon ISFSI, and provides general descriptions of the co-located Diablo Canyon Power Plant (DCPP) and the ISFSI. Also, agents and contractors are identified, as well as material incorporated by reference. Some of the information pertaining to DCPP and the ISFSI site was taken from Chapters 1 and 2 of the DCPP FSAR Update (Reference 1 in Section 1.5 of this FSAR). Information pertaining to the Diablo Canyon ISFSI and its dry cask storage system was taken from the storage system vendor documents cited in FSAR Section 1.5.

In February 2010, the NRC approved a license amendment (LA) 1 to allow the use of Metamic as an alternative neutron absorber in the Multi-Purpose Canister (MPC); revise the MPC boron verification requirements by reducing the time of sampling prior to loading or unloading an MPC, allowing a boron concentration based on the maximum initial fuel assembly enrichment, and limiting the need to sample for boron concentration when out of the Spent Fuel Pool; eliminate the time limit for a loaded MPC in the CTF; revise the helium leak testing requirements for the MPC. Additionally, some clarifications were made, and Administrative requirements for combustible gas monitoring during welding and cutting, cladding oxidizing atmosphere control, and boron dilution control, were added.

In (Month) (Year), the NRC approved license amendment (LA) 2 to allow the loading of high-burnup (>45,000 MWD/MTU) in the MPC-32, add allowance for loading of neutron source assemblies (NSAs) and instrument tube tie rods (ITTRs) as non-fuel hardware, add allowance for loading of fuel with different names provided the critical characteristics are met, eliminate the restriction on loading high-burnup Zirlo clad fuel, delete the option for vacuum drying of fuel, specify the reference temperature for the helium backfill pressure range, identify in the Technical Specification that the HI-STORM can be considered operable with up to 50% vent blockage, and add requirements for use of a Supplemental Cooling System when loading high-burnup fuel. Additionally, changes to Administrative requirements were made to support the changes.

1.1 INTRODUCTION

DCPP consists of two nuclear generation units located on the California coast approximately 6 miles northwest of Avila Beach, California. The two units are essentially identical pressurized water reactors (PWRs), each rated at a nominal 1,100 megawatts-electric (MWe). The two units share a fuel handling building/auxiliary building (FHB/AB) as well as certain components of auxiliary systems. The reactors, including their nuclear steam supply systems, were furnished by Westinghouse Electric Corporation. Each reactor has a dedicated fuel handling system and spent fuel pool (SFP). Both SFPs share a single 125-ton capacity crane for fuel handling activities. Both units and the plant site are owned and operated by PG&E.

Unit 1 began commercial operation in May 1985 and Unit 2 in March 1986. The operating licenses expire in November 2, 2024 for Unit 1 and August 26, 2025 for Unit 2. In general, the operating and spent fuel storage histories of DCPP Unit 1 and Unit 2 are similar to those of other PWRs. The spent fuel storage racks were initially of low-density design, capable of accommodating only one and one-third cores of spent fuel assemblies. These low-density racks were replaced in the late 1980s with high-density racks that are currently in use.

Each reactor core contains 193 fuel assemblies, and both units are currently operating on 18- to 21-month refueling cycles. Typically, 76 to 96 spent fuel assemblies are permanently discharged from each unit after a refueling. The SFP for each unit presently has sufficient capacity for the storage of 1,324 fuel assemblies, excluding the temporary cask pit racks.
The Diablo Canyon ISFSI consists of the storage pads, a cask transfer facility (CTF), an onsite cask transporter, and the dry cask storage system. The dry cask storage system that has been selected by PG&E for the Diablo Canyon ISFSI is the Holtec International (Holtec) HI-STORM 100 System. The HI-STORM 100 System is comprised of a multi-purpose canister (MPC), the HI-STORM 100SA storage overpack, and the HI-TRAC transfer cask. The HI-STORM 100 System is certified by the Nuclear Regulatory Commission (NRC) for use by general licensees as well as site-specific licensees (see NRC 10 CFR 72 Certificate of Compliance [CoC] No. 1014, Amendment 1) (Reference 2, Section 1.5).

The Holtec CoC No. 1014, Amendment 1 (Reference 2), includes a HI-STORM 100SA storage overpack, an MPC-32 design (for storage of 32 PWR spent fuel assemblies), and additional 24 PWR assembly capacity MPC designs with different fuel storage (for example, high burnup fuel and certain damaged fuel). As discussed below, Holtec CoC No. 1014, Amendment 1, supports the Diablo Canyon ISFSI. PG&E understands, however, that ~~several~~ *some* of the features in Holtec CoC No. 1014, Amendment 1, ~~such as the designs to accommodate high burnup fuel,~~ are not currently applicable to the Diablo Canyon ISFSI.

Later Holtec CoC No. 1014 Amendments have been used to support changes made in amendments to the Diablo Canyon ISFSI License. Specifically, CoC Amendment 2 was used to support the use of a variable dissolved boron concentration in the MPC based on maximum fuel assembly initial enrichment loaded (LA 1). CoC Amendment 3 was used as the basis for the selection criteria for high-burnup fuel (LA 2), allow loading of

NSAs as non-fuel hardware (LA 2), change the MPC leakage criteria from measuring leak rate from the lid-to-shell weld and the port cover plates to only verifying the port cover plates to leak-tight criteria (LA 1). CoC Amendment 5 was used to support the thermal evaluation methodology, 3-D Computational Fluid Dynamics (CFD) model, change (LA 2), allow for the HI-STORM to be considered OPERABLE with up to 50% vent blockage, and decoupling of the 100% rod rupture and 100% vent blockage accidents (LA 2). CoC Amendment 6 was used to support the addition of ITTRs as non-fuel hardware (LA 2).

Revision 2 of this FSAR incorporates site-specific modifications, which pertain only to the MPC-32 and related components. These modifications, which will facilitate the fuel-loading campaigns, include: (1) use of a single-failure proof fuel handling building crane; (2) shortening the MPC-32 and transfer cask to allow vertical handling of the transfer cask throughout each load campaign; (3) use of a low profile transporter to transport a loaded transfer cask from the FHB/AB to the cask transporter; (4) elimination of the CTF lifting platform; (5) use of a single-failure proof transporter for heavy load handling outside the FHB/AB; and (6) modifying the overpack lid. The MPC-32 can store up to 32 intact fuel assemblies that meet the approved content requirements of the Diablo Canyon ISFSI Technical Specifications (TS). The MPC-24, MPC-24E, and MPC-24EF were originally licensed to store up to 24 fuel assemblies that meet the approved content requirements of the Diablo Canyon ISFSI TS, including limited storage of damaged fuel assemblies and fuel debris. The originally-licensed MPC-24s will require modifications and analyses similar to the MPC-32 prior to their use.

The Diablo Canyon ISFSI is designed to hold up to 140 storage casks (138 casks plus 2 spare locations). The physical characteristics of the spent fuel assemblies to be stored are described in Section 3.1. Based on the current fuel strategy and the principal use of the MPC-32, the ISFSI with a storage pad capacity of 140 casks will be capable of storing the spent fuel generated by DCPP Units 1 and 2 through 2021 and 2025, respectively.

The Diablo Canyon ISFSI incorporates these designs in a preferred cask system licensing approach as follows:

(1) The Diablo Canyon ISFSI site-specific license incorporates the MPC capabilities as specified in the CoC No. 1014, Amendment 1. The NRC issued a Safety Evaluation Report (SER) in July 2002. While the MPC capabilities covered by the Holtec CoC No. 1014, Amendment 1, does not completely envelope all of the spent fuel characteristics eventually needed for DCPP fuel, it covers most of the current SFP inventory and will permit the storage of nearly all spent fuel and associated nonfuel hardware generated during the license term.

(2) MPC designs that may be needed for the balance of the DCPP spent fuel characteristics will be addressed in future revisions to the CoC. As these changes are submitted by Holtec and approved by the NRC, PG&E will

amend the Diablo Canyon ISFSI site-specific license to incorporate these changes. The resulting capability will provide PG&E with the flexibility to store onsite all the spent fuel and nonfuel hardware from DCPP Units 1 and 2 generated during the term of its operating licenses.

(3) In a Federal Register Notice dated October 11, 2001 (66 FR 51823), the NRC issued the final rule change regarding greater than class C (GTCC) waste (for example, split pins and thimble tubes). The rule change applies only to the interim storage of GTCC waste generated or used by commercial nuclear power plants. The rule change allows interim storage of reactor-related GTCC wastes under a 10 CFR 72 site-specific license. In accordance with the guidance contained in Interim Staff Guidance Document 17 (ISG 17), PG&E plans to request a modification to its proposed site-specific license at a future date to allow interim storage of GTCC wastes at the Diablo Canyon ISFSI.

(4) Exemptions pertaining to the Diablo Canyon ISFSI license are identified in Table 1.1-1.

~~(5)To be consistent with the guidance contained in ISG-11, Revision 3, issued on November 17, 2003, fuel assemblies to be stored initially at the Diablo Canyon ISFSI will be limited to a maximum average burnup of ≤45,000 MWD/MTU (defined in ISG-11 as low burnup fuel) (see PG&E Letter DIL-04-002, dated January 16, 2004). This burnup limit is more restrictive than that contained in the HI-STORM 100 System CoC No. 1014, Amendment 1.~~

~~Because the HI-STORM 100 System licensing and design basis incorporated by reference in this FSAR is taken from Revision 1A of the HI-STORM 100 System FSAR (Reference 4), many of the design and safety evaluations discussed in this FSAR are for bounding burnups exceeding those authorized for loading at the Diablo Canyon ISFSI (see, for example, the ISFSI thermal design discussed in Section 4.2, the radiological analyses in Chapter 7, and selected accident analyses in Chapter 8). Based on the fuel burnup limit of ≤45,000 MWD/MTU, these generic design and safety evaluations are conservative and bound the allowed cask contents.~~

~~The fuel burnup limit is specified in Section 10.2 and in the Diablo Canyon ISFSI Technical Specifications. PG&E anticipates requesting authorization to store fuel with higher burnups consistent with future HI-STORM amendments.~~

Licensing of the Diablo Canyon ISFSI also involved NRC review of a number of site-specific issues. They included the site-specific environmental review, geotechnical issues related to the site and natural phenomena, and other site-specific matters.

Although the Holtec CoC No. 1014, Amendment 1 includes a high-seismic capability for the storage overpack (the HI-STORM 100SA), it did not incorporate some Diablo Canyon specific information (for example, the pad design, the overpack seismic anchorage design, the cask transporter seismic design, and the CTF design). PG&E submitted information on these items as part of its site-specific application and these issues were reviewed and licensed as part of the PG&E site-specific 10 CFR 72 license.

This FSAR refers to a number of dry storage and ancillary components licensed under the HI-STORM 100 System CoC, Amendment 1 and Holtec FSAR, Revision 1A (Section 1.5). Some of these components were modified by Holtec International under the provisions of 10 CFR 72.48. Wherever necessary, these changes are discussed in the text, tables, and figures in this FSAR.

In accordance with 10 CFR 72.42, the Diablo Canyon ISFSI license was issued for a term of 20 years. If near the end of the initial license, permanent or interim DOE High Level Waste (HLW) facilities are unavailable for acceptance of commercial nuclear spent fuel, PG&E expects to submit an application for ISFSI license renewal pursuant to 10 CFR 72.42(b).

The Diablo Canyon ISFSI is designed to protect the stored fuel and prevent release of radioactive material under all normal, off-normal, and accident conditions of storage in accordance with all applicable regulatory requirements contained in 10 CFR 72. This FSAR was prepared in compliance with the requirements of 10 CFR 72 and using the guidance contained in Regulatory Guide 3.62, "Standard Format and Content for the Safety Analysis Report for Onsite Storage of Spent Fuel Storage Casks," (February 1989); and NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," (March 2000).

Additionally, the NRC has issued license amendments allowing PG&E to take credit for soluble boron in the spent fuel pools (Reference 11) and permit cask handling activities in the DCPP fuel handling building/auxiliary building (Reference 12). Also, PG&E applied for and received an exemption from the criticality requirements of 10 CFR 68(b)(1) during loading, unloading, and handling of the MPC in the DCPP SFP (References 13 and 14, respectively).

1.5 MATERIAL INCORPORATED BY REFERENCE

1. Diablo Canyon Power Plant Units 1 & 2 Final Safety Analysis Report Update.

2. 10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 1, July 15, 2002.

3. Deleted in Revision 2.

4. Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 1A, January 2003.

5. Submittal of Holtec Proprietary Design Drawing Packages, PG&E Letter to the NRC DIL-01-008, dated December 21, 2001

6. Diablo Canyon Power Plant Units 1 & 2, Emergency Plan.

7. Diablo Canyon ISFSI Technical Specifications.

8. Diablo Canyon ISFSI Training Program.

9. Deleted in Revision 0.

10. Diablo Canyon ISFSI Preliminary Decommissioning Plan.

11. License Amendment 154, Credit for Soluble Boron in the Spent Fuel Pool Criticality Analysis, issued by the NRC, September 15, 2002.

12. License Amendments 162 and 163, Spent Fuel Cask Handling, issued by the NRC, September 26, 2003.

13. PG&E Letter DCL-03-126 to the NRC, Request for Exemption from 10 CFR 50.68, Criticality Accident Requirements for Spent Fuel Cask Handling, October 8, 2003, supplemented by PG&E Letters DCL-03-150 and DIL-03-014, Response to NRC Request for Additional Information Regarding Potential Boron Dilution Events with a Loaded MPC in the DCPP SFP, November 25, 2003.

14. Exemption From the Requirements of 10 CFR 50.68(b)(1), Issued by the NRC, January 30, 2004.

15. *10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 2, 06/07/05.*

16. *10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 3, May 29, 2007.*

17. *10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 5, July 14, 2008.*

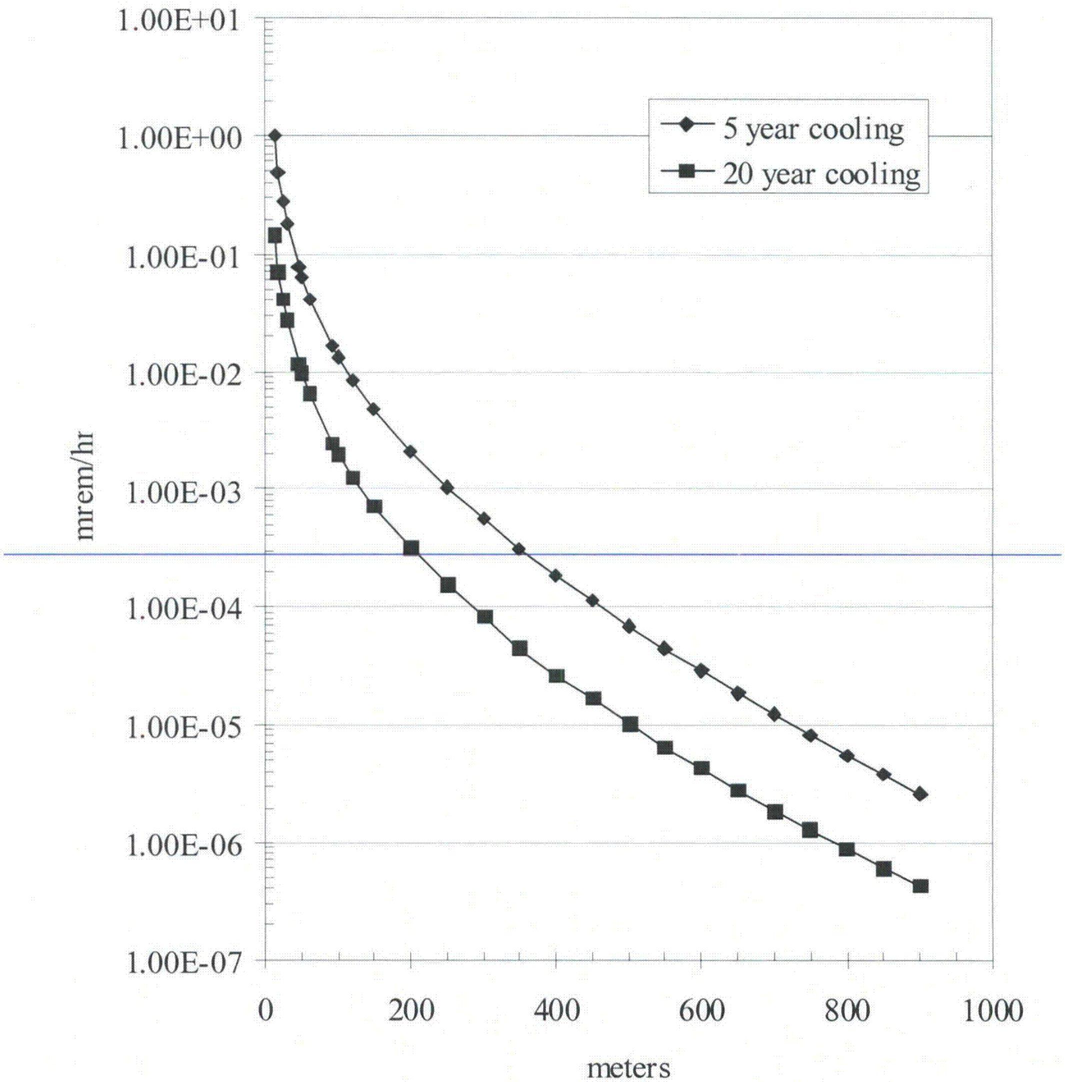
18. *10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 6, August 17, 2009.*

TABLE 1.1-1

DIABLO CANYON ISFSI LICENSE EXEMPTIONS

Code of Federal Regulations Reference	Exemption
10 CFR 72.72(d)	As specified in License Condition 16 of the Diablo Canyon ISFSI License SNM-2511, the NRC has granted PG&E an exemption from the provisions of 10 CFR 72.72(d) with respect to maintaining a duplicate set of spent fuel storage records. PG&E may maintain records of spent fuel and high level radioactive waste in storage either in duplicate, as required by 10 CFR 72.72(d), or, alternatively, a single set of records may be maintained at a records storage facility that satisfies the standards of ANSI N45.2.9-1974. All other requirements of 10 CFR 72.72(d) must be met .
10 CFR 50.68(b)(1)	10 CFR 50.68(b)(1) prohibits the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water. Specifically, the regulation ensures a subcritical condition will be maintained without credit for soluble boron. For an MPC loaded with fuel having the highest permissible reactivity, soluble boron credit is necessary to ensure the MPC remains subcritical in the SFP. Therefore, PG&E requested an exemption from 10 CFR 50.68(b)(1) to allow MPC loading, unloading, and handling operations without meeting the requirement of being subcritical under the most adverse moderation conditions feasible by unborated water. In the exemption request (Reference 13, Section 1.5 of this FSAR), PG&E evaluated the possibility of an inadvertent criticality during MPC loading, unloading, and handling in the DCPP SFP. Based on the alarms, procedures, administrative controls, assumption of zero burnup fuel, and availability of trained operators described in Reference 13, the NRC granted an exemption from the criticality requirements of 10 CFR 50.68(b)(1) during loading, unloading, and handling of the MPC in the DCPP SFP (Reference 14 in Section 1.5 of this FSAR).

10 CFR 72.236(f)	*10 CFR 72.236(f) requires that a spent fuel storage cask must be designed to provide adequate heat removal capacity without active cooling. PG&E requested an exemption from 10 CFR 72-236(f) for the supplemental cooling system used when the loaded, helium filled MPC is in the transfer cask. The supplemental cooling system is required to maintain high burnup fuel cladding temperatures less than the ISG-11 Rev. 3 limits.*



~~FSAR UPDATE~~
~~DIABLO CANYON ISFSI~~
~~FIGURE 7.3-4~~ ~~DOSE RATE VERSUS DISTANCE FROM A SINGLE HI-STORM 100SA OVERPACK CONTAINING AN MPC-32 LOADED WITH FUEL OF BURNUP 32,500 MWD/MTU~~

CHAPTER 3

PRINCIPAL DESIGN CRITERIA

This chapter describes the design bases and criteria for the Diablo Canyon ISFSI. Section 3.1 provides the purposes of the installation, while Sections 3.2 through 3.4 provide the design criteria for the ISFSI structures, systems, and components (SSCs) classified as important to safety. These SSCs include the multi-purpose canister (MPC), the storage overpack, the HI-TRAC transfer cask, the storage pads, the cask transporter, and the cask transfer facility (CTF). Section 3.2 provides the design criteria for environmental conditions and natural phenomena, while Section 3.3 provides the other design criteria for these SSCs. Section 3.4 summarizes the principal design criteria. Chapter 4 provides the descriptive design information for these SSCs with emphasis on those design features that are important to safety, are covered by the quality assurance program, and are employed to withstand environmental and accident forces. Appendix A is a discussion of conformance with NRC Interim Staff Guidance 15 (ISG-15) dated January 10, 2001, on dry cask storage materials.

3.1 PURPOSES OF INSTALLATION

The Diablo Canyon ISFSI is designed for interim, dry, and above-ground storage of intact and damaged spent nuclear fuel assemblies, fuel debris, and nonfuel hardware from DCPP Units 1 and 2. The ISFSI will use the Holtec International HI-STORM 100 System storage system, as discussed in Section 1.1. Installation requirements for the storage pad and its embedments, the cask transfer facility, and the lateral restraints for the cask transporter can be found in Sections 3.3.2.3, 3.3.4.2.4, and 3.3.4.2.5, respectively.

The material from the DCPP spent fuel pool (SFP) will be sealed in MPCs, transported to the CTF in the transfer cask, the MPC transferred to the HI-STORM 100SA overpack, and stored in HI-STORM 100SA ventilated storage overpacks arranged on and anchored to a reinforced concrete pad. The stand-alone ISFSI will allow additional spent fuel to be stored in the SFP allowing for continued operation of DCPP. The Diablo Canyon ISFSI is designed to ultimately store up to 4,400 spent fuel assemblies or up to 138 casks, with 2 spare locations.

The MPC-32 will be used to store up to 32 intact fuel assemblies that meet the approved content requirements of the Diablo Canyon ISFSI Technical Specifications (TS). The MPC-24, MPC-24E, and MPC-24EF were originally licensed to store up to 24 fuel assemblies that meet the approved content requirements of the Diablo Canyon ISFSI TS, including limited storage of damaged fuel assemblies and fuel debris. The originally-licensed MPC-24s will require modifications and analyses similar to the MPC-32 prior to their use (refer to Section 1.1).

3.1.1 MATERIAL TO BE STORED

The materials to be stored at the ISFSI consist of intact fuel assemblies, damaged fuel assemblies, fuel debris, and nonfuel hardware. Each fuel assembly contains approximately 1,100 pounds (500 kg) of UO_2. Nonfuel hardware may be stored within fuel assemblies and consists of borosilicate absorber rods, wet annular burnable absorber rods (WABAs), thimble plug devices (TPDs)*, neutron source assemblies (NSAs), instrument tube tie rods (ITTRs)*, and rod cluster control assemblies (RCCAs). Discussed herein are the characteristics of these materials and how the HI-STORM 100 System storage system design criteria envelopes these characteristics.

While the fuel rod cladding is a confinement barrier, credit is not taken for it in the design of the MPC or in the Diablo Canyon ISFSI Technical Specifications (TS).

3.1.1.1 Physical Characteristics

The spent fuel assemblies to be stored *currently* consists of both Westinghouse LOPAR and VANTAGE 5 assemblies. Both types are configured in a 17-by-17 array and the fuel rods consist of UO_2 pellets encapsulated in zirconium alloy tubing that is plugged and seal-welded at the ends. The VANTAGE 5 fuel rods have the same cladding wall thickness as the LOPAR fuel rods, but the fuel rod diameter is reduced to optimize the water-to-uranium ratio. Details of the physical characteristics of the DCPP fuel to be stored are provided in Section 4.2.1.2 and Table 4.1-1 of the DCPP FSAR Update (Reference 1) and are summarized in Table 3.1-1. Also provided in Table 3.1-1 are limiting values from the Holtec Certificate of Compliance (CoC) No. 1014, Amendment 1 (Reference 2). ~~With the exception of DCPP fuel assemblies with Zirlo clad fuel with burnup> 45,000 MWD/MTU,~~ ~~t~~*T*he LOPAR and VANTAGE 5 fuel assemblies (including VANTAGE 5 using Zirlo, sometimes referred to as VANTAGE+) are bounded by the 17x17B and 17x17A array/classes of fuel assemblies, respectively, as described in Holtec CoC No. 1014, Amendment 1. The LOPAR and VANTAGE 5 fuel currently covers all fuel loaded for operation at DCPP through Cycle 16. *The Diablo Canyon ISFSI license was modified in LA 2 to allow alternate fuel types that meet the previously established fuel characteristics in anticipation of upcoming changes in fuel loading strategies.* ~~As necessary,~~ PG&E ~~anticipates~~ *will* modify~~ing~~ this site-specific license in the future*, as necessary* to include additional ~~fuel types and~~ fuel characteristics.

The following fuel assembly physical characteristics constitute the most significant limiting parameters for storage of intact fuel assemblies at the Diablo Canyon ISFSI:

(1) Initial Fuel Enrichment

The maximum initial fuel enrichment of any fuel that is stored at the ISFSI is limited to 5 percent as required by the Diablo Canyon ISFSI TS and Section 10.2.

(2) Physical Configuration/Condition

Only fuel and associated nonfuel hardware irradiated at DCPP Units 1 and 2 with the physical configuration described in this section and Section 10.2 is stored in the Diablo Canyon ISFSI.

Fuel records will be maintained that identify the configuration and initial enrichment of each fuel assembly. Each fuel assembly and associated nonfuel hardware are engraved with a unique identification number. A verification of these numbers is made to ensure that only approved fuel and associated nonfuel hardware is loaded in MPCs in accordance with the Diablo Canyon ISFSI TS and Section 10.2.

3.1.1.2 Thermal and Radiological Characteristics

Details of the thermal and radiological characteristics of the DCPP fuel to be stored are provided in Table 3.1-2. The following fuel assembly thermal and radiological characteristics constitute the most significant limiting parameters for storage of fuel assemblies at the Diablo Canyon ISFSI.

(1) Heat Generation

The maximum heat generation rate for an assembly that is stored at the Diablo Canyon ISFSI is less than or equal to that specified in Section 10.2.

The heat generation rate of an individual fuel assembly is dependent on four factors: the initial fuel enrichment, the uranium mass, the fuel burnup, and the amount of cooling time. Fuel records are used to ensure that the heat generation per assembly is less than or equal to that specified in Section 10.2. Although not required, PG&E will conservatively apply a 5 percent burnup uncertainty allowance when calculating the decay heat for each loaded MPC.

(2) Fuel Burnup

The maximum average fuel burnup per assembly of any fuel that is stored at the ISFSI is limited to that specified in Section 10.2 *and the Diablo Canyon ISFSI TS*. The maximum allowed burnup is a function of the fuel cooling time. ~~To be consistent with the guidance contained in ISG-11, Revision 3, issued on November 17, 2003 (Reference 5), fuel assemblies to be stored initially at the Diablo Canyon ISFSI are limited to a nominal maximum average burnup of ≤45,000 MWD/MTU (defined in ISG-11 as low burnup fuel) (see PG&E Letter DIL-04-002, dated January 16, 2004). This burnup limit is more restrictive than that contained in Holtec CoC No. 1014, Amendment 1, which is otherwise used as the basis for this FSAR.~~

A review of Materials License SNM-2511 and its associated Safety Evaluation Report; PG&E Letter DIL-04-002; and ISG-11, Revision 3, shows there is no regulatory requirement to include burnup uncertainty when evaluating compliance with TS burnup limits. Therefore, burnup uncertainty will not be applied to calculated fuel assembly burnup values when evaluating the eligibility of fuel assemblies for storage at the Diablo Canyon ISFSI.

~~Because the HI-STORM 100 System licensing and design basis incorporated by reference in this FSAR is taken from Revision 1A of the HI-STORM 100 System FSAR (Reference 4), many of the design and safety evaluations discussed in this FSAR are for bounding burnups exceeding those authorized for loading at the Diablo Canyon ISFSI (see, for example, the ISFSI thermal design discussed in Section 4.2, the radiological analyses in Chapter 7, and selected accident analyses in Chapter 8). Based on the fuel burnup limit of ≤45,000 MWD/MTU, these generic design and safety evaluations are conservative and bound the allowed cask contents.~~

~~The fuel burnup is specified in Section 10.2 and in the Diablo Canyon ISFSI TS. PG&E anticipates requesting authorization to store fuel with higher burnups consistent with future HI-STORM CoC amendments.~~

(3) Cooling Time

The cooling time of any fuel that is stored at the ISFSI is greater than or equal to 5 years as specified in Section 10.2. The minimum required cooling time is a function of the fuel burnup and decay heat.

(4) Surface Dose Rates

The transfer cask and overpack surface dose rates from the fuel assemblies stored in an individual HI-STORM 100SA overpack at the Diablo Canyon ISFSI are dependent on the initial fuel enrichment, uranium mass, burnup, cooling time, and the presence of nonfuel hardware.

Fuel records are used to verify that, prior to loading, all fuel parameters are in compliance with Section 10.2.

3.1.1.3 Nonfuel Hardware

Nonfuel hardware, consisting of borosilicate absorber rods, wet annular burnable absorber rods, thimble plug devices, *neutron source assemblies, instrument tube tie rods,* and rod cluster control assemblies may be stored integral with the spent fuel assemblies. The nonfuel hardware type, burnup, and cooling time will be limited to that specified in Section 10.2. ~~DCPP neutron sources are not authorized for loading into the~~

~~HI-STORM 100 System at the present time. Neutron sources will be added to the authorized contents of the HI-STORM 100 System by amendment at a later date.~~

3.1.2 GENERAL OPERATING FUNCTIONS

The overall operation of the HI-STORM 100 system is summarized in Chapter 1 of the HI-STORM 100 System FSAR. The following major operational sequences include:

- Moving the transfer cask containing the empty MPC into the SFP
- Loading of spent fuel assemblies into the MPC in the SFP
- Removal of the loaded MPC and transfer cask from the SFP
- MPC closure welding and draining, drying, and helium backfill operations
- Transfer of the MPC from the transfer cask to the overpack at the CTF
- Movement of the loaded overpack to the ISFSI storage pad

The above operational sequences are discussed generically in the HI-STORM 100 System FSAR. PG&E will develop site-specific implementing procedures that meet the intent of the HI-STORM 100 System FSAR and consider site-specific needs and capabilities. An overview of HI-STORM 100 System loading operations at Diablo Canyon is provided below. A more detailed discussion of operations is provided in Sections 4.4 and 5.1.

After the HI-STORM 100 System components are received onsite, inspected, and cleaned as necessary, they are prepared for movement into the DCPP fuel handling building/auxiliary building (FHB/AB). The transfer cask is moved into the Unit 2 cask washdown area where the MPC is installed. The transfer cask containing an empty MPC is then lifted and lowered into the SFP. DCPP spent fuel assemblies are loaded into the MPC in the SFP. After the completion of fuel loading and fuel assembly verification, the MPC lid is lowered into the MPC. The loaded transfer cask is lifted vertically out of the SFP and moved laterally to a point above the Unit 2 cask washdown area. The loaded transfer cask is lowered into the cask washdown area, decontaminated to the extent practicable, and prepared for welding operations.

The MPC lid is welded to the MPC shell. The transfer cask water jacket is filled with water to provide neutron shielding (this may occur before or after lid welding at the discretion of the DCPP radiation protection organization). The MPC is then drained of water, dried by ~~vacuum or by~~ forced helium dehydration, and backfilled with helium. *If the MPC contains high-burnup fuel, the supplemental cooling system is placed in service.* The vent and drain port cover plates are welded on and leak testing performed, and the MPC closure ring is welded on. The transfer cask lid is installed, and the loaded transfer cask is lifted and placed onto the low profile transporter (LPT).

At the CTF, the cask transporter positions the transfer cask above an empty overpack that has been previously placed in a below-grade vault at the CTF. The MPC is lowered from the transfer cask into the overpack and the transfer cask is removed from atop the overpack. The overpack top lid is installed and the cask transporter is used to lift the overpack out of the CTF and transport it to its designated storage location on the ISFSI storage pad, where it is anchored in place. Section 5.1 discusses the detailed operational steps involved in this process. Equipment required to be available to mitigate off-normal conditions such as a loss of transporter power or hydraulics are discussed in Chapter 8.

While in its storage configuration, no active components are needed to ensure safe storage of the spent fuel. Cooling is provided by natural convective flow of ambient air into the inlet air vents at the bottom of the overpack and out of the outlet vents at the top of the overpack. No utilities (that is, water, compressed air, electric power) are required to cool the spent fuel during storage. Adequate cooling air is assured through periodic surveillance of the overpack air duct inlet and outlet perforated plates (screens) at the ISFSI pad to verify that the air duct perforated plates (screens) are not blocked and are intact as required by the Diablo Canyon ISFSI TS.

3.1.3 REFERENCES

1. Diablo Canyon Power Plant Units 1 & 2 Final Safety Analysis Report Update.

2. 10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 1, July 15, 2002.

3. Deleted in Revision 2.

4. Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 1A, January 2003.

5. Interim Staff Guidance Document 11 (ISG-11), Revision 3, Cladding Considerations for the Transportation and Storage of Spent Fuel, USNRC, November 17, 2003.

6. *10 CFR72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 3, May 29, 2007..*

3.2 DESIGN CRITERIA FOR ENVIRONMENTAL CONDITIONS AND NATURAL PHENOMENA

This section describes the design criteria for the Diablo Canyon ISFSI that are classified as important to safety and designed to withstand the effects of site-specific environmental conditions and natural phenomena. Regulatory requirements and guidance were drawn, as applicable, from 10 CFR 72 (Reference 1), Regulatory Guide 3.62 (Reference 2), the Standard Review Plan for ISFSIs (Reference 3), and the Standard Review Plan for Dry Cask Storage Systems (Reference 4). Diablo Canyon site-specific information for environmental conditions and natural phenomena was taken primarily from other parts of this FSAR and from the DCPP FSAR Update (Reference 5). Holtec storage system design information was taken primarily from the Holtec Certificate of Compliance (CoC) No. 1014, Amendment 1 (Reference 6), and the HI-STORM 100 System FSAR (Reference 7).

As discussed in Section 4.5, the ISFSI structures, systems, and components (SSCs) are classified as important-to-safety (ITS) or not important-to-safety (NITS) based on their design function. Among the SSCs classified as important to safety are the multi-purpose canisters (MPCs), the HI-STORM 100SA overpack, the storage pad, the HI-TRAC transfer cask, the onsite cask transporter, and the cask transfer facility (CTF). The ITS classification indicates that at least one subcomponent of the main component is classified as ITS. Other subcomponents may be classified as NITS, based on the function of the subcomponent. Design criteria for environmental conditions and natural phenomena for these entire key ISFSI SSCs are described in this section. Other design criteria for these key ISFSI SSCs are contained in Section 3.3.

Environmental conditions and natural phenomena specific to the Diablo Canyon ISFSI and DCPP sites are described and characterized in Chapters 2 and 3 and in the DCPP FSAR Update. The DCPP FSAR Update is maintained up to date by PG&E and is, for the most part, directly applicable to the Diablo Canyon ISFSI. Some natural phenomena are different for the ISFSI site than for the power plant site. For example, flooding is not a credible event at the ISFSI site because of drainage and elevation differences between the power plant and the ISFSI site. Such differences are appropriately considered in this and other parts of the ISFSI FSAR.

The storage system selected for the Diablo Canyon ISFSI, the HI-STORM 100 System, is designed to ensure that fuel criticality is prevented, fuel cladding and confinement integrity are maintained, the fuel remains retrievable, and reasonable radiation shielding is maintained under all Diablo Canyon site-specific design-basis loadings due to environmental conditions and natural phenomena.

The safe storage of the spent fuel assemblies depends upon the capability of the HI-STORM 100 System to perform its design functions. The HI-STORM 100 System is a self-contained, independent, passive system that does not rely on any other system for operation. At Diablo Canyon, the shortened and anchored version of the HI-STORM 100 System overpack, known as the HI-STORM 100SA, will be used. A description of the HI-STORM 100SA overpack is provided in Section 4.2.3. Stability under design-basis seismic loadings at the Diablo Canyon ISFSI is ensured by anchoring the HI-STORM 100SA overpack to the ISFSI pads, as described in Section 4.2.1. The overpack anchorage is the only required interface between the HI-STORM 100SA overpacks and other ISFSI components. Except for the anchorage details, all other overpack design features and functions are identical to the freestanding version of the system described in the HI-STORM 100 System FSAR. Therefore, the text of this section will refer to HI-STORM 100 System for simplicity.

The criteria used for the design of the HI-STORM 100 System were developed for generic certification of the HI-STORM 100 System under 10 CFR 72, Subpart L. The design criteria were chosen to bound the site-specific design criteria for most nuclear power plants in the United States, so that virtually any 10 CFR 50 licensee could use the HI-STORM 100 System at an onsite ISFSI under the general license provisions of 10 CFR 72. The principal design criteria for the HI-STORM 100 System meet all requirements of 10 CFR 72 and are described in Chapter 2 of the HI-STORM 100 System FSAR.

Environmental conditions and phenomena are summarized in this section for the important-to- safety SSCs, and include:

- Tornado and wind loadings, including tornado-borne missiles
- Water level (flood) design
- Seismic design
- Snow and ice loadings
- Combined load criteria
- Lightning
- Temperature and solar radiation.

The HI-STORM 100 System design features are evaluated in detail for fuel handling activities in the DCPP FHB/AB in 10 CFR 50 LAR 02-03 submitted to the NRC in April 2002 (Reference 22). The LAR describes MPC fuel loading in the spent fuel pools; draining, drying, sealing, helium filling, and helium leak testing the MPC while inside the HI-TRAC transfer cask; and loading the transfer cask onto the cask transporter for onsite transfer to the CTF. The NRC issued DCPP License Amendments 162 and 163 (Reference 23) to allow implementation of LAR 02-03.

3.2.1 TORNADO AND WIND LOADINGS

3.2.1.1 Applicable Design Parameters

As stated in Section 2.3.2, the highest recorded peak wind gust at the DCPP site was 84 mph. For storage system design purposes, a wind velocity of 80 mph is used (Section 3.3.1 of the DCPP FSAR Update) with a gust factor of 1.1, which envelopes the recorded, peak-gust value of 84 mph.

Tornado winds and outdoor tornado-borne missiles for the DCPP site are included in Section 3.3.2.1 of the DCPP FSAR Update. Specific wind speeds, pressure drops, and missile descriptions applicable to the operating configurations associated with the ISFSI site are presented in Tables 3.2-1 and 3.2-2. As shown in Table 3.2-1, the Diablo Canyon ISFSI tornado wind speeds are based on the DCPP FSAR Update and are bounded by those evaluated for licensing of the HI-STORM 100 System.

The HI-STORM 100 System, which includes all operating configurations applicable to the Diablo Canyon ISFSI, is generically designed to withstand pressures, wind loads, and missiles generated by a tornado as described in Section 2.2.3.5 of the HI-STORM 100 System FSAR. The design-basis tornado and wind loads for the HI-STORM 100 System are consistent with Regulatory Guide 1.76 (Reference 9), ANSI/ANS 57.9 (Reference 10), and ASCE 7-88 (Reference 11).

The tornado wind and missile evaluations for the DCPP ISFSI are based on the DCPP site licensing-basis wind speed of 200 mph shown in Table 3.2-1, and are considered representative of the ISFSI site. The tornado missiles evaluated for the Diablo Canyon ISFSI are listed in Table 3.2-2 and are a compilation of those from the DCPP FSAR Update; NUREG-0800, Section 3.5.1.4 (Reference 12) Spectrum II missiles; and three 500-kV tower missiles specific to the Diablo Canyon ISFSI site. Several of these missiles differ from those identified in the HI-STORM 100 System FSAR. The effects of these missiles are evaluated for Level D stress limits and cask penetration. The evaluation is consistent with the design criteria, as specified in NUREG-0800, Section 3.5.1.4, to withstand tornados in accordance with 10 CFR 72.120(a) and 72.122(b).

3.2.1.2 Determination of Forces on Structures

Tornado wind loads include consideration of the following, as applicable: (a) tornado wind load, (b) tornado differential pressure load, and (c) tornado missile impact load. The method of combining the applicable effective tornado wind, differential pressure, and missile impact loads to determine the total tornado load is done in accordance with NUREG-0800, Section 3.3.2.

3.2.1.3 Tornado Missiles

The HI-STORM 100 System, including the overpack and the transfer cask, is generically designed to withstand three types of tornado-generated missiles in accordance with NUREG-0800, Section 3.5.1.4, as noted in Table 3.2-2. The design basis for these missiles is discussed in Section 2.2.3.5 of the HI-STORM 100 System FSAR. The mass and velocity of these missiles, along with the design-basis tornado missiles for the Diablo Canyon ISFSI site are presented in Table 3.2-2. Table 3.2-2 also lists the DCPP licensing-basis tornado missiles. Due to the proximity of a 500-kV transmission tower to the ISFSI site, other missiles were evaluated as shown in Table 3.2-2. Missile evaluations are described in detail in Section 8.2.2 for cask transport from the FHB/AB, activities at the CTF, and at the ISFSI storage pad.

3.2.2 WATER LEVEL (FLOOD) DESIGN

The Diablo Canyon ISFSI pad is located at elevation +310 ft mean sea level (MSL). The Diablo Canyon ISFSI site surface hydrology is described in Section 2.4. It is concluded in Section 2.4 that there is no potential for flooding in the vicinity of the ISFSI. Therefore, flooding is not a consideration for ISFSI operations or on the capability of the dry storage cask system to safely store the spent fuel. Likewise, due to the elevation of the ISFSI site, tsunami is not a threat to the HI-STORM 100 Systems that are stored on the pad. Since the CTF is located adjacent to the ISFSI, these conclusions are also applicable for the potential flooding and tsunami impact on the CTF. A design-basis flooding event occurring during movement of the cask to or from the CTF along the transport route is not considered credible. Flooding of the overpack while it is located in the underground vault at the CTF is precluded by the use of a sump designed to remove any significant accumulation of water in the vault.

Therefore, while the HI-STORM 100 System is designed to withstand pressure and water forces associated with floods, such design features are unnecessary for the Diablo Canyon ISFSI and do not need to be evaluated. In conclusion, the ISFSI design is consistent with the design criteria of NUREG-0800 and ASCE 7-88 and can withstand floods as required by 10 CFR 72.120(a) and 72.122(b).

3.2.3 SEISMIC DESIGN

In accordance with 10 CFR 72.102(f)(1), the seismic design of the important-to-safety ISFSI SSCs, which include the HI-TRAC transfer cask, the HI-STORM 100SA overpack, the MPC, the CTF, the onsite cask transporter, LPT and ISFSI storage pads, is based on design-earthquake ground motions that have been established for the plant site. Site seismic characteristics and vibratory ground motion are discussed in Sections 2.6.1 and 2.6.2.

The ISFSI SSCs are designed to withstand seismic loads during: (a) onsite transport of the loaded transfer cask, (b) transfer operations at the CTF, (c) transport of loaded overpack to the storage pad, and (d) storage of the overpack on the ISFSI pad. The design bases for the ISFSI SSCs, including analyses and design procedures, are discussed in Sections 4.2, 4.3, 4.4.5, and 8.2.1. Seismic design for the loading and handling of the transfer cask while in the FHB/AB are addressed as part of the 10 CFR 50 LAR submitted to the NRC (Reference 22).

The HI-STORM 100SA is the short, anchored version of the HI-STORM 100S System. In contrast to a freestanding cask, the HI-STORM 100SA relies upon the anchorage hardware and its embedment into the ISFSI pad for resistance to overturning and sliding. The primary structural difference between the freestanding and anchored overpacks is the enlargement of the overpack base-plate diameter to accommodate a flange bolt circle, an upper ring, and a number of vertical gussets (Figure 4.2-7). Pretensioned anchor bolts are used to secure the overpack to an embedment in the pad. The ISFSI pads and associated embedments are an integral part of the seismic design of the cask system.

3.2.4 SNOW AND ICE LOADINGS

As noted in Section 2.3.2, essentially no snow or ice occurs at the ISFSI site. Therefore, even though the HI-STORM 100 System is designed to accommodate snow and ice loadings typical of the contiguous United States and Alaska, such design features are unnecessary for the Diablo Canyon ISFSI and do not need to be evaluated. In summary, the ISFSI meets the requirements of 10 CFR 72.120(a) and 72.122(b) for snow and ice loadings.

3.2.5 COMBINED LOAD CRITERIA

The HI-STORM 100 System is designed for normal, off-normal, and accident conditions, the definitions and design criteria for which are described in HI-STORM 100 System FSAR Sections 2.2.1, 2.2.2, and 2.2.3, respectively. The service limits, design loads, and load combinations are described in Sections 2.2.5, 2.2.6 and 2.2.7 of the HI-STORM 100 System FSAR.

HI-STORM 100 System FSAR Section 3.1.2 provides additional detail regarding the generic analyses performed using the design criteria, loads and load combinations. This section also includes discussion of the methodologies used in the analyses. Load combinations for the CTF steel structure and equipment are discussed in Section 2.3.3.1 of the HI-STORM 100 System FSAR. The load combinations for the concrete portions of the CTF are in Section 3.3.4.2.4.1. Load combinations for the ISFSI pad concrete and HI-STORM 100SA anchor studs are in Section 3.3.2.3.1 and 3.3.2.3.2, respectively. As noted in Section 3.3.4.2.4, the cask transporter meets the applicable load criteria for the CTF, which are delineated in Section 2.3.3.1 of the HI-STORM 100 System FSAR. Therefore, the load combinations specified by the design criteria are appropriately considered for the design of ITS SSCs, as required by 10 CFR 72.122(b).

3.2.6 LIGHTNING

As noted in Section 2.3.1, thunderstorms at west-coast sites are rare phenomena. However, potential lightning strikes have been evaluated for the HI-STORM 100 System. This evaluation is described in Section 11.2.12.2 of the HI-STORM 100 System FSAR and in Section 8.2.8. The HI-STORM 100 System is a large, metal/concrete cask designed to be stored on an unsheltered ISFSI pad. As such, it may be subject to lightning strikes. If the HI-STORM 100 SYSTEM overpack is struck by lightning, the charge will travel through the steel shell of the overpack into the pad and ultimately into the ground. The overpack outer shell is made of a conductive material (carbon steel). This same shell will have two copper ground cables attached to it providing a direct path to the ground grid. The anchors associated with the HI-STORM 100SA overpack would further enhance grounding. The MPC is protected by the overpack and not subject to direct lightning strikes, which will be absorbed by the overpack. The possibility of lightning striking the cask during transport to and from the CTF is addressed in Sections 4.3 and 8.2.8. Therefore, the lightning design criteria meet the requirements of 10 CFR 72.122(b).

3.2.7 TEMPERATURE AND SOLAR RADIATION

Ambient temperature and incident solar radiation (insolation) values applicable to the ISFSI site are summarized in Section 2.3.2. The highest and lowest hourly temperature, as recorded at one of the recording stations at the Diablo Canyon site, is 97°F in October 1987 and 33°F in December 1990, respectively. The annual average temperature is approximately 55°F. The maximum insolation values for the ISFSI site are estimated to be 766 g-cal/cm^2 per day for a 24-hour period and 754 g-cal/cm^2 for a 12-hour period.

Table 2.2.2 of the HI-STORM 100 System FSAR provides the design environmental and soil temperatures for the HI-STORM 100 System. This includes temperatures and insolation (or lack thereof), as applicable for normal, off-normal, and extreme (accident) conditions. The design temperature for normal conditions is an annual average temperature of 80°F. The extreme (three-day average) temperature limits for the HI-STORM 100 System are -40°F and 125°F, although cask loading, transport, and unloading operations must be conducted with a working area ambient temperature greater than or equal to 0°F (Reference 6, Appendix B, Section 3.4.8).

Sections 4.4.1.1.8 and 4.5.1.1.3 of the HI-STORM 100 System FSAR describe how the HI-STORM 100 System design meets the 10 CFR 71.71(c) insolation requirements (that is, 800 g-cal/cm^2 for flat surfaces and 400 g-cal/cm^2 for curved surfaces) for normal storage conditions and normal handling and transport conditions, respectively. By meeting the insolation requirements of 10 CFR 71.71(c), the HI-STORM 100 System design bounds the maximum insolation values expected for the ISFSI site.

In summary, the HI-STORM 100 System design bounds both the temperature and insolation values expected at the Diablo Canyon ISFSI site. Evaluation of the thermal design for the cask system was carried out during licensing of the HI-STORM 100 System and is documented in the NRC's HI-STORM 100 System Safety Evaluation Report supporting the HI-STORM 100 System CoC.

3.2.8 CRITERIA FOR SLOPE STABILIZATION MEASURES

The ISFSI site is designed to provide a pad site and slopes that are: (a) stable in the long-term under seismic conditions, and (b) conform to the requirements in Appendix A of 10 CFR 100, 10 CFR 72.102, and guidance in NUREG-1567. The design is based on site conditions, field investigations, laboratory testing, material properties, slope analyses, and recommendations discussed in Section 2.6. Surface and overall stability of cut slopes were evaluated using kinematic, limit equilibrium, pseudostatic, and dynamic analyses.

Slope anchorage will conform to Post Tensioning Institute guidelines (Reference 13) and the manufacturer design, installation, and proof testing criteria. Anchor design shall provide a factor of safety over rock block seismic forces of 1.3, as determined in Section 2.6.5.2.2.5. Locations and numbers of anchors will be adjusted as necessary to accommodate any change in site conditions encountered during excavation and installation.

Measures will be taken as required to prevent raveling and limit weathering of the surface and to drain water from inside the hillside to limit buildup of hydrostatic pressure. Design, installation, and testing are to be per ACI 211.2-1998, 214-1997, 304.24-1996, and 506.2-1995; and ASTM A185-1997, C39-2001, and C1116-2000 (References 14 through 20), at a minimum.

Measures will be taken to mitigate any debris or rock falls from the slopes. A defense-in-depth design approach was adopted and an ISFSI slope hazard mitigation system designed that incorporates several protection elements. The rockfall fencing impact design criteria were developed using very conservative results based on the Diablo Canyon slope field observations. A design criterion of 295 ft-tons is used for the maximum impact loading, which envelopes analyses results. The kinetic energy of 295 ft-tons was selected using a hypothetic 5-ft diameter by 10-ft long cylindrical block that has a mass approximately 10 times the mass of the more realistic 3-ft diameter by 3-ft long cylindrical block or close to 20 times the mass of a 3-ft elongated rectangular block that PG&E considers the most probable block size that can reasonably be expected at the site. The rockfall barrier will be manufactured to ISO 9001 quality standards (Reference 21). Additional description of the rockfall barrier fence is provided in Section 4.2.1.1.9.2.

The bench in the cutslope will be sloped to the level of the storage pads.

A drainage system will divert and collect water from slopes, benches, and ISFSI pads in a controlled fashion and convey it to site drainage. Erosion control measures will protect vegetated slopes around the perimeter of the excavated slopes.

3.2.9 REFERENCES

1. 10 CFR 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.

2. Regulatory Guide 3.62, Standard Format and Content for the Safety Analysis Report for Onsite Storage of Spent Fuel Storage Casks, USNRC, February 1989.

3. Standard Review Plan for Spent Fuel Dry Storage Facilities, USNRC, NUREG-1567, March 2000.

4. Standard Review Plan for Dry Cask Storage Systems, USNRC, NUREG-1536, January 1997.

5. Diablo Canyon Power Plant Units 1 & 2 Final Safety Analysis Report Update.

6. 10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 1, July 15, 2002.

7. Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 1A, January 2003.

8. Deleted in Revision 2.

9. Regulatory Guide 1.76, Design Basis Tornado for Nuclear Power Plants, USNRC, April 1974.

10. ANSI/ANS 57.9-1992, Design Criteria for an Independent Spent Fuel Storage Installation (dry type), American National Standards Institute.

11. Standard ASCE 7-88, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 1988.

12. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, USNRC, NUREG-0800, July 1981.

13. Recommendations for Prestressed Rock and Soil Anchors, Post Tensioning Institute, 1996.

14. ACI-211.2-98, Standard Practice for Selecting Proportions for Lightweight Concrete, American Concrete Institute.

15. ACI-214-97, Recommended Practice for Evaluation of Strength Test Results of Concrete, American Concrete Institute.

16. ACI-304.24-96, Placing Concrete by Pumping Methods, American Concrete Institute.

17. ACI-506.2-95, Specification for Shotcrete, American Concrete Institute.

18. ASTM A185-97, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement, American Society for Testing and Materials.

19. ASTM C39-2001, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, American Society for Testing and Materials.

20. ASTM C1116-2000, Standard Specification for Fiber-Reinforced Concrete and Shotcrete, American Society for Testing and Materials.

21. ISO 9001 Quality Standards, Quality Management Systems Requirements, Third Edition, 2000.

22. License Amendment Request 02-03, Spent Fuel Cask Handling, PG&E Letter DCL-02-044, April 15, 2002.

23. License Amendments 162 and 163, Spent Fuel Cask Handling, issued by the NRC, September 26, 2003.

3.3.1.2.2 Cask Cooling

The HI-STORM 100 System provides decay heat removal both during processing and final storage of the MPC. As described previously, the transfer cask conducts heat from the MPC until the MPC is transferred to the overpack where convective cooling is established. *For MPCs containing high burnup fuel (HBF), heat transfer from the transfer cask is augmented by the supplemental cooling system, to maintain the cladding temperature of the fuel cladding below the long term temperature limit for HBF.* The thermal design of the HI-STORM 100 System is discussed in detail in Chapter 4 of the HI-STORM 100 System FSAR and in Section 4.2.3.3.3 of this FSAR.

3.4 SUMMARY OF DESIGN CRITERIA

The major ISFSI structures, systems, and components (SSCs) classified as important to safety are the HI-STORM 100 System, the storage pad, the transporter, and the cask transfer facility (CTF). The principal design criteria for these SSCs are summarized in Tables 3.4-1 through 3.4-6.

- Table 3.4-1 provides the site-specific design criteria for environmental conditions and natural phenomena.
- Table 3.4-2 provides design criteria applicable to the HI-STORM 100 System. Detailed design criteria for the MPC, the overpack, and the transfer cask are listed in the HI-STORM 100 System FSAR (References 1 *and 3*), Tables 2.0.1, 2.0.2, and 2.0.3, respectively. Detailed anchorage design requirements are discussed in Section 4.2.
- Table 3.4-3 provides the design criteria for the storage pad.
- Table 3.4-4 provides the design criteria for the cask transporter.
- Table 3.4-5 provides the design criteria for the CTF.
- Table 3.4-6 provides a list of ASME Code alternatives for the HI-STORM 100 System.

3.4.1 REFERENCES

1. Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 1A, January 2003.

2. Deleted in Revision 2.

3. *Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 7, August 17, 2009*

TABLE 3.1-2

SUMMARY OF FUEL THERMAL AND RADIOLOGICAL CHARACTERISTICS

Parameter	Diablo Canyon[(a)]	MPC Limiting Values
Maximum decay heat per assembly	1,500 Watts	See footnote (b)
Maximum assembly average burnup	~58,000 MWD/MTU	See footnotes (b) ~~and (c)~~
Maximum initial enrichment	5 percent	See footnote (b)
Minimum cooling time	5 years	See footnote (b)

(a) These are the DCPP fuel characteristics. The DCPP license limits the peak fuel rod burnup to 62,000 MWD/MTU, which corresponds to a fuel assembly average burnup of approximately 58,000 MWD/MTU.

(b) In many instances, allowable fuel parameters are a function of several factors such as MPC type, fuel condition, and the use of a uniform or regionalized loading strategy. Some are also dependent upon one another (that is, burnup and cooling time or decay heat and cooling time). The limiting assembly decay heat, burnup, initial enrichment, and cooling times are specified in FSAR Section 10.2, which is consistent with the applicable limiting values in the Holtec CoC No. 1014, Amendment ~~1~~3. In all cases, the fuel stored is within the limits controlled by the Diablo Canyon ISFSI Technical Specifications and specified in FSAR Section 10.2.

~~(c) ZIRLO clad fuel is limited to a burnup of 45,000 MWD/MTU.~~

TABLE 3.4-1

TABLE 3.4-1

TABLE 3.4-2

PRINCIPAL DESIGN CRITERIA APPLICABLE TO THE HI-STORM 100 SYSTEM

Design Criterion	Design Value	Reference Documents
GENERAL		
HI-STORM 100 System Design Life	40 years	Holtec FSAR[(a)], Section 2.0.1 and Diablo Canyon ISFSI FSAR Section 3.3.1.3.1
ISFSI Storage Capacity	140 casks (138 required + 2 spare locations)	Diablo Canyon ISFSI FSAR Section 3.1
Number of Fuel Assemblies	4,400 (approx.)	Diablo Canyon ISFSI FSAR Section 3.1
Nonfuel Hardware	Borosilicate absorber rods Wet annular burnable absorber rods Thimble plug devices Rod cluster control assemblies *Neutron Source Assemblies* *Instrument Tube Tie Rods*	Diablo Canyon ISFSI FSAR Section 3.1.1.3 and Table 3.1-1 and Table 10.2-10
SPENT FUEL SPECIFICATIONS		
Type of Fuel	Non-consolidated PWR - Westinghouse 17 x 17 LOPAR and VANTAGE 5*, and later variants*	Diablo Canyon ISFSI FSAR Section 3.1.1, 10.2.1.1, and Tables 10.2-1 through 10.2-5
Fuel Characteristics	See Diablo Canyon ISFSI FSAR Tables 3.1-1 and 3.1-2 for physical, thermal, and radiological characteristics	See Diablo Canyon ISFSI FSAR Section 3.1.1, 10.2.1.1 and Tables 10.2-1 through 10.2-5
Fuel Classification	Intact, Damaged, Debris	Diablo Canyon ISFSI FSAR Section 3.1.1, 10.2.1.1, Tables 10.2-1 through 10.2-10, and Diablo Canyon ISFSI TS
STRUCTURAL DESIGN		
Design Codes	ASME III-95, with 1996 and 1997 Addenda, Subsection NB ASCE 7-88; ANSI N14.6 (93); ACI-318 (95); and ACI-349 (85)	Holtec FSAR[(a)], Tables 2.2.6, 2.2.7, 2.2.14, and 2.2.15
Environmental Conditions and Natural Phenomena	See Diablo Canyon ISFSI FSAR Table 3.4-1	Diablo Canyon ISFSI FSAR Sections 3.2 & 3.3

TABLE 3.4-2

Design Criterion	Design Value	Reference Documents
Weights	Maximum loaded transfer cask handling weight = 250,000 lb Maximum loaded overpack weight = 360,000 lb Transporter weight = 190,000 lb	Reference 4 Section 9.1.4.2.1.3 (fuel handling building crane capacity); Holtec FSAR[(a)], Section 3.2 HI-2002501, Rev.8, Table 4.2
STRUCTURAL DESIGN (continued)		
MPC Internal Pressure	Normal/off-normal = 100 psig Accident = 200 psig	Holtec FSAR[(a)], Table 2.0.1
Cask Loads and Load Combinations	See HI-STORM 100 System FSAR	Holtec FSAR[(a)], Sections 2.2.1 through 2.2.3 and Tables 2.2.13 and 2.2.14
THERMAL DESIGN		
Maximum Cask Heat Duty	Varies by MPC model, fuel loading strategy (uniform loading vs. regionalized loading), fuel assembly burnup, and cooling time Maximum PWR basket heat duty = 28.74 kW	Holtec FSAR[(a)], Section 4.4.2 and Table 4.4.28
Peak Fuel Cladding Temperature Limits	Long term (normal) ~~limits vary based on fuel cooling time~~= *752°F (400°C)* Short term (accident) = 1058°F	Holtec FSAR[(~~b~~a)], *ISG-11, Rev. 3,*Tables 4.3.7 and 4.A.2 for normal conditions and Table 4.3.1 for short term conditions
Other SSC Temperature Limits	Varies by material	Holtec FSAR[(a)(b)], Tables 2.0.1 through 2.0.3
MPC Backfill Gas	99.995% pure helium	Holtec FSAR[(a)], Section 1.2.2.1 and Diablo Canyon ISFSI FSAR Section 10.2.2.4
Maximum Air Inlet to Outlet Temperature Rise	126°F	Holtec CoC No. 1014, Amendment 1, Appendix A, LCO 3.1.2
RADIATION PROTECTION AND SHIELDING DESIGN		
Storage Cask Dose Rate Objectives	60 mrem/hr on the sides, top, and adjacent to air ducts	Holtec FSAR[(a)], Section 2.3.5.2; and Diablo Canyon ISFSI FSAR 3.3.1.5.2
Occupational Exposure Dose Limits	5 rem/yr or equivalent	10 CFR 20.1201
Restricted Area Boundary Dose Rate Limit	2 mrem/hr	10 CFR 20.1301
Normal Operation Dose Limits to Public	25 mrem/yr whole body 75 mrem/yr thyroid 25 mrem/yr and other critical organ	10 CFR 72.104

Design Criterion	Design Value	Reference Documents
RADIATION PROTECTION AND SHIELDING DESIGN (continued)		
Accident Dose Limits to Public	5 rem TEDE 50 rem DDE plus CDE 15 rem lens dose equivalent 50 rem shallow dose equivalent to skin or extremity	10 CFR 72.106
Overpack Unreinforced Concrete	Various	Holtec FSAR[ab], Appendix 1.D, *NUREG-1536*
CRITICALITY DESIGN		
Maximum initial fuel enrichment	≤ 5%	Holtec FSAR[a], Section 6.2.2.4; and Diablo Canyon ISFSI FSAR Sections 3.3.1.4.1 and 3.1.1.1, Tables 10.2-1 through 10.2-5, and the Diablo Canyon ISFSI TS
Control Method (Design Features)	MPC-32 fuel storage cell pitch ≥ 9.158 In and B-10 loading 0.0372 g/cm^2 (Boral) or ≥0.0310 g/cm^2 (Metamic) MPC 24: flux trap size ≥1.09 inch and B-10 loading ≥0.0267 g/cm^2 (Boral) or ≥0.0223 g/cm^2 (Metamic) MPC-24E AND 24EF: flux trap size ≥0.776 inch for cells 3,6, 19 and 22; ≥1.076 inch for all other fuel cells; and B-10 loading ≥0.0372 g/cm^2 (Boral) or ≥0.0310 g/cm^2 (Metamic)	Diablo Canyon ISFSI TS

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Design Criterion	Design Value	Reference Documents
Control Method (Operational)	For all MPC with maximum initial enrichment of ≤ 4.1 wt % ≥ 2000 ppm soluble boron in the MPC water during loading and unloading For MPC-24/24E/24EF with maximum initial enrichment of >4.1 and ≤ 5.0 wt% ≥ 2000 ppm soluble boron in the MPC water during loading and unloading For MPC-32 with maximum initial enrichment of 5.0 wt% ≥ 2600 ppm soluble boron in the MPC water during loading and unloading (soluble boron scaled based on MPC maximum initial enrichment between 4.1 and 5.0 wt%).	Diablo Canyon ISFSI TS
CRITICALITY DESIGN (continued)		
Maximum k_{eff}	<0.95	Holtec FSAR[(a)], Table 2.0.1; and Diablo Canyon ISFSI FSAR Section 3.3.1.4
CONFINEMENT DESIGN		
Confinement Method	MPC with redundant welds	Holtec FSAR[(a)], Section 2.3.2.1 and Chapter 7
Confinement Barrier Design	Multi-purpose canister: ASME III, NB	Holtec FSAR[(a)], Tables 2.2.6 and 2.2.15, and Diablo Canyon ISFSI TS
Maximum Confinement Boundary Leak Rate	5.0×10^{-6} atm-cm^3/sec, *for MPCs not containing high burnup fuel* *Leaktight per ANSI N14.5-1997 (1.0×10^{-7} atm-cc^3/sec), for MPCs containing high burnup fuel*	Diablo Canyon ISFSI FSAR Section 10.2.2.5

(a) Holtec HI-STORM 100 FSAR, Revision 1A
(b) Holtec HI-STORM 100 FSAR, Revision 7

TABLE 3.4-6

4.2.3.3 Design Bases and Safety Assurance

The governing codes used for the design and construction of the HI-STORM 100 System steel components are listed in HI-STORM 100 System FSAR, Table 2.2.6, and are summarized below. Clarifications on the applicability of ACI 349-85 (Reference 10) to the unreinforced concrete used in the HI-STORM 100 overpack are provided in Appendix 1.D to the HI-STORM 100 System FSAR *(Reference 41)*. Table 3.4-6 provides a list of ASME Code alternatives for the HI-STORM System.

- MPC

Pressure boundary	ASME Code Section III, Subsection NB
Fuel Basket	ASME Code Section III, Subsection NG

- DFC

Lifting Bolts	ANSI N14.6 per applicable guidelines of NUREG-0612, Section 5.1.6
Steel Structure	ASME Code Section III, Subsection NG

- Overpack

Steel	ASME Code Section III, Subsection NF
Unreinforced Concrete	ACI-349-85*, NUREG-1536*

- Transfer Cask

Steel Structure	ASME Code Section III, Subsection NF
Lifting Trunnion Blocks	ASME Code Section III, Subsection NF and ANSI N14.6 per applicable guidelines of NUREG-0612, Section 5.1.6
Lifting Trunnions	ANSI N14.6 per applicable guidelines of NUREG-0612, Section 5.1.6

The safety classification of the components comprising the HI-STORM 100 System was determined using NUREG/CR-6407 (Reference 11) as a guide. Section 4.5 provides the safety classification of the HI-STORM 100 System components and additional detail on safety classification of components used at the Diablo Canyon ISFSI.

4.2.3.3.1 System Layout

In its storage configuration, the HI-STORM 100 System consists of a fully-welded MPC placed inside of a vertical concrete overpack. Each MPC holds either 24 or 32 PWR spent fuel assemblies in an internal basket, depending on the particular MPC model. The specifics of the material approved for storage in the HI-STORM 100 System at the Diablo Canyon ISFSI storage site are discussed in Sections 3.1.1 and 10.2 and the Diablo Canyon ISFSI TS.

4.2.3.3.2.3 Thermal Expansion

Thermal expansion-induced mechanical stresses due to non-uniform temperature distribution are identified in Section 3.4.4.2 of the HI-STORM 100 System FSAR. There is adequate space (gap) between the MPC basket and shell, and between the MPC shell and overpack or transfer cask, to ensure there will be no interference during conditions of thermally induced expansion or contraction. *This was confirmed for the Diablo Canyon ISFSI specific MPC-32 derivative, when updating to a 3-Dimensional (3-D) computational fluid dynamics (CFD) model in support of LA 2 (Reference 40).*

Table 4.4.15 of the HI-STORM 100 System FSAR provides a summary of HI-STORM 100 System component temperature inputs for the structural evaluation, consisting of temperature differences in the basket periphery and MPC shell between the top and bottom portions of the HI-STORM PWR MPC (MPC-24, MPC-24E, MPC-24EF, and MPC-32). The temperature gradients were used to calculate resultant thermal stresses in the MPC that were included in the load combination analysis. The stresses resulting from the temperature gradients were shown to be within Code allowables. Section 3.4.4.2 of the HI-STORM 100 System FSAR provides a discussion of the analysis and results of the differential thermal expansion evaluation. The Diablo Canyon ISFSI TS and Section 10.2 ensure that the characteristics of the DCPP fuel to be loaded in a HI-STORM 100 System meet the limits delineated in Section 3.1.1. These limits are consistent with the bounding fuel limits for array/class 17-by-17A and 17-by-17B fuel assemblies in Appendix B to the HI-STORM 100 System CoC. Therefore, the thermal expansion evaluation, discussed above, in the HI-STORM 100 System FSAR bounds the conditions at the Diablo Canyon ISFSI.

4.2.3.3.2.4 Handling Loads

Handling loads for normal and off-normal conditions are addressed in the HI-STORM 100 System FSAR, Sections 2.2.1.2, 2.2.3.1, and 3.1.2.1.1.2. The normal handling loads that were applied included vertical lifting and transfer of the overpack with a loaded MPC through all movements. The MPC and overpack were designed to withstand loads resulting from off-normal handling assumed to be the result of a vertical drop. In the case of Diablo Canyon, however, the vertical drop during onsite transport, outside the FHB/AB, is precluded with the use of a cask transporter that is designed, fabricated, inspected, maintained, and tested in accordance with the applicable guidelines of NUREG-0612. Likewise, drops are precluded while the cask is lifted at the CTF since the transporter lifting mechanism is designed, fabricated, inspected, operated, maintained, and tested in accordance with NUREG-0612. This approach is consistent with the provisions in the HI-STORM 100 System CoC described in Section 4.2.3.3.2.5 below. The preclusion of drop events was chosen as a design strategy to accommodate the anchored HI-STORM 100SA overpack, which requires a robust pad to ensure that the anchor studs and embedment structure remain fixed during postulated earthquake and tornado events.

4.2.3.3.3 Thermal Design

The environmental thermal design criteria for the Diablo Canyon ISFSI are discussed in Section 3.2.7. Thermal performance for the HI-STORM 100 System is addressed in Chapter 4 of the HI-STORM 100 System FSAR. The HI-STORM 100 System is designed for long-term storage of spent fuel and safe thermal performance during onsite loading, unloading, and transfer operations. The HI-STORM 100 System is also designed to minimize internal stresses from thermal expansion caused by axial and radial temperature gradients. The thermal model and its benchmarking with full size cask test data is described in Reference 20.

The HI-STORM 100 System is designed to transfer decay heat from the spent fuel assemblies to the environment. The MPC design, which includes the all-welded honeycomb basket structure, provides for heat transfer by conduction, convection, and radiation away from the fuel assemblies, through the MPC basket structure and internal region, to the MPC shell. The internal MPC design incorporates top and bottom plenums, with interconnected downcomer paths, to accomplish convective heat transfer via the thermosiphon effect. The MPC is pressurized with helium, which assists in transferring heat from the fuel rods to the MPC shell by conduction and convection. Gaps exist between the basket and the MPC shell to permit unrestrained axial and radial thermal expansion of the basket without contacting the shell, thus minimizing internal stresses. The stainless steel basket conducts heat from the individual spaces for storing fuel assemblies out to the MPC shell.

The HI-STORM 100SA overpack design provides an annular space between the MPC shell and the inner steel liner of the overpack for airflow up the annulus. Relatively cool air enters the four inlet ducts at the bottom of the overpack, flows upward through the annulus removing heat from the MPC shell by convection, and exits the four outlet ducts at the top of the cask.

The thermal analysis, discussed in Chapter 4 of the HI-STORM 100 System FSAR was performed using the ANSYS and FLUENT (Reference 14) computer codes. The HI-STORM PWR MPCs (MPC-24, MPC-24E, MPC-24EF, and MPC-32) were evaluated to determine the temperature distribution under long-term, normal storage conditions, assuming the MPCs are loaded with design basis PWR fuel assemblies.

Maximum-assembly, decay-heat-generation rates for fuel to be loaded into these two MPC models are specified in Section 10.2. ~~The decay-heat-generation limits vary by cooling time.~~

The thermal analysis assumed that the HI-STORM overpacks are in an array, subjected to an 80°F-annual-average ambient temperature, with full insolation. The annual-average temperature takes into account day-and-night and summer-and-winter temperatures throughout the year. The annual-average temperature is the principal design parameter in the HI-STORM 100 System design analysis, because it establishes the basis for demonstration of long-term spent nuclear fuel integrity. The long-term integrity of the spent fuel cladding is a function of the average-ambient temperature over the entire storage period, which is assumed to be at the maximum annual-average temperature in every year of storage for conservatism. The results of this analysis are presented in Tables 4.4.9, 4.4.26 and 4.4.27 of the HI-STORM 100 System FSAR for MPC-24, MPC-24E, MPC-24EF, and MPC-32, respectively. The results, summarized in HI-STORM 100 System FSAR Table 4.2-3, indicate that temperatures of all components are within normal condition temperature limits. These results bound the Diablo Canyon ISFSI site since the average-annual temperature at the site is only 55°F (Section 2.3.2).

Section 11.1.2 of the HI-STORM 100 System FSAR discusses the temperatures of the HI-STORM 100 System for a maximum off-normal, daily-average ambient temperature of 100°F, which is an increase of 20° F from the normal conditions of storage discussed above. The maximum off-normal temperatures were calculated by adding 20° F to the maximum normal temperatures from the highest component temperature for the MPC-24, MPC-24E, MPC-24EF, and MPC-32. All of the maximum off-normal temperatures are below the short-term peak fuel cladding temperature limits (HI-STORM 100 System FSAR Table 2.2.3). Therefore, all components are within allowable temperatures for the 100° F-ambient-temperature condition. Since the highest hourly temperature recorded at the Diablo Canyon Site is 97° F (Section 2.3.2), the HI-STORM 100 System FSAR evaluation bounds the Diablo Canyon ISFSI site.

The thermal analysis in the HI-STORM 100 System FSAR discussed above includes the following global assumptions: (a) the concrete pad is assumed to be an insulated surface (that is, no heat transfer to or from the pad is assumed to occur), (b) adjacent casks are assumed to be sufficiently separated from each other (that is, cask pitch is sufficiently large) so that their ventilation actions are autonomous, and (c) the cask is assumed to be subject to full solar insolation on its top surface as well as view-factor-adjusted solar insolation on its lateral surface, based on 12-hour insolation levels recommended in 10 CFR 71 (800g-cal/cm^2 averaged over a 24-hour period as allowed in NUREG-1567). The evaluation of insolation is further discussed in Section 4.4.1.1.8 of the HI-STORM 100 System FSAR.

Ambient-temperature and incident solar radiation (insolation) values applicable to the ISFSI site are summarized in Section 2.3.2. The highest and lowest hourly recorded temperature, as recorded at one of the recording stations at the Diablo Canyon site, is 97° F in October 1987 and 33°F in December 1990, respectively. The annual-average temperature is approximately 55° F. The maximum insolation values for the ISFSI site are estimated to be 766 g-cal/cm^2 per day for a 24-hour period and 754 g-cal/cm^2 for a 12-hour period.

Second-order effects such as insolation heating of the concrete pad, heating of feed air traveling downward between casks and entering the inlet ducts of the reference cask, and radiative heat transfer from adjacent spent fuel casks were not explicitly modeled in the HI-STORM 100 System FSAR analysis.

Within a loaded transfer cask, heat generated in the MPC is transported from the contained fuel assemblies to the MPC shell. A small, diametrical air gap exists between the outer surface of the MPC and the inner surface of the transfer cask. Heat is transported across this gap by the parallel mechanisms of conduction, natural convection, and thermal radiation. Assuming that the MPC is centered and does not contact the transfer cask walls conservatively minimizes heat transport across this gap. Additionally, thermal expansion that would minimize the gap is conservatively neglected.

Heat is transported through the cylindrical wall of the transfer cask by conduction through successive layers of steel, lead, and steel. A water jacket, which provides neutron shielding for the transfer cask, surrounds the cylindrical steel wall. The water jacket is composed of a carbon steel shell attached to the outer shell of the transfer cask by radial fins. Conduction heat transfer occurs through both the water cavities and the fins. While the water jacket openings are sufficiently large for natural convection loops to form, this mechanism is conservatively neglected. Heat is passively rejected to ambient from the outer surface of the transfer cask by natural convection and thermal radiation.

In the vertical position, the bottom face of the transfer cask is in contact with a supporting surface. This face is conservatively modeled as an insulated surface. Because the transfer cask is not used for long-term storage in an array, radiative heat blocking does not need to be considered. The transfer cask top lid is modeled as a surface with convection, radiative heat exchange with air, and a constant, maximum-incident solar heat flux load. Insolation on cylindrical surfaces is conservatively based on 12-hour levels prescribed in 10 CFR 71 and averaged on a 24-hour basis. Concise descriptions of these models are described in Section 4.5 of the HI-STORM 100 System FSAR.

The HI-STORM 100 System was analyzed for an extreme hot ambient temperature of 125°F averaged over a 72-hour time period. Section 8.2.10 of this FSAR and Section 11.2.15 of the HI-STORM 100 System FSAR provide discussions of the analysis of this extreme temperature condition. The ambient temperature is applied coincident with full solar insolation. Resulting fuel cladding temperatures are well below their short-term temperature limit. The balance of the HI-STORM 100 System structure remains insignificantly affected. Since the extreme hot ambient temperature at the Diablo Canyon site is 104°F, the extreme hot ambient temperature evaluation in the HI-STORM 100 System FSAR bounds the conditions at Diablo Canyon.

The HI-STORM 100 System was also evaluated for a -40°F, extreme-low ambient temperature condition, as discussed in Section 4.4.3 of the HI-STORM 100 System FSAR. Zero decay heat generation from spent fuel, and no solar insolation were conservatively assumed. All materials of construction for the MPC and overpack will perform their design function under this extreme cold condition. Since the minimum temperature at the Diablo Canyon site is greater than 24°F (Table 3.4-1), the extreme low ambient temperature evaluation in the HI-STORM 100 System FSAR bounds the conditions at Diablo Canyon.

At Diablo Canyon, ~~T~~*t*he thermal performance of the MPC to limit fuel cladding temperature inside the transfer cask during welding, draining, drying, and helium backfill operations, and during transportation of the loaded transfer cask to the CTF is bounded by the thermal evaluation performed with the MPC *helium filled and in the transfer cask with the annulus void of water.*~~under a hypothetical, complete-vacuum condition.~~ Th*ise* ~~vacuum~~ condition is bounding for the other transient operational conditions mentioned above, because *it maximizes the resistance* there is ~~no fluid medium~~ to *heat* transfer ~~heat~~ from ~~the fuel to~~ the MPC shell *to the environment*. In the other conditions, there *are temperature controls on*~~is some amount of~~ either *the* helium or water in the MPC cavity *to limit the cladding temperature.* ~~to enhance heat transfer. All internal MPC heat transfer in the vacuum condition is through conduction and radiation.~~*The maximum cladding temperature for this bounding condition is well below the 1058°F short term limit.*

When a modified MPC-32 was developed for use at the Diablo Canyon ISFSI, a site specific thermal evaluation (Reference 36) was performed to verify that the modified design was in compliance with the limits established for the HI-STORM 100 system. This analysis demonstrated that for all conditions of system operation with a design basis heat load, that the required temperature limits were met.

In support of LA 2, the site specific thermal analysis was updated to a 3-D CFD analysis (Reference 40), and the analysis was modified to address the storage of HBF in accordance with the requirements of ISG-11, Rev. 3. This analysis demonstrated that fuel cladding temperatures met the requirements for all conditions, although a supplemental cooling system (SCS) was required for a helium filled, MPC loaded with HBF in the HI-TRAC. The SCS is used to maintain the temperature of the MPC shell at a temperature that ensures that the maximum temperature of the fuel cladding does not exceed its long term limits. As part of this new analysis some of the individual component temperature limits were updated to those authorized in later HI-STORM Amendments (through Amendment 5).~~Sections 4.5.1.1.4 and 4.5.2.2 of the HI-STORM 100 System FSAR discuss the thermal evaluation of the MPC under vacuum conditions~~

~~and the resultant MPC and fuel cladding temperatures with design-basis heat load. Maximum fuel cladding temperatures for the MPC-24, MPC-32, and MPC-24E are shown to be 960 °F, 1040 °F, and 942 °F, respectively, in Table 4.5.9 of the HI-STORM 100 System FSAR. All of these temperatures are less than the short-term temperature limit of 1058 °F. The design-basis heat load used for this evaluation bounds the heat load for all combinations of DCPP fuel to be loaded into the HI-STORM 100 System. The characteristics of the operations to be performed at Diablo Canyon are the same as those described in the HI-STORM 100 System FSAR. Therefore, the evaluations described in Section 4.5 of the HI-STORM 100 System FSAR bound operations at DCPP.~~

The above discussion demonstrates that the HI-STORM 100 System as deployed at the Diablo Canyon ISFSI meets the requirements of 10 CFR 72.122(h), 72.128(a)(4), and 72.236(f) and (g) for thermal design.

4.2.3.3.3.1 HI-STORM Overpack at the CTF

The site-specific design of the Diablo Canyon CTF involves transferring a loaded MPC into the overpack with the overpack located below grade in a vault. The thermal implications of the difference between a loaded overpack located in a vault and one located at grade level have been evaluated.

Under normal conditions, the loaded overpack remains in the vault only for the time it takes to remove the transfer cask from atop the overpack, retrieve and install the overpack lid, and raise the overpack out of the vault with the transporter. This is expected to take less than 4 hours and has an insignificant effect on heat removal and fuel cladding temperatures.

Under off-normal conditions, such as a transporter failure affecting the CTF lift operation, the condition could last several hours, depending upon the time it takes to complete corrective actions to restore the transporter, or to provide an alternate lift capability. The effect of a loss of function of the transporter on the ability of the overpack to transfer the heat from the MPC to the environs is discussed in Section 8.1.7. The evaluation shows that *ISG-11 Rev. 3* cladding temperature limits are not exceeded, and the MPC can remain in this configuration for as long as necessary to allow restoration of transporter function, as described in Section 8.1.7.

4.2.3.3.4 Shielding Design

Shielding design and performance for the HI-STORM 100 System is addressed in Section 3.3.1.5.2 and Chapter 7 of this FSAR specifically for the Diablo Canyon ISFSI, and in Chapter 5 of HI-STORM 100 System FSAR *(Reference 42)* for the HI-STORM 100 System generically. The HI-STORM 100 System is designed to maintain radiation exposure ALARA in accordance with 10 CFR 72.126(a). The concrete overpack is designed to limit the average external contact dose rates (gamma and neutron) to ~~60~~

135 mrem/hr on the sides, 60 mrem/hr on top, and ~~60~~ 135 mrem/hr at the air inlets and outlets based on HI-STORM design basis fuel.

The overpack is a massive structure designed to provide gamma and neutron shielding of the spent fuel assemblies stored within the MPC. Most of the side shielding is provided by the overpack, although the MPC structure is credited in the shielding model. The overpack steel inner shell, the concrete-filled annulus, and the steel outer shell provide radiation shielding for the side of the overpack. The steel MPC lid and the overpack lid provide axial shielding at the top. The MPC lid is approximately 10 inches thick and is stainless steel. The overpack lid consists of a 4-inch thick steel top plate and steel-encased concrete. The lid shield configurations differ between the HI-STORM 100 and the HI-STORM 100S designs as shown on the respective drawings in Section 1.5 of the HI-STORM 100 System FSAR. In both designs, particular emphasis is placed on providing overpack lid shielding above the annulus between the MPC and the overpack inner shell, which is a streaming path.

The configuration of the inlet and outlet ducts in relation to the MPC prevents a direct radiation-streaming path from the MPC to outside the cask. The duct dose rates are further reduced by the installation of duct photon attenuators to minimize scatter (Figure 4.2-7). The HI-STORM 100 System design allows for necessary personnel access during inspection and maintenance operations, while keeping dose rates ALARA. The HI-STORM 100 System FSAR *(Reference 42)*, Section 5.1.1 provides generic calculated dose rates around the sides and top of the HI-STORM 100S overpack. Predicted Diablo Canyon ISFSI dose rates and site-specific dose evaluations are presented in Chapter 7 for the HI-STORM 100 System, and meet the requirements of 10 CFR 72.104 and 72.106.

The transfer cask provides shielding to maintain occupational exposures ALARA in accordance with 10 CFR 20, while also maintaining the maximum load on the FHB crane hook to 125 tons or less. The ~~plant specific~~ dose rates for a transfer cask loaded with design basis fuel *which* are used to perform the occupational exposure estimate for MPC loading, closure, and transfer operations, a*re*~~s~~ described in Chapter 7. The actual dose rates from a loaded transfer cask during operations in support of loading fuel for the Diablo Canyon ISFSI will be lower because the actual MPCs to be loaded will not contain design-basis fuel in every fuel storage location. Occupational exposures during transfer cask operations are monitored and maintained ALARA in accordance with the DCPP radiation protection program and the requirements of 10 CFR 20.

The above discussion demonstrates that the HI-STORM 100 System as used at the Diablo Canyon ISFSI meets the requirements of 10 CFR 72.104, 72.106, 72.128(a)(2), and 72.236(d) for shielding design.

4.2.3.3.5 Criticality Design

Criticality of the HI-STORM 100 System is addressed in Section 3.3.1.4 of this FSAR and Chapter 6 of the HI-STORM 100 System FSAR. The HI-STORM 100 System is designed to maintain the spent fuel subcritical in accordance with 10 CFR 72.124(a) and (b) with the MPC materials and geometry. The acceptance criterion for the prevention of criticality is that k_{eff} remain below 0.95 for all normal, off-normal, and accident conditions.

Criticality safety of the HI-STORM 100 System depends upon the following four principal design parameters:

- Administrative limits on the maximum fuel assembly enrichment and physical properties acceptable for storage in the MPC
- The inherent geometry of the fuel basket designs within the MPC, including the flux-traps in the MPC-24, MPC-24E, and MPC-24EF (water gaps for loading fuel into submerged MPCs)
- The incorporation of permanent, fixed, neutron-absorbing panels (Boral or Metamic) in the fuel basket structure to assist in control of reactivity
- Administrative controls requiring minimum concentrations of soluble boron in the MPC water during fuel loading and unloading, depending upon MPC model and fuel enrichment

The criticality analysis performed for the HI-STORM 100 System assumes only fresh fuel with no credit for burnup as a conservative bounding condition. In addition, no credit is taken for fuel-related burnable neutron absorbers, and it is assumed that the Boron-10 content in the Boral is only 75 percent of the manufacturer's minimum specified content, and the Boron-10 content of Metamic is only 90 percent of the manufacturer's minimum. Boral or Metamic panels are intended to have no significant flaws. However, to account for manufacturing deviations occurring during installation of the panels into the MPC fuel basket, neutron absorber damage up to the equivalent of a 1-inch diameter hole in each panel has been analyzed and found to be acceptable (Appendix H of Reference 37). Other assumptions made to ensure the results of the analysis are conservative are identified in Section 6.1 of the HI-STORM 100 System FSAR.

In its storage configuration, the HI-STORM 100 System is dry (no moderator), and the reactivity is very low (k_{eff} less than 0.515). At the Diablo Canyon ISFSI, the fuel is always in a dry, inert-gas environment. It is sealed within a welded MPC, and no credible accident will result in water entering the MPC. The limiting reactivity condition occurs in the SFP during fuel loading, where assemblies are loaded into the MPC in close proximity to each other, with moderator between assemblies. All fuel loaded into the MPC-32, regardless of enrichment, requires a certain amount of soluble boron in the MPC during loading to preserve the assumptions of the criticality analyses. Higher enriched fuels loaded into the MPC-24, MPC-24E, or MPC-24EF also require soluble boron in the MPC during loading operations. The Diablo Canyon ISFSI TS ensure that soluble boron is appropriately maintained during fuel loading operations.

The results of the criticality analyses of different fuel types are shown in Chapter 6 of the HI-STORM 100 System FSAR for the MPC-24, MPC-24E, MPC-24EF, and MPC-32. The results confirm that the maximum reactivities of the MPCs are below the design criteria (k_{eff} less than 0.95) for fuels with specified maximum allowable enrichments, considering calculational uncertainties. The PWR fuel types for which these analyses were performed are shown in Table 2.1.3 of the HI-STORM 100 System FSAR. ~~With the exception of DCPP fuel assemblies with Zirlo clad fuel with burnup >45,000 MWD/MTU, a~~All DCPP fuel is bounded by array/classes 17x17A and 17x17B. No credit is taken for neutron poison in the form of gadolinium in the fuel pellets or in the IFBA rods; therefore, fuel assemblies containing these poisons are acceptable for loading.

Accident conditions have also been considered, and no credible accidents have been identified that would result in exceeding the regulatory limit on reactivity. In Section 6.1 of the HI-STORM 100 System FSAR Holtec determined that the physical separation between overpacks due to the large diameter and cask pitch, and the concrete and steel radiation shields, are each adequate to preclude any significant neutronic coupling between HI-STORM 100 Systems.

Section 6.4.4 of the HI-STORM 100 System FSAR discusses the results of criticality analyses on MPCs storing damaged fuel in a Holtec damaged fuel container. Analyses were performed for three possible scenarios. The scenarios are:

- Lost or missing fuel rods, calculated for various numbers of missing rods in order to determine the maximum reactivity.
- Fuel assembly broken with the upper segments falling into the lower segment creating a close-packed array. For conservatism, the array was assumed to retain the same length as the original fuel assemblies.
- Fuel pellets lost from the assembly and forming powdered fuel dispersed through a volume equivalent to the height of the original fuel, with the flow channel and cladding material assumed to disappear.

Results of these analyses confirm that, in all cases, the maximum reactivity of the HI-STORM 100 System with design-basis failed fuel in the most adverse post-accident condition will remain well below the regulatory limit within the enrichment range analyzed.

The HI-STORM 100 System is designed such that the fixed neutron absorber (Boral or Metamic) will remain effective for a storage period greater than 20 years, and there are no credible means to lose the Boral or Metamic effectiveness. As discussed in Section 6.3.2 of the HI-STORM 100 System FSAR, the reduction in Boron-10 concentration due to neutron absorption from storage of design-basis fuel in a HI-STORM 100SA overpack over a 50-year period is expected to be negligible. Further, the analysis in Appendix

3.M of the HI-STAR 100 System FSAR demonstrates that the sheathing, which affixes the Boral or Metamic panel, remains in place during all credible accident conditions, and thus the Boral or Metamic panel remains fixed for the life of the Diablo Canyon ISFSI. Therefore, verification of continued efficacy of the Boral or Metamic neutron absorber is not required. This is consistent with the requirements of 10 CFR 72.124(b).

For MPCs filled with pure water, the reactivity of any PWR assembly with nonfuel hardware inserted into the guide tubes is bounded by (that is, lower than) the reactivity of the same assembly without the inserts. This is because the inserts reduce the amount of moderator, while the amount of fissile material remains unchanged. In the presence of soluble boron in the water, especially for higher-required soluble boron concentrations, it is possible that the nonfuel hardware in the PWR assembly results in an increase of reactivity. This is because the insert not only replaces water, but also replaces the neutron absorber in the water with a nonpoison material. To account for this effect, analyses with and without nonfuel hardware in the assemblies were performed for higher soluble boron concentrations in support of Holtec LAR 1014-1. The highest reactivities for either case are used as the basis of the criticality evaluation. Section 6.4.8 of the HI-STORM 100 System FSAR provides additional discussion of the criticality effect of nonfuel hardware stored with PWR spent fuel assemblies.

During development of the DC ISFSI License Application, PG&E identified that a criticality analysis had not been performed for the VANTAGE 5 option of annular pellets in the axial blanket region of the fuel assemblies, should the annular pellets be flooded with water. Holtec subsequently performed the analysis and documented it in Appendix R of Holtec Report HI-2012771, Revision 12, "HI-STAR 100 and HI-STORM 100 Additional Criticality Calculations", dated April 30, 2006. This analysis concluded that up to 12 inches of annular pellets, of various IDs, in the axial blanket regions of a fuel assembly show no significant reactivity effects, even if the annular region is flooded with pure water. All Holtec criticality calculations for PWR fuel assemblies have been performed using solid pellets along the entire length of the active fuel region, and the results are directly applicable to those PWR assemblies with annular pellets. This analysis was accepted by the NRC during the HI-STORM CoC Amendment 3 review, as documented in the associated SER. As such, there is no need for an administrative restriction to the VANTAGE 5 fuel allowed for loading and storage at the DC ISFSI based on the use of the annular pellet option.

During cask loading and unloading activities in the FHB/AB, criticality monitoring requirements of 10 CFR 72.124(c) are met using a combination of installed and portable radiation monitoring instrumentation, in accordance with GDC-63 (to detect conditions that may result in excessive radiation levels and to initiate appropriate safety actions). As discussed in PG&E letter DCL-97-058, dated April 3, 1997, the radiation monitoring instrumentation generally conforms to the guidance of Regulatory Guide 8.12, "Criticality Accident Alarm Systems," and ANSI/ANS 8.3-1979, "Criticality Accident Alarm System." As discussed in DCPP FSAR Update Section 9.1.2.2, spent fuel pool radiation monitors RM-58 and RM-59 provide personnel protection and general surveillance of the spent fuel pool area. As discussed in DCL-97-058, portable radiation monitors are placed in the cask washdown area to provide personnel protection and general surveillance of this area. On November 12, 1997, the NRC granted PG&E an exemption from the requirements of 10 CFR 70.24 concerning criticality monitors. In DCL-02-044 dated April 15, 2002, which submitted License Amendment Request 02-03, Spend Fuel Cask Handling, PG&E requested an exemption from the 10 CFR 72. 124(c) criticality monitoring requirement by requesting an extension of the NRC's November 12, 1997, exemption for the FHB/AB to envelop the activities associated with the Diablo Canyon ISFSI FSAR.

In PG&E letter DCL-02-117, "Change in Licensing Basis Compliance from 10 CFR 70.24 to 10 CFR 50.68(b)," dated October 2, 2002, PG&E informed the NRC that PG&E would revise the DCPP licensing basis to reflect compliance with 10 CFR 50.68(b) in lieu of 10 CFR 70.24 and that the exemption request in PG&E letter DCL-02-044 would be revised to request a similar exemption from 10 CFR 50.68(b) in lieu of 10 CFR 70.24.

10 CFR 50.68(b)(1) prohibits the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water. Specifically, the regulation ensures a subcritical condition will be maintained without credit for soluble boron. For an MPC loaded with fuel having the highest permissible reactivity, soluble boron credit is necessary to ensure the MPC remains subcritical in the DCPP SFP. Therefore, PG&E requested an exemption from 10 CFR 50.68(b)(1) to allow MPC loading, unloading, and handling operations without meeting the requirement of being subcritical under the most adverse moderation conditions feasible by unborated water.

In the exemption request (Reference 30), PG&E evaluated the possibility of an inadvertent criticality during MPC loading, unloading, and handling in the DCPP SFP. Based on the alarms, procedures, administrative controls, assumption of zero burnup fuel, and availability of trained operators described in Reference 30, the NRC granted an exemption (Reference 31) from the criticality requirements of 10 CFR 50.68(b)(1) during loading, unloading, and handling of the MPC in the DCPP SFP.

The Holtec design, associated procedural controls, the proposed Diablo Canyon ISFSI Technical Specifications (TS) and Section 10.2 preclude accidental criticality when the spent fuel has been properly placed in the storage cask confinement system and the confinement system has been adequately drained, dried, inerted, and sealed.

The analysis of a fuel assembly drop onto the racks, and the drop of a fuel cask in the SFP, shows criticality is prevented and is also addressed in the 10 CFR 50 spent fuel cask handling LAR and license amendments (References 32 and 33, respectively).

The above discussion demonstrates that the HI-STORM 100 System as deployed at the Diablo Canyon ISFSI meets the requirements of 10 CFR 72.124 and 72.236(c) for criticality design.

4.2.3.3.6 Confinement Design

Confinement design for the HI-STORM 100 System is addressed in Chapter 7 of the HI-STORM 100 System FSAR. The confinement vessel of the HI-STORM 100 System is the MPC, which provides confinement of all radionuclides under normal, off-normal, and accident conditions in accordance with 10 CFR 72.122(h). The MPC consists of the MPC shell, bottom base plate, MPC lid, vent and drain port cover plates, and the MPC closure ring, which form a totally welded vessel for the storage of spent fuel assemblies. The MPC requires no valves, gaskets, or mechanical seals for confinement. All components of the confinement system are classified as important to safety.

The MPC is a totally welded pressure vessel designed to meet the stress criteria of ASME Section III, Subsection NB. No bolts or fasteners are used for closure. All factory welds are examined per ASME Section III and helium leak tested to ensure conformance to the offsite dose analysis. All closure welds are examined using the liquid-penetrant method. Two penetrations are provided in the MPC lid for draining, drying, and backfilling during loading operations. Following loading operations, vent and drain port cover plates are welded to the MPC lid and helium leak tested to ensure their integrity. A closure ring, which covers the penetration cover plates and welds, is welded to the MPC lid to provide redundant closure of the MPC vessel. The loading and welding operations are performed inside the DCPP FHB/AB. There are no confinement boundary penetrations required for MPC monitoring or maintenance during storage.

For those MPCs to be loaded with HBF, the confinement boundary will be considered leak tight. The factory shell welds and the vent and drain port cover plate welds will be helium leakage tested to the "leaktight" criteria of ANSI N.14.5-1997. The lid-to-shell (LTS) weld is a large, multi-pass weld which is placed and inspected in accordance with ISG-15; therefore in accordance with ISG-18, leakage from this weld is considered non-credible.

The confinement features of the HI-STORM 100 System meet the requirements of 10 CFR 72.122(h).

4.2.6 REFERENCES

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3. ANSYS Finite Element Modeling, ANSYS Inc., Southpointe 275 Technology Drive; Canonsburg, PA.

4. ACI-349-97, Code Requirements for Nuclear Safety Related Concrete Structures, American Concrete Institute, 1997.

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14. FLUENT Computational Fluid Dynamics Software, Fluent, Inc., Centerra Resource Park, 10 Cavendish Court, Lebanon, NH 03766.

15. PG&E Calculation No, 52.27.100.705 (PGE-009-CALC-001), "Embedment Support Structure."

16. Calculation PGE-009-CALC-006, "ISFSI Cask Storage Pad Concrete Shrinkage and Thermal Stresses."

17. Calculation PGE-009-CALC-007, ISFSI Cask Storage Pad Steel Reinforcement."

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21. PG&E Calculation OQE-017, "Cask Transfer Facility Seismic Restraint Configuration."

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25. Holtec International Report No. HI-2053370, "Structural Analysis of CTF at DCNP Under Design Basis Loads," Revision 2.

26. PG&E Letter DIL-03-003 to the NRC, Revised Response to NRC Request for Additional Information 5-1 for the Diablo Canyon ISFSI Application, March 27, 2003.

27. PG&E Letter DIL-03-004 to the NRC, Supplemental Slope Stability Response to Additional NRC Questions for the Diablo Canyon ISFSI Application, March 27, 2003.

28. PG&E Letter DIL-03-007 to the NRC, Supplemental Slope Stability Design Mitigation Features Information to Additional NRC Questions for the Diablo Canyon ISFSI Application, May 6, 2003.

29. PG&E Letter DIL-03-015 to the NRC, Additional Information on Cask Transfer Facility Cask Transporter Lateral Restraint System, December 4, 2003.

30. PG&E Letter DCL-03-126 to the NRC, Request for Exemption from 10 CFR 50.68, Criticality Accident Requirements for Spent Fuel Cask Handling, October 8, 2003, supplemented by PG&E Letters DCL-03-150 and DIL-03-014, Response to NRC Request for Additional Information Regarding Potential Boron Dilution Events with a Loaded MPC in the DCPP SFP, November 25, 2003.

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33. License Amendments 162 and 163, Spent Fuel Cask Handling, issued by the NRC, September 26, 2003.

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4.3.2.5 MPC Lift Cleats

The MPC lift cleats are ancillary devices temporarily attached to the MPC lid and used during transfer of the loaded MPC between the transfer cask and the overpack. The MPC lift cleats transmit the weight of the loaded MPC to the MPC downloader slings. The MPC lift cleats are classified as important to safety. The MPC lift cleats are special lifting devices that are designed in accordance with ANSI N14.6 per the guidance of NUREG-0612, Section 5.1.6. *As documented in Holtec Report HI-992234 (Reference 9) the MPC Lift Cleat nuts are only required to be tightened to wrench tight to perform their intended function.*

4.3.5 REFERENCES

1. 10 CFR 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.

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8. Holtec International Report No. HI-2053390, "Structural Evaluation of the Low Profile Transporter," Revision 4.

9. *Holtec International Report HI- 992234, "Stress Analysis of MPC Lift Cleat," Revision 5*

4.4.1.2.3 MPC and HI-TRAC Preparation for Storage

The loaded transfer cask and MPC are lowered to the Unit 2 cask washdown area inside a seismic restraint structure and the cask is decontaminated.

The water level in the MPC is lowered slightly, and the MPC lid is welded to the MPC shell using the automated welding system (AWS) augmented by manual welding as necessary. Liquid penetrant (PT) examinations will be performed on the root and final weld layers, and each approximately 3/8-inch of weld depth. For the MPC-24, -24E, and –32, which have a 3/4-inch deep MPC lid-to-shell weld, this will require one or two intermediate PT examinations. For the MPC-24EF, which has a 1-1/4 inch deep lid-to-shell weld, four intermediate PTs will be required. The examinations are performed in accordance with the commitments in the HI-STORM 100 System FSAR.

After MPC-lid welding, the water in the MPC is raised again and a hydrostatic test is performed. Upon successful hydrostatic test completion, the MPC is completely drained of water using the MPC blowdown system. *The MPC to transfer cask annulus is drained of water, and* ~~T~~the last of the water is removed ~~via evaporation through the use of a vacuum drying system (as the pressure in the MPC is reduced, causing evaporation of residual water) or~~ *from the MPC* through the use of a forced helium dehydration (FHD) system. The design criteria for the FHD system are provided in Section 10.2. The Diablo Canyon ISFSI TS program controls and Section 10.2 specify the dryness acceptance criteria ~~for both methods of drying~~. After meeting the drying acceptance criteria, the MPC is backfilled with 99.995 percent pure helium to within a pressure range defined by Section 10.2.

When the MPC has been satisfactorily drained, dried, backfilled with helium, *if the MPC contains any high burnup fuel assemblies (> 45,000 MWD/MTU) the transfer cask annulus is filled with demineralized water and the supplemental cooling system (SCS) is placed in service.* t*T*he MPC vent and drain port cover plates are welded on, inspected, and helium leak tested in accordance with the commitments in the HI-STORM 100 System FSAR, including ANSI N14.5-97 (Reference 3). Then, the MPC closure ring is welded in place and inspected in accordance with the HI-STORM 100 System FSAR. The inner diameter of the closure ring is welded to the MPC lid and the outer diameter is welded to the top of the MPC shell. The MPC-to-transfer cask annulus will have been drained prior to drying using FHD, and if vacuum drying is used the annulus may be drained at any time after the MPC has been successfully backfilled with helium.

The transfer cask top lid is installed*, the SCS, if in use, is temporarily removed,* and the cask is released from the cask washdown area seismic restraint structure. The transfer cask is then lifted by the single failure proof FHB/AB crane. The height to which the transfer cask is lifted is carefully controlled to that needed to move the cask onto the LPT.

The transfer cask is then moved laterally to the LPT and attached to the LPT baseplate. The LPT with the loaded transfer cask is moved out of the FHB/AB on removable tracks to a position just outside the FHB/AB door. The transfer cask is positioned under the lift beam of the cask transporter and the transfer cask lift links are connected to the cask. The transfer cask is unbolted from the LPT, then raised and secured within the transporter for the trip to the CTF. *When the transfer cask is secured to the transporter, the SCS is reestablished, if required.*

4.4.1.2.4 MPC Transfer and Overpack Storage at the ISFSI

Outside the FHB/AB, the loaded transfer cask is rigged to the cask transporter and moved to the CTF in the vertical position. These evolutions and the cask transport system design, including associated lifting components, are described in more detail in Sections 4.3 and 5.1. The design of the CTF is discussed in Section 4.4.5.

At the CTF, the empty overpack is prestaged in the subterranean vault with approximately the top 3 ft of the overpack extending above grade level. At this stage of the loading process, the overpack is supported by the CTF baseplate and fitted with a cask-mating device. When the cask transporter arrives at the CTF, it moves the transfer cask over the overpack*, the SCS is disconnected,* and *the transfer cask is* place*d*s it atop the cask mating device on the overpack.

After the transfer cask is placed atop the overpack, the MPC lift cleats are installed. The MPC downloader and MPC lift slings are used to lift the MPC by the lift cleats just enough to take the weight of the MPC off the transfer cask bottom lid. The MPC downloader system is integral to the cask transporter and is located on the bottom flange of the horizontal lift beam of the cask transporter. Once the weight of the loaded MPC is taken off the bottom lid, the bottom lid is unbolted and the cask-mating device is used to remove the lid, creating a clear path between the transfer cask and the overpack. The MPC is then lowered into the overpack using the MPC downloader slings and the slings are lowered onto the top of the MPC. The transfer cask is removed from the top of the overpack and placed out of the way, allowing the downloader slings and MPC lift cleats to be removed. The overpack lid is installed and the overpack is transported to the storage pad using the cask transporter.

4.4.1.3.1 Considerations Inside the 10 CFR 50 Facility

NUREG-0612 provides guidelines to licensees to ensure the safe handling of heavy loads. The guidelines define acceptable alternatives for heavy load movements, which include using a single failure proof handling system or analyzing the effects of a load drop.

Inside the FHB/AB, the cask and any ancillary components are lifted, handled, and moved in accordance with DCPP procedures and the DCPP Control of Heavy Loads Program for lifting heavy loads, as applicable. The FHB/AB crane hoist is used with a lift yoke to perform all lifts of the cask inside the FHB/AB. The transfer-cask-lifting trunnions and the lift yoke are designed, fabricated, inspected, maintained, and tested in accordance with NUREG-0612 to ensure that structural failures of these items are not credible. PG&E's Control of Heavy Loads Program controls the design of special lifting devices in accordance with ANSI N14.6 (Reference 5). This program is fully described in DCPP FSAR Update, Section 9.1.4.3.5. The existing FHB/AB crane has been upgraded to be single-failure proof, as defined in NUREG-0612, Section 5.1.2 (Reference 6). Therefore, cask drops inside the FHB/AB when using the FHB/AB crane are not considered credible.

In the Unit 2 cask washdown area, a seismic restraint structure secures the transfer cask while preparing the transfer cask and empty MPC for fuel loading in the SFP, preparing the loaded MPC and transfer cask for transport to the CTF, and, if necessary, preparing the transfer cask and loaded MPC for fuel unloading in the SFP. The seismic restraint structure is located in the corner of the cask washdown area and consists of a wall mounted platform with a restraining strap and a floor mounted restraining plate. The capability of the seismic restraint structure to prevent tip-over or damage to the HI-TRAC during postulated seismic events is demonstrated in analyses provided in Holtec Report HI-2063593 (Reference 15).

Cask tipover events are precluded during transport of the loaded cask while on the LPT through the design of the LPT. A structural analysis of the cask on the LPT during seismic events was performed in Holtec Report HI-2053390 (Reference 16), which measured the peak displacements of the top of the cask relative to the ground. The analysis results show that overturning of the loaded cask during seismic events is not credible. During a seismic event the maximum potential longitudinal sliding along the tracks for a loaded LPT is on the order of 45 inches. The LPT and loaded transfer cask would not experience accelerations greater than the 45 g design basis limit during any sliding event.

A boron dilution analysis was performed and submitted to the NRC (Reference 13) to determine the time available for operator action to ensure criticality does not occur in an MPC-32 during fuel loading and unloading operations. The analysis results show that operators have approximately 5 hours available to identify and terminate the source of unborated water flow from the limiting boron dilution event to ensure criticality in the MPC-32 does not occur. To minimize the possibility of a dilution event, a temporary administrative control is implemented while the MPC is in the SFP that will require, with the exception of the 1-inch line used to rinse the cask as it is removed from the SFP, at least one valve in each potential flow path of unborated water to the SFP is to be closed and tagged out. During the cask rinsing process, the MPC has a lid in place that minimizes entry of any unborated water into the MPC. The flow path with the highest potential flow rate of 494 gpm is doubly isolated by having two valves closed and tagged out while the MPC is in the SFP.

Based on the alarms, procedures, administrative controls, assumption of zero burnup fuel, and availability of trained operators described in Reference 13, the NRC has granted an exemption (Reference 14) from the criticality requirements of 10 CFR 50.68(b)(1) during loading, unloading, and handling of the MPC in the SFP.

When high-burnup fuel is loaded in the MPC, the SCS is required to maintain cladding temperatures within limits, following draining of the MPC, and when the MPC is not being recirculated by the forced helium dehydration system. The SCS may be out of service for short periods of time (per the associated TS) to perform necessary evolutions. A loss of supplemental cooling is evaluated as an accident in Chapter 8.

4.4.3.3 Subsystem Maintenance

The HI-STORM 100 System does not include any subsystems that provide auxiliary cooling ~~during loading operations or~~ in its final storage configuration. Normal maintenance and calibration testing is required on the ~~vacuum~~ *forced helium* drying, helium backfill, recirculation and cooldown, *supplemental cooling,* and leakage testing systems. Rigging, remote welders, cranes, and lifting beams are inspected prior to each loading campaign to ensure this equipment is ready for service.

4.4.5.3 CTF Analysis

The load path parts of the CTF are conservatively designed in accordance with the ASME Code, Section III, Subsection NF. The CTF was purchased ITS-B and is qualified for MPC and overpack transfer operations.

Analyses have been performed to verify that, during MPC transfer from the HI-TRAC to the HI-STORM overpack, the main shell of the CTF and its surrounding foundation are sufficient to maintain the overpack in the vertical position.

There are no impact factors considered in the CTF analysis. After the empty overpack is positioned in the CTF, any radial gaps between the CTF shell and the body of the overpack just below the top of the CTF are closed to the extent practical by adding metallic wedge assemblies at the top of the CTF shell. Small gaps may still remain even after the addition of wedge assemblies to close the gap. These very small gaps (compared to the scale of the structure) may give rise to high frequency impact forces upon contact. However, since the structural analysis for Code qualification focuses on the response to low frequency loads from a seismic loading, any high frequency impact loads arising from the existence of any remaining very small gaps after wedge assembly installation have been omitted.

After MPC transfer, the HI-TRAC transfer cask and mating device are removed, the lid is installed on the loaded overpack and the wedge assemblies are removed. The actual time between MPC transfer into the overpack and raising the overpack out of the CTF is expected to be less than an operating shift, or 8 hours. With the CTF wedge assemblies in place between the loaded overpack and the CTF walls, there is still some convective heat transfer through the overpack, albeit not at a rate commensurate with the conditions on the ISFSI pad. The thermal analyseis (HI-2053376, Reference 17 *& HI-2104625, Reference 18*) demonstrates that the overpack and MPC can remain in the CTF indefinitely and fuel cladding temperature limits for long term storage are not exceeded.

The analysis performed in Holtec Report HI-2053370 (Reference 10) evaluates the CTF under design basis loads. Loadings involving seismic events were considered only for the longer duration scenario when the loaded stack was supported by the base of the CTF. In this configuration, the lowest frequencies are associated with lateral bending of the stacked configuration as a beam-like structure. The vertical frequency of the stacked casks is in the rigid range, so no amplifier is used for vertical loads when the system is resting on the base of the CTF.

4.4.6 REFERENCES

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4. Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NF, American Society of Mechanical Engineers, 1995 Edition including 1996 and 1997 addenda.

5. ANSI N14.6, Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4,500 kg) or More, American National Standards Institute, 1993 Edition.

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12. License Amendments 162 and 163, Spent Fuel Cask Handling, issued by the NRC, September 26, 2003.

13. PG&E Letter DCL-03-126 to the NRC, Request for Exemption from 10 CFR 50.68, Criticality Accident Requirements for Spent Fuel Cask Handling, October 8, 2003, supplemented by PG&E Letters DCL-03-150 and DIL-03-014, Response to NRC Request for Additional Information Regarding Potential Boron Dilution Events with a Loaded MPC in the DCPP SFP, November 25, 2003.

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17. Holtec International Report No. HI-2053376, "Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 7.

18. Holtec International Report No. HI-2104625, "Three-Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 2.

TABLE 4.2-1

PHYSICAL CHARACTERISTICS OF THE HI-STORM MPC

PARAMETER	NOMINAL VALUE	REFERENCE
Outside Diameter	68 $^{1}/_{2}$ inches	Figure 4.2-13
Length	181 $^{5}/_{16}$ inches	Figure 4.2-13
Maximum Heat Load (Intact Fuel)	27.8 kW for MPC-24 28.2 kW for MPC-24E and MPC-24EF 28.74 kW for MPC-32	Table 1.2.2 of the HI-STORM 100 System FSAR, Revision 1A
Maximum Heat Load (Damaged fuel or fuel debris)	26.8 kW for MPC-24E 26.8 kW for MPC-24EF	Table 2.1.7 of the HI-STORM 100 System FSAR, Revision 1A
Material of Construction	Stainless Steel (except neutron absorber and aluminum washer in vent and drain ports)	Table 2.2.6 of the HI-STORM 100 System FSAR, Revision 1A
Maximum Weight with Fuel	79,987 lb for MPC-24 82,389 lb for MPC-24E & MPC-24EF 90,000 lb for MPC-32	Table 2.0.1 of the HI-STORM 100 System FSAR, Revision 1A
Internal Atmosphere	Helium	Table 2.0.1 of the HI-STORM 100 System FSAR, Revision 1A

TABLE 4.2-2

PHYSICAL CHARACTERISTICS OF THE
HI-STORM 100SA OVERPACK

PARAMETER	VALUE	REFERENCE
Height	229 $^{1}/_{2}$ inches	Figure 4.2-7
Outside Diameter	146 $^{1}/_{2}$ inches (bottom baseplate)	Figure 4.2-7
Capacity	One loaded MPC-32	Table 2.0.2 of the HI-STORM 100 System FSAR, Revision 1A
Material of Construction	Concrete (lid and side shielding) Carbon steel (lid and shell structure)	Table 2.2.6 of the HI-STORM 100 System FSAR[(a)], Revision 1A
Maximum Weight with a loaded MPC	360,000 lb	Table 2.0.2 of the HI-STORM 100 System FSAR, Revision 1A
Design Life	40 years	Table 2.0.2 of the HI-STORM 100 System FSAR, Revision 1A

[(a)] *HI-STORM FSAR Rev. 7*

TABLE 4.2-4

SUMMARY OF MPC-32 MPC CAVITY PRESSURES[a][b]
FOR NORMAL CONDITIONS

Condition	Pressure (psig)
Initial Backfill (at 70°F)	33.3 (Maximum)
Normal Condition with no rod rupture	~~68.4~~*67.0*
Normal Condition with 1% rods ruptured (storage)	~~69.4~~*68.1*
Normal Condition with ~~1%~~*no* rod~~s~~ rupture~~d~~ (transport)	~~77.4~~*74.5*

(a) Per NUREG-1536, pressure analyses with ruptured fuel rods (including BPRAs) is performed with release of 100% of the ruptured fuel rod fill gas and 30% of the significant radioactive gaseous fission products.

(b) Calculated normal condition pressures are taken from HI-*2104625*~~2053376~~, Revision *1*~~5~~.

TABLE 4.2-5

TABLE 4.3-1

IMPORTANT-TO-SAFETY COMPONENTS OF THE CASK TRANSPORTATION SYSTEM

Component	Function	Applicable Design Codes
Cask Transporter	Lift, handle, and transport a loaded HI-TRAC transfer cask or a HI-STORM 100SA overpack	Purchased commercial grade and tested prior to use in accordance with NUREG-0612
Lift Links	Transmit the force of the lifted load from the transfer cask lifting trunnions to the cask transporter lift points during vertical lifts. Transmit the force of the lifted load from the overpack lifting brackets to the cask transporter lift points during vertical lifts under off-normal or accident conditions with a loaded overpack in the CTF.	ANSI N14.6 per NUREG-0612, Section 5.1.6
HI-STORM Slings	Transmit the force of the loaded overpack from the lift links and HI-STORM lift brackets to remove the overpack from the CTF.	ASME B30.9 Purchased commercial grade and tested prior to use in accordance with NUREG-0612
MPC Downloader Slings	Transmit the force of the loaded MPC from the MPC lift cleats to the MPC downloader	ASME B30.9 Purchased commercial grade and tested prior to use in accordance with NUREG-0612
MPC Lift Cleats	Provide a lift point for raising and lowering the loaded MPC between the transfer cask and overpack	ANSI N14.6 per NUREG-0612, Section 5.1.6
HI-STORM Lifting Brackets	Transmit the force of the lifted load from the overpack lid studs to the cask transporter lift points during vertical lifts	ANSI N14.6 per NUREG-0612, Section 5.1.6
Connector Pins	Connect the transfer cask lift links or the overpack lifting brackets to the cask transporter lift links	ANSI N14.6 per NUREG-0612, Section 5.1.6
Supplemental Cooling System	*Provides cooling of the MPC while in the transfer cask to maintain the cladding of high burnup fuel below the normal temperature limit.*	*See Section 10.2*

TABLE 4.5-1

QUALITY ASSURANCE CLASSIFICATION OF
MAJOR STRUCTURES, SYSTEMS, AND COMPONENTS

IMPORTANT TO SAFETY[a]	NOT IMPORTANT TO SAFETY
Classification Category A	
Multi-Purpose Canister	Security Systems
Fuel Basket	Fencing
Damaged Fuel Container	Lighting
Transfer Cask	Electrical Power
MPC Lift Cleats	Communications Systems
MPC Downloader Slings[b]	Automated Welding System (AWS)
HI-STORM Lifting Brackets	MPC Helium Backfill System
HI-STORM Mating Device Bolts and Shielding Frame	MPC Forced Helium Dehydration System
	MPC Vacuum Drying System
Lateral Restraints[b] (HI-TRAC and transporter at CTF)	Rockfall Fence
	Rock-bolted Cutslope
Lift Links	
Classification Category B	
HI-STORM Overpack	
ISFSI Storage Pads	
Overpack Anchorage Hardware	
CTF	
Upper Fuel Spacers	
Transporter Connector Pins	
Helium Fill Gas[b]	
Cask Transporter[b]	
LPT[c]	
Supplemental Cooling System	
Classification Category C	
HI-STORM Cask Mating Device (except bolts and shielding frame)	

[a] Major cask system components are listed according to the highest QA category of any subcomponent comprising the major component. The safety classification of the subcomponents and the determination of the ITS category of each item is administratively controlled by PG&E via design and procurement control procedures with input from the storage cask vendor.

[b] Purchased commercial grade and qualified by testing prior to use.

[c] Refer to 10 CFR 50 Q-List Section 1.

TABLE 4.7-1