Pacific Gas and Electric Company®

James M. Welsch
Station Director

Diablo Canyon Power Plant
Mail Code 104/5/502
P. O. Box 56
Avila Beach, CA 93424

805.545.3242
Internal: 691.3242
Fax: 805.545.4234
Internet: JMW1@pge.com

July 31, 2012

PG&E Letter DIL-12-007

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Director, Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
11555 Rockville Pike
Rockville, MD 20852

10 CFR 72.56

Materials License No. SNM-2511, Docket No. 72-26
Diablo Canyon Independent Spent Fuel Storage Installation
License Amendment Request 12-03
Revision to Technical Specifications (TS) 2.0, 2.3, 3.1.1, and 3.1.4

Dear Commissioners and Staff:

The Diablo Canyon Independent Spent Fuel Storage Installation (DC ISFSI) Materials License, SNM-2511, License Amendment (LA) 2, established a limitation on loading high burnup fuel (HBF) to a maximum heat load of 24kW for uniform loading. Pacific Gas and Electric Company (PG&E) has removed the vast majority of the fuel eligible under the current license from the spent fuel pool to the DC ISFSI.

Pursuant to 10 CFR 72.56, PG&E hereby requests an amendment to Materials License No. SNM-2511, Docket No. 72-26, for the DC ISFSI, to revise the technical specifications (TS) as follows:

(1) Tables 2.1-7, 2.1-8, and 2.1-9 in TS 2.0, "Approved Contents," are revised allowing up to a 28.74kW heat load for uniform loading and 25.572kW heat load for regionalized loading. This changes the maximum allowable decay heat per storage location, in watts, determined from Table 2.1-7 or 2.1-9 to be consistent with this proposed license amendment request. Table 2.1-8 is revised to delete the note that limits Zirlo clad fuel to a burnup of 45,000 MWD/MTU and replace the existing Note 3 with a note that refers to TS 2.3, "Alternate MPC-32 Fuel Selection Criteria."

(2) TS 2.3, "Alternate MPC-32 Fuel Selection Criteria," is revised to add reference to Table 2.1-9 as regionalized loading of high burn-up fuel.

NMSS26

(3) TS 3.1.1, "Multi-Purpose Canister (MPC)," Surveillance Requirement (SR) 3.1.1.2 is revised to add a new helium backfill pressure range for MPCs with heat loads less than or equal to 28.74kW.

(4) TS 3.1.4, "Supplemental Cooling System," Applicability is changed to only be applicable for unloading of high burnup fuel loaded in 2012 under the provisions of LA 2.

PG&E is providing supporting documentation including analyses in Enclosure Attachments 1 through 6. Attachments 1, 2, 3, and 4 are nonproprietary. They include a markup of the affected TS pages, a clean version of revised TS pages, a markup of the affected TS Bases pages, and a mark up of affected FSARU pages, respectively. Attachment 5 is also nonproprietary. It contains Holtec International Report HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0. Attachment 6 is proprietary and contains the proprietary version of the same Holtec Report, including proprietary thermal data files on optical storage media (OSM), DVD-ROM.

Attachment 7 contains an affidavit signed by Holtec, the owner of the proprietary information. The affidavit sets forth the basis on which the Holtec information contained in Enclosure, Attachment 6, including the DVD-ROMs, may be withheld from public disclosure by the Commission consistent with the Freedom of Information Action ("FOIA"), 5 USC Section 552(b)(4) and the Trade Secrets Act, 18 USC Section 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1). PG&E requests that the Holtec proprietary information be withheld from public disclosure in accordance with these laws and regulations.

Correspondence with respect to the proprietary aspects of the application or the Holtec affidavits provided in Enclosure, Attachment 6 should be addressed to Ms. Kelly Kozink, Holtec International, 555 Lincoln Drive West, Marlton, New Jersey 08053.

The changes in this license amendment request (LAR) are required to allow the additional loading and moving of high burnup spent fuel from the spent fuel pool to the ISFSI in order to ensure adequate space in the spent fuel pool. The changes in this LAR are not required to address an immediate safety concern. PG&E requests a medium priority for review and approval of this LAR be assigned, and requests that the amendment be issued no later than July 1, 2013, to enable a cask loading campaign scheduled to begin by August 1, 2013. PG&E requests the License Amendment be made effective upon NRC issuance, to be implemented within 60 days of issuance.

PG&E has determined that this LAR is consistent with the considerations governing issuance of the initial license per 10 CFR 72.58. Pursuant to 10 CFR 51.22(b), an environmental assessment or environmental impact statement is not required in connection with issuance of this proposed amendment.

PG&E makes no regulatory commitments (as defined by NEI 99-04) in this letter. This letter includes no revisions to existing regulatory commitments.

In accordance with 10 CFR 50.91, PG&E is notifying the State of California of this LAR by transmitting a copy of this letter and enclosure to the designated State Official.

If you have any questions regarding this response, please contact Mr. Lawrence Pulley at (805) 545-6165.

I state under penalty of perjury that the foregoing is true and correct.

Executed on July 31, 2012.

Sincerely,

James M. Welsch

James M. Welsch
Interim Site Vice President

Mjrm/4557/50500439
Enclosure
cc: Diablo Distribution
cc/enc: Gonzalo L. Perez, California Department of Public Health
Elmo E. Collins, NRC Region IV
John M. Goshen, NRC Project Manager, Office of Nuclear Material Safety and Safeguards
Michael S. Peck, NRC Senior Resident Inspector

~~Attachment 6 of the Enclosure Contains Proprietary Information~~
~~Withhold from public disclosure under 10 CFR 2.390~~

Evaluation of the Proposed Change

Subject: License Amendment Request 12-03, "Revision to Technical Specification (TS) 2.0, 2.3, 3.1.1, and 3.1.4"

1.0 SUMMARY DESCRIPTION

2.0 DETAILED DESCRIPTION

3.0 TECHNICAL EVALUATION

4.0 ENVIRONMENTAL CONSIDERATION

5.0 PRECEDENT

6.0 REFERENCES

ATTACHMENTS:

1. Proposed Technical Specification Changes (markup)
2. Proposed Technical Specification Changes (retyped)
3. Proposed Technical Specification Bases Changes
4 Proposed Updated Final Safety Analysis Report (UFSAR) Changes
5. Holtec International Report HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0 –Non-Proprietary Version
6. Holtec International Report HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0 - Proprietary Version, with 10 discs of proprietary data files on optical storage medium (OSM) DVD-ROM
7. Holtec Affidavit for Holtec International Report HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0 - Proprietary Version, and the associated 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).

The DC ISFSI Materials License, SNM-2511, License Amendment (LA) 2 (Reference 3), established a Multi-Purpose Canister (MPC) MPC-32 thermal limitation on loading of high burnup fuel (HBF) to a maximum heat load limit of 24 kilowatts (kW) using only a uniformly-loaded configuration. This LAR proposes to eliminate the MPC-32, 24kW thermal limitation, allow regional loading of HBF in the MPC-32, and establish the MPC-32 maximum total heat load limits at the values identical to those for low burnup fuel, (i.e., 25.572kW for regional loading and 28.74kW for uniform loading).

This LAR also proposes to increase the MPC-32 helium backfill pressure (Reference TS 3.1.1) in support of the proposed HBF thermal limits, and modify the applicability of TS 3.1.4, Supplemental Cooling System (SCS), which was added in LA 2 (Reference 3), but is only required for unloading operations of MPC-32s loaded under Amendment 2 of the license based on the reanalysis performed in support of this LAR.

2.0 DETAILED DESCRIPTION

<u>Proposed Amendment</u>

The proposed LAR would modify TS 2.0, "Approved Contents," by revising Tables 2.1-7 and 2.1-9 to increase the allowable MPC-32 Assembly Decay Heat load up to a 28.74kW heat load for uniform loading and 25.572kW heat load for regionalized loading. This changes the maximum allowable decay heat per storage location, in Watts, and allows for both uniform and regional loading configurations of HBF. The proposed LAR modifies Table 2.1-8 for regionalized loading to delete the note that limits Zirlo clad fuel to a burnup of 45,000 MWD/MTU and replace it with a note that refers to TS 2.3, "Alternate MPC-32 Fuel Selection Criteria." The proposed LAR adds new limits in TS 3.1.1, "Multi-Purpose Canister (MPC)," Surveillance Requirement (SR) 3.1.1.2 for the helium backfill pressure range for an MPC-32 containing HBF with a total heat load up to 28.74kW. The proposed LAR would also modify TS 3.1.4, "Supplemental Cooling System," which was added in LA 2 to accommodate transporting HBF in the HI-TRAC transfer cask.

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 DC ISFSI TS 5.1.1, "Technical Specifications (TS) Bases Control Program," at the time the related license amendment is implemented. Attachment 4 contains changes to the Updated Final Safety Analysis Report (UFSAR) in support of this LAR.

Purpose for Proposed Amendment

On March 22, 2004, the NRC issued Materials License No. SNM-2511 to Pacific Gas and Electric Company (PG&E) to allow PG&E to receive, possess, store, and transfer spent fuel and associated radioactive materials resulting from operation of Diablo Canyon Power Plant (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 an 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 4). At the time of issuance 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 (Reference 9). 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 LA 1 to SNM-2511 on February10, 2010 (Reference 2), 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.

The NRC issued LA 2 to SNM-2511 on January 19, 2012 (Reference 3), which revised the licensing basis to: (1) allow only uniform loading of HBF with a maximum heat load of 24kW in the MPC-32, (2) support the addition of NSAs and ITTRs as approved contents, (3) add an alternative calculation methodology from the Holtec HI-STORM 100 CoC Amendment 3 (Reference 7) for burnup limits for fuel assemblies in an MPC-32, (4) eliminate the vacuum drying option, (5) add a reference temperature of 70°F for the MPC helium backfill pressure range, (6) allow the HI-STORM to be considered operable with up to 50 percent vent blockage, (7) add TS supplemental cooling capability in support of HBF loading operations, (8) change the B_4C content in METAMIC to less than or equal to 33.0 wt percent, and (9) delete the requirement for maintaining the

annulus full during vacuum drying and to restore the requirement for maintaining the annulus full during reflood (unloading).

Also in LA 2 (Reference 3) the NRC approved: (1) an upgrade of the thermal analysis methodology to a three dimensional (3D) Computational Fluid Dynamics (CFD) model, (2) removal of the requirement for 100 percent fuel failure coincident with 100 percent vent blockage, (3) a change of some allowed component temperatures in the thermal evaluation (peak cladding, concrete, overpack metal, transfer cask lid neutron shielding), (4) reduction of the required torque criteria for the MPC lift cleats, and (5) addition of design criteria for the SCS including a new accident for loss of SCS.

In this LAR, PG&E proposes to amend the current materials license to load HBF in MPC-32s up to a 28.74kW heat load for uniform loading and 25.572kW heat load for regionalized loading configurations in order to load the current and future inventory of the SFP. In support of the higher heat load, a new helium backfill pressure range is added to SR 3.1.1.2 for MPCs containing HBF. This LAR also modifies TS 3.1.4, Supplemental Cooling System to only be applicable to the unloading of high burnup fuel loaded in 2012. The high burnup fuel was loaded based on the Amendment 2 lower helium backfill pressure limit.

In support of the proposed TS changes for loading of the higher heat load HBF, PG&E is proposing the following methodology changes:

- Holtec International Report HI-2125191 is provided to support loading of the higher heat load HBF and the handling of that HBF without supplemental cooling. Appendix B of the report describes the methodology applied to the site-specific Diablo HI-STORM 100SA. Appendix C of the report describes the methodology applied to the site-specific Diablo HI-TRAC 125D transfer cask and introduces new transfer cask thermal modeling methodology reviewed and accepted by the NRC in Holtec International HI-STORM 100 CoC License Amendment Request No. 9 (Reference 11), currently in rulemaking (Reference 12). In Appendix E, storage and transfer cask thermal models are validated using ASME V&V 20-2009 (Reference 10) procedures.

The new analysis reports are provided as Attachments 5 and 6 to this submittal.

3.0 TECHNICAL EVALUATION

TS 2.0 Approved Contents – TS Tables 2.1-7 and 2.1-9 are revised allowing up to a 28.74 kilowatt heat load for uniform loading and 25.572 kilowatt heat load for regionalized loading in MPC-32s. TS Table 2.1-8, Note 3, which limited loading of fuel with Zirlo cladding to a burnup of less than or equal to 45,000 MWD/MTU,

has been revised to allow the use of the alternate fuel selection criteria contained in TS 2.3 for MPC-32 loading.

TS 2.3, "Alternate MPC-32 Fuel Selection Criteria" – TS 2.3 is revised to add reference to Table 2.1.9 in support of the changes in this LAR.

TS 3.1.1, "Multi-Purpose Canister (MPC)" – SR 3.1.1.2 is revised to add a new helium backfill pressure range for MPC containing HBF with heat loads less than or equal to 28.74kW in support of the higher allowed heat loads.

TS 3.1.4, "Supplemental Cooling System (SCS)" – The use of a SCS is no longer required for HBF in future loadings, as the maximum computed fuel cladding temperature of 684°F (Section C.5.1 in the Holtec International Report HI-2125191), (Attachments 5 and 6) is significantly less than the allowed temperature limit of 752°F for HBF. However, since the new analysis utilizes higher MPC helium backfill pressures, casks loaded under Amendment 2 Tech Spec backfill limits will be required to utilize the SCS during onsite transfer of an MPC containing HBF during any unloading operation that occurs. An editorial change is also made moving the surveillance requirements down a line and making the line below the actions table a double line.

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-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0, (Attachments 5 and 6), is an evaluation and report, which utilizes a same 3D-CFD model for MPC-32 in HI-STORM as approved in LA 2 of the DC ISFSI license. The methodology adopted for the thermal evaluations using the HI-TRAC cask is consistent with the methodology in rulemaking for the HI-STORM 100 License Amendment No.9 (Reference 12).

  In accordance with RAI 6.1A provided by the NRC on November 18, 2011 (Reference 6), the grid convergence index (GCI) described in Appendices B and E to Holtec Report HI-2125191 for both normal condition of storage and cask transfer facility configuration is in accordance with the procedure described in American Society of Mechanical Engineers Verification and Validation 20-2009 (ASME V&V 20-2009), "Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer" (Reference 10).

HI-2125191 (Attachments 5 and 6) assumes the average annual temperature for the site of 80°F for all HI-TRAC transport activities. This has not been modified in support of this LAR. However, for long term storage on the ISFSI pad and while a loaded MPC is located in a HI-STORM overpack within the CTF, a normal ambient temperature of 65°F is assumed.

Per UFSAR (Reference 8) Section 2.3.2, Local Meteorology, the average site temperature is 55°F. This is based on historical data from the DCPP primary meteorological tower. Based on the actual 55°F site average temperature, a conservative normal ambient temperature of 65°F was assumed in the new site specific analysis. Use of the 65°F still maintains a considerable margin between the local meteorological data and the assumed limit.

To support the internal heat transfer and to ensure a stable, inert environment for long term storage, MPC-32s containing HBF with heat loads less than or equal to 28.74kW, are required to have a higher helium backfill pressure. SR 3.1.1.2 is revised to add these new requirements.

Based on the proposed changes the following results were attained:

- The temperatures of all the components of the MPC and HI-STORM 100SA, including HBF, for the bounding scenarios 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 5).

Also in HI-2125191, (Attachments 5 and 6), evaluation of off-normal and accident conditions listed in DC ISFSI UFSAR, Chapter 8, continue to be met.

As a result of the proposed changes, there are no changes in the dose values and all previously provided analyses are unchanged, as they were performed using the bounding heat load and burnup values.

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

UFSAR Changes

- FSARU Sections 3.1.1.1, 3.2.7, 3.3.3, 4.2, 8.1, 8.2, and 10.2.1 are modified to allow a maximum heat load of 28.74 kilowatt heat load for uniform loading and 25.572 kilowatt heat load for regionalized loading in a MPC-32 containing HBF.
- FSARU Section 10.2.2.4 is modified to provide a new helium backfill pressure range for MPC-32s containing HBF with heat loads less than or equal to 28.74kW.
- FSARU Sections 3.1.2, 3.3.1.2.2, 4.2.3.3.3, 4.4.1.2.3, 4.4.1.3.1, 5.1.1.2, 5.1.1.3, 10.2.1, 10.2.2.1, and 10.2.5.2 are modified to limit the requirement for the use of a SCS for MPC-32s with HBF to unloading operations of those loaded under Amendment 2 to this license with the lower helium backfill pressure. An option for using the SCS to lower MPC temperature for operational convenience is allowed.

All of these changes are in accordance with the Holtec International Report HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74kW Decay Heat," Revision 0 (Attachments 5 and 6).

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. 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

None

6.0 REFERENCES

1. Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation dated March 22, 2004
2. Amendment 1 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation dated February 10, 2010
3. Amendment 2 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation dated January 19, 2012
4. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 1, dated July 15, 2002
5. Holtec International HI-STORM 100 FSAR, Revision 7
6. NRC letter dated November 18, 2011, Diablo Canyon Independent Spent Fuel Storage Installation Materials License No. SNM-2511, Amendment Request No. 2 – Second Request For Additional Information, Part 1
7. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, Amendment 3, dated May 29, 2007
8. DC ISFSI UFSAR, Revision 4, March 2012
9. U.S. NRC SFST-ISG-11, Cladding Considerations for the Transportation and Storage of Spent Fuel, Revision 3, November 17, 2003

10. American Society of Mechanical Engineers ASME V&V 20-2009, Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer

11. Holtec International HI-STORM 100 Certificate of Compliance No. 1014, License Amendment Request No.9, dated September 10, 2010

12. U.S. NRC Memorandum, Holtec International HI-STORM 100 Cask System, Amendment No. 9, Rulemaking, dated February 13, 2012 (ADAMS Package No. ML120450596)

Proposed Technical Specification Changes (markup)

2.0 APPROVED CONTENTS (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 Tables 2.1-7 and 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 E235.

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 (e.g. 898~~750~~ ~~w~~Watts, use 0.898~~750~~)

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 2.1-7

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) [BU ≤45,000 MWd/MTU]	MPC-32 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts) [BU >45,000 MWd/MTU]
≥ 5	1157	1173	1115	898	898~~750~~
≥ 6	1123	1138	1081	898~~873~~	898~~750~~
≥ 7	1030	1043	991	898~~805~~	898~~750~~
≥ 8	1020	1033	981	898~~800~~	898~~750~~
≥ 9	1010	1023	972	898~~794~~	898~~750~~
≥ 10	1000	1012	962	898~~789~~	898~~750~~
≥ 11	996	1008	958	898~~785~~	898~~750~~
≥ 12	992	1004	954	898~~782~~	898~~750~~
≥ 13	987	999	949	898~~773~~	898~~750~~
≥ 14	983	995	945	898~~769~~	898~~750~~
≥ 15	979	991	941	898~~766~~	898~~750~~

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 using Section 2.3.~~Burnup for fuel assemblies with cladding made of ZIRLO is limited to 45,000 MWD/MTU or the value in this table, whichever is less.~~

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.

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	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 for an MPC containing only low burnup fuel. • ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70 F for an MPC-32 originally loaded uniformly with high burnup fuel with a total heat load ≤ 24 kW. • ≥ 34 psig and ≤ 40 psig at a reference temperature of 70 F for an MPC-32 containing high burnup fuel loaded up to the maximum regional or uniform total heat load.	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

3.1.4 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 (≤ 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 to a loaded MPC-32 4 hours after transferring the MPC into the TRANSFER CASK for unloading operations if the MPC-32 contains one or more fuel assemblies with an average burnup of >45,000 MWD/MTU and the MPC-32 was originally loaded with a helium backfill pressure of ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70 F.~~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

Make double line, move down

SURVEILLANCE REQUIREMENTS

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

Proposed Technical Specification Changes (retyped)

Remove Page	Insert Page
2.0-1a	**2.0-1a**
2.0-10	**2.0-10**
2.0-11	**2.0-11**
2.0-12	**2.0-12**
3.1-2	**3.1-2**
3.1-5	**3.1-5**

2.0 APPROVED CONTENTS (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 Tables 2.1-7 and 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 E235.

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 (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 2.1-7

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) [BU ≤45,000 MWd/MTU]	MPC-32 Assembly Decay Heat (INTACT FUEL ASSEMBLIES) (Watts) [BU >45,000 MWd/MTU]
≥ 5	1157	1173	1115	898	898
≥ 6	1123	1138	1081	898	898
≥ 7	1030	1043	991	898	898
≥ 8	1020	1033	981	898	898
≥ 9	1010	1023	972	898	898
≥ 10	1000	1012	962	898	898
≥ 11	996	1008	958	898	898
≥ 12	992	1004	954	898	898
≥ 13	987	999	949	898	898
≥ 14	983	995	945	898	898
≥ 15	979	991	941	898	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 using 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.

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 for an MPC containing only low burnup fuel. • ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70 F for an MPC-32 originally loaded uniformly with high burnup fuel with a total heat load ≤ 24 kW. • ≥ 34 psig and ≤ 40 psig at a reference temperature of 70 F for an MPC-32 containing high burnup fuel loaded up to the maximum regional or uniform total heat load.	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

3.1.4 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 (≤ 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 to a loaded MPC-32 4 hours after transferring the MPC into the TRANSFER CASK for unloading operations if the MPC-32 contains one or more fuel assemblies with an average burnup of >45,000 MWD/MTU and the MPC-32 was originally loaded with a helium backfill pressure of ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70 F.

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

Proposed Technical Specification Bases Changes

(Markup for Information Only)

BASES (continued)

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. To accommodate the MPC-32s containing HBF with a maximum heat load of ≤28.74Kw and no requirement for supplemental cooling system usage, a higher backfill pressure is specified to ensure the storage system performs as required.

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)

BASES (continued)

REFERENCES

1. Diablo Canyon ISFSI UFSAR Sections 3.1.2, and 3.3.1.7
2. Diablo Canyon ISFSI UFSAR Section 4.2.3.3 and Table 4.5-1
3. Diablo Canyon ISFSI UFSAR Section 5.1.1.2 and Table 5.1-1
4. Diablo Canyon ISFSI UFSAR Sections 7.5.2.1 and Table 7.4-1
5. Diablo Canyon ISFSI UFSAR Section 8.2.7.2.2
6. Diablo Canyon ISFSI UFSAR Sections 10.2.2.3, 10.2.2.4, 10.2.2.5 and Figure 10.2-4.
7. Amendment No. 2 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation.
8. Amendment No. 3 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation

B 3.1 SPENT FUEL STORAGE CASK (SFSC) INTEGRITY

B 3.1.4 Supplemental Cooling System

BASES

BACKGROUND

The Supplemental Cooling System (SCS) is a passive cooling system that enables 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 only required for ~~all~~ the MPC-32s ~~meeting~~ loaded under Amendment 2 of this license and containing high ~~the~~ burnup fuel ~~and TRANSFER CASK orientation combinations~~as specified in the Applicability of the LCO for an unloading operation.

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 ($\le$ 45,000 MWD/MTU), SCS operation is not required, because the fuel cladding temperature cannot exceed the limit of 570°C (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 for Amendment 2 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-32 originally loaded with a helium backfill pressure of ≥ 29.3 psig and ≤ 33.3 psig at a reference temperature of 70 F, and 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 (752°F) 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

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 off-normal 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 3.1.4.1

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 onsite 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

1. Diablo Canyon ISFSI UFSAR Section 4.3
2. Diablo Canyon ISFSI UFSAR Section 4.5
3. Diablo Canyon ISFSI UFSAR Section 5.1
4. Diablo Canyon ISFSI UFSAR Section 8.2.17
5. Diablo Canyon ISFSI UFSAR Section 10.2.2.7
6. Amendment No. 2 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation.
~~6.~~7. Amendment No. 3 to Materials License No. SNM-2511 for the Diablo Canyon Independent Spent Fuel Storage Installation.

Proposed Updated Final Safety Analysis Report (UFSAR) Changes

(Markup for Information Only)

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 consist 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). The 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. The Diablo Canyon ISFSI license was modified in LA 3 to allow loading of HBF with a maximum heat load of 28.74 Kw.~~PG&E will modify this site-specific license in the future, as necessary to include additional 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.

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 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.

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.

In support of allowing HBF with a maximum heat load of 28.74 Kw a site-specific thermal analysis was performed which evaluated two normal ambient temperatures depending on the storage or transfer configurations (Reference 24). A normal ambient temperature of 65°F was assumed for a loaded MPC contained in a HI-STORM overpack on the ISFSI pad and for a loaded MPC contained in a HI-STORM overpack within the CTF. All transport configurations with a loaded MPC contained within the HI-TRAC assumed a normal ambient temperature of 80°F.

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

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.

24. Holtec International Document No. HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat", Revision 0.

the MPC until the MPC is transferred to the overpack where convective cooling is established. For unloading MPCs containing high burnup fuel (HBF) that were loaded under Amendment 2 of this license, heat transfer from the transfer cask is augmented by the supplemental cooling system to maintain the fuel cladding temperature below the long term temperature limit for HBF. For other situations, heat transfer from the transfer cask may be augmented by the supplemental cooling system to reduce MPC temperature for operational handling reasons. 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.

3.3.1.3 Protection by Equipment and Instrumentation Selection

3.3.1.3.1 Equipment

The cask transporter and CTF provide protection functions to the MPC and are discussed in Sections 3.3.3 and 3.3.4, respectively.

3.3.1.3.2 Instrumentation

No instrumentation is required for storage of spent nuclear fuel and associated nonfuel hardware at the Diablo Canyon ISFSI. Due to the welded closure of the MPC, the passively-cooled storage cask design, and the Diablo Canyon ISFSI Technical Specifications (TS) requirement for periodic checks of the casks, the loaded overpacks do not require continuous surveillance and monitoring or operator actions to ensure the safety functions are performed during normal, off-normal or postulated accident conditions.

3.3.1.4 Nuclear Criticality Safety

The HI-STORM 100 System is designed to ensure the stored fuel remains subcritical with k_{eff} less than 0.95 under all normal, off-normal, and accident conditions. A detailed discussion of the criticality analyses for the HI-STORM 100 System is provided in Chapter 6 of the HI-STORM 100 System FSAR. Section 4.2.3.3.5 of this FSAR includes a summary discussion of the HI-STORM 100 System criticality design.

3.3.1.4.1 Control Methods for Prevention of Criticality

The design features and control methods used to prevent criticality for all MPC configurations are the following:

(1) Incorporation of permanent neutron absorbing material (Boral or Metamic) attached to the MPC fuel basket walls with a minimum required loading of the ^{10}B isotope.

(2) Favorable geometry provided by the MPC fuel basket.

HI-STORM 100 System FSAR analysis bounds the Diablo Canyon ISFSI design criteria specified for live loads in Section 3.2.

As described above, the transfer cask dead load includes the weight of the cask plus the heaviest loaded MPC. The stresses calculated for the dead loads of the MPC and the transfer cask are shown to be within applicable Code allowables and, therefore, meet the Diablo Canyon ISFSI design criteria in Section 3.2.5 for dead loads.

4.2.3.3.2.2 Internal and External Pressure

Internal and external pressure loads are addressed in the HI-STORM 100 System FSAR, Sections 3.4.4.3.1.2 and 3.4.4.3.1.7, respectively. The normal and off-normal condition design pressures for the MPC are 100 psig for internal pressure and 0 psig (ambient) for external pressure as shown in Table 2.2.1 of the HI-STORM 100 System FSAR. For accident conditions, the design pressure for the MPC is 200 psig for internal pressure and 60 psig for external pressure. Table 4.2-4 provides the maximum calculated MPC pressures for two normal conditions; no fuel rods ruptured and 1 percent fuel rods ruptured, as calculated in Reference 36. The resultant pressure for the 10 percent rods rupture off-normal condition is provided in Section 8.1.1 and is below the 100 psig design pressure. The calculations assumed design basis heat load and bounding maximum fuel rod off-gas and internal pressure for DCPP fuel, considering a site-specific bounding value for fuel rod internal pressure. The internal pressure calculations for the MPC-32 bound those for the MPC-24, MPC-24E, and MPC-24EF because there is less free volume and more fuel inside the MPC-32 cavity, which creates higher pressures for the scenarios analyzed.

The MPCs loaded up through 2012 were backfilled with helium during fuel loading operations to a nominal pressure of 31.3 psig (maximum 33.3 psig) at a reference temperature of 70°F. Future MPCs with maximum heat load up to 28.74 Kw are backfilled with helium during the loading operation to a normal pressure of ≥ 34 psig and ≤ 40 psig at a reference temperature of 70 F. The internal pressure rises in proportion to the rise in MPC cavity gas absolute temperature due to the decay heat emitted by the stored fuel and as temperatures equilibrate to those associated with the normal conditions ~~80°F~~ day/night annual average ambient temperatures evaluated in the thermal analysis. This normal condition ambient temperature is higher than, and is therefore bounding for, the average day/night ambient temperature at the Diablo Canyon ISFSI site (Reference 12, Section 1.2.1.3).
MPC internal pressures were also evaluated for postulated accident conditions, including 100 percent fuel rod cladding rupture, assuming all rod fill gas and a conservative fraction of fission product gases are released from the failed rods into the MPC. The resultant pressure from the 100 percent fuel rod rupture is provided in Section 8.2.14 and is below the MPC accident design pressure of 200 psig.

The stresses resulting from the internal and external pressure loads were shown to be within Code allowables. 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 are

low ambient temperature evaluation in the HI-STORM 100 System FSAR bounds the conditions at Diablo Canyon.

At Diablo Canyon, the 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. This condition is bounding for the other transient operational conditions mentioned above, because it maximizes the resistance to heat transfer from the MPC shell to the environment. In the other conditions, there are temperature controls on either the helium or water in the MPC cavity to limit the cladding temperature. 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, 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. That analysis covers uniform loading of HBF up to a 24 kilowatt heat load limit. In support of LA 3, an additional site specific thermal analysis was performed using the same methodology allowing up to a 28.74 kilowatt heat load for uniform loading and 25.572 kilowatt heat load for regionalized (Reference 43). 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) and two normal ambient temperatures were assumed based on the system configuration. A normal ambient temperature of 65°F was assumed for a loaded MPC contained in a HI-STORM overpack on the ISFSI pad and for a loaded MPC contained located in a HI-STORM overpack within the CTF. All transport configurations with a loaded MPC contained within the HI-TRAC assumed a normal ambient temperature of 80°F.

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

34. Regulatory Guide 1.142, Safety Related Concrete Structure for Nuclear Power Plants (Other than Reactor Vessels and Containment), USNRC, November 2001.

35. Regulatory Guide 1.199, Anchoring Components and Structural Supports in Concrete, USNRC, November 2003.

36. Holtec International Report No. HI-2053376, "Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 5.

37. Holtec International Report No. HI-2012771, "HI-STAR 100 and HI-STORM 100 Additional Criticality Calculations," Revision 12.

38. Drawing 6021750, Sheet 310, DCPP ISFSI Cask Transfer Facility (CTF) Concrete Sections and Detail, Revision 2.

39. Drawing 6021750, Sheet 312, DCPP ISFSI Transporter Seismic Restraint Anchor Block, Revision 2.

40. Holtec International Report No. HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 9.

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

42. Final Safety Analysis Report for the HI-STORM 100 System, Holtec International Report No. HI-2002444, Revision 5, June 2007.

43. Holtec International Report No. HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat," Revision 0.

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 the last of the water is removed 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. 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 supplemental cooling system (SCS) is placed in service by filling the transfer cask annulus and associated keep-full tank with demineralized water. T~~the 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 N14.5-1997 (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 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, the annulus is drained, and the transfer cask is placed 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.

4.4.1.2.5 Off-Normal and Accident Conditions

For off-normal and accident conditions, the necessary response is a function of the nature of the event. Chapter 8 describes the off-normal and accident events for which the cask system is designed and provides suggested corrective actions. The HI-STORM 100 System is designed to maintain confinement integrity under all design-basis, off-normal, and accident conditions, including natural phenomena and drop events. For Diablo Canyon, cask drops inside the FHB/AB are not considered credible since the FHB/AB crane is single failure proof in accordance with the criteria of NUREG-0612; cask drops outside the FHB/AB are not considered credible since the transporter is single failure proof in accordance with the criteria of NUREG-0612. Cask tipover events are precluded during transport of the loaded cask while on the LPT through the design of the LPT. Based on the circumstances of an actual event, plant personnel will take appropriate action ranging from inspections of the affected cask components to movement of the cask back into the SFP and unloading of the spent fuel assemblies.

4.4.1.2.6 Unloading Operations

To unload a HI-STORM 100 System, the loading operations are essentially performed in reverse order, using the same lifting and handling equipment. Should any MPCs loaded under Amendment 2 of this license require unloading, implementation of the supplemental cooling system is required. Once the transfer cask is returned to the cask washdown area in the FHB/AB, the MPC closure ring and vent and drain port cover plates are removed by cutting their attachment welds. Fuel cooldown is performed, if necessary, using the vent and drain and the helium cooldown system until the helium temperature is reduced to the maximum temperature specified in Section 10.2. Helium cooldown is required prior to reflooding the MPC with water (borated as necessary) to prevent flashing of the water and the associated pressure excursions. Once the fuel is sufficiently cool, the MPC is flooded with borated water and the lid weld is removed

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.~~

4.4.1.3.2 Considerations Outside the 10 CFR 50 Facility

Cask drop events are precluded during transport of the loaded cask from the FHB/AB to the CTF, and from the CTF to the storage pad, through the design of the cask transport system, including the cask transporter (Section 4.3). Drop events are precluded by lift devices designed, fabricated, operated, inspected, maintained, and tested in accordance with NUREG-0612. The cask transport system is designed in accordance with these requirements and appropriate design codes and standards to preclude drop events on the transport route. The cask transporter is also designed to withstand applicable, site-design-basis natural phenomena, such as seismic events and tornadoes, without dropping the load or leaving the transport route. The load-path parts of the cask transporter are designed as specified in Section 4.3.2.1. The cask transporter is procured commercial grade and is qualified by functional testing prior to service for MPC and overpack transfer operations at the CTF. Uncontrolled movement of the cask transporter is prevented by setting the brakes, an emergency stop switch, and a dead-man switch, as discussed in Section 4.3.2.1.2; these components also are procured commercial grade and are qualified by functional testing prior to service.

4.4.2 DECONTAMINATION SYSTEM

Standard decontamination methods are used to remove surface contamination, to the extent practicable, from the transfer cask and accessible portions of the MPC (that is, the lid) resulting from their submersion in the SFP. The cask and MPC lid are rinsed with clean water while over the SFP. Final decontamination of the transfer cask and MPC lid is performed in the cask washdown area in the FHB/AB. Decontamination is typically performed manually. While the entire MPC is submerged in the SFP during fuel loading, the annulus seal and annulus overpressure system prevent contaminated water from coming in contact with the sides of the MPC, leaving the MPC lid as the only exterior surface of the HI-STORM 100 System at the ISFSI storage pad that has been exposed to SFP water.

4.4.3 STORAGE CASK REPAIR AND MAINTENANCE

Chapter 9 of the HI-STORM 100 System FSAR describes the required maintenance for the storage cask system. The HI-STORM 100 System is totally passive by design.

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 analyses (HI-2053376, Reference 17 and HI-2125191~~04625~~, Reference 18) demonstrate 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

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

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

3. ANSI N14.5, Leakage Tests on Packages for Shipment, American National Standards Institute, 1997 Edition.

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.

6. Control of Heavy Loads at Nuclear Power Plants, NUREG-0612, USNRC, July 1980.

7. Holtec International Report No. HI-2002570, "Design Criteria Document for the Diablo Canyon Cask Transfer Facility," Revision 5.

8. PG&E Calculation No. 52.27.100.716 (GEO.DCPP.01.06), "Development of Lateral Bearing Capacity for DPCP CTF Stability Analysis."

9. PG&E Calculation No. 52.27.100.713 (GEO.DCPP.01.03), "Development of Allowable Bearing Capacity for DCPP ISFSI Pad and CTF Stability Analysis."

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

11. License Amendment Request 02-03, Spent Fuel Cask Handling, PG&E Letter DCL-02-044, April 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. NRC Letter to PG&E dated January 30, 2004, Exemption from the Requirements of 10 CFR 50.68(b)(1).

15. Holtec International Report No. HI-2063593, "Dynamic Analysis of the HI-TRAC in Cask Washdown Area When Restrained," Revision 5.

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

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-2125191~~04625~~, "Three-Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat~~Design~~," Revision ~~9~~0.

TABLE 4.2-4

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

Condition	Pressure (psig)
Initial Backfill (at 70°F) MPCs loaded under Amendments 0, 1, and 2	33.3 (Maximum)
Initial Backfill (at 70°F) MPCs loaded under Amendment 3 and later	40.0 (Maximum)
Normal Condition with no rod rupture	~~64~~77.1
Normal Condition with 1% rods ruptured (storage)	~~65.1~~78.2
Normal Condition with no rod rupture (transport)	~~74.5~~79.0

(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-2125191, Revision ~~9~~0.

5.1.1.2 MPC Loading and Sealing Operations

This section describes the general sequence of operations to load and seal the MPC, including the movement of the transfer cask within the FHB/AB. Site-specific procedures control the performance of the operations, including inspection and testing. At a minimum, these procedures control the performance of activities and alert operators to changes in radiological conditions around the cask. As described in this section, several operational sequences have important time limitations including time-to-boil following MPC lid attachment~~, and time limits to establish and suspend supplemental cooling~~. These sequences are controlled by the Diablo Canyon ISFSI TS and Section 10.2.

Several auxiliary components are used during the cask loading process. A discussion of these items is provided for the sole purpose of describing the loading process. These items, along with their design and use, are controlled under the DCPP Control of Heavy Loads Program.

A work platform in the Unit 2 cask washdown area (CWA) assists in transfer cask and MPC preparation and closure operations. The work platform is part of the transfer cask seismic restraint system.

All handling of the transfer cask inside the FHB/AB will be made using a single failure proof crane to preclude a vertical cask drop event.

Placement of loaded overpacks at the ISFSI is a cyclical process involving the movement of a loaded overpack to the ISFSI and returning with an empty transfer cask for the next loading process. The operations described herein start at the time the empty MPC is loaded into the transfer cask and is ready for movement into the FHB/AB.

An empty MPC-32 is also verified to have been cleaned, inspected, and is then raised, and inserted into the transfer cask. This insertion activity may take place either prior to entering the FHB/AB or once inside the FHB/AB. Upon completion of the insertion activity alignment marks are verified to ensure correct rotational alignment between the MPC and the transfer cask.

The transfer cask is brought into the FHB/AB through the Unit 2 roll-up door in a vertical orientation on a low-profile transporter (LPT). There is no LPT rail system for Unit 1, thus transfer casks designated for transporting spent fuel from both units enter through the Unit 2 roll-up door. If not previously installed, an empty MPC-32 will be installed when the transfer cask is in the CWA restraint. The LPT is equipped with heavy-duty rollers that engage with a set of temporary tracks that runs from inside the FHB/AB to the access road located outside the Unit 2 FHB/AB roll-up door. The track and rollers are used because dimensional limitations of the FHB/AB roll-up door prevent access of the cask transporter inside the FHB/AB.

After an acceptable hydrostatic test has been completed, the remaining MPC water is displaced from the MPC by blowing pressurized helium gas into the vent port of the MPC, thus displacing the water through the drain line. Using helium during MPC water displacement and moisture removal ensures that there will be no oxidization of the fuel cladding during loading operations (fuel is covered with water prior to blowdown).

The moisture removal system is connected to the MPC and is used to remove the remaining liquid water from the MPC and to reduce the moisture content of the MPC cavity to an acceptable level. This is accomplished using a forced helium dehydration (FHD) system. When using the FHD system the annular gap is verified to have no water present.

When the FHD system is used, any water that has not drained from the MPC cavity is removed through introducing dry gas into the MPC cavity that absorbs the residual moisture in the MPC. This humidified gas exits the MPC and the absorbed water is removed through condensation and/or mechanical drying. During use of the FHD system, the circulated helium is monitored until it meets the dryness criteria of the DC ISFSI TS. Once this is met, the helium pressure in the MPC cavity is adjusted to within the required pressure range in accordance with the DC ISFSI TS.

Helium backfill to the required pressure and purity level ensures that the conditions for heat transfer inside the MPC are consistent with the thermal analyses and provides an inert atmosphere to ensure long-term fuel integrity.

After successful helium backfill operations~~, if the MPC contains any high burnup (>45,000 MWD/MTU) fuel assemblies, the supplemental cooling system (SCS) is installed and the annulus between the transfer cask and MPC is filled with demineralized water within the time required by the Diablo Canyon ISFSI TS. T~~the MPC vent and drain port cover plates are then installed, welded, inspected, examined, and helium leak tested in accordance with ANSI N14.5-1997. The MPC closure ring is then installed, welded, and examined. The MPC closure ring provides a second welded boundary, in addition to the confinement boundary, and is described further in Section 3.3.1.1.1 that has references to the design drawings in the HI-STORM 100 System FSAR. Note that at any time after helium backfill, the supplementary cooling system (SCS) may be installed and the HI-TRAC annulus filled with demineralized water to lower the MPC temperature for transfer operations if desired.

The temporary shield ring is removed. The transfer cask and accessible portions of the MPC are checked to ensure any removable contamination is within applicable limits. Additional decontamination and surveys may be performed throughout the loading process. The transfer cask top lid is installed and secured with four bolts.

The lift yoke is re-attached to the transfer cask. The transfer cask is raised and the bottom surface of the transfer cask is decontaminated using long-handled tools or other

remotely-operated devices which do not require personnel to directly access the bottom of the transfer cask.

The CWA seismic restraint is released and the FHB crane then moves the transfer cask laterally away from the CWA. The transfer cask is positioned on and bolted down to the LPT. If not performed earlier, the transfer cask and LPT are surveyed to ensure that any fixed contamination is within acceptable limits. The loaded transfer cask and LPT are then rolled out of the Unit 2 FHB/AB to an area outside of the FHB/AB where the cask transporter can access the transfer cask.

~~If necessary, the SCS may be removed from service during the movement of the transfer cask from the CWA restraint to the cask transporter, provided the time limits set forth in the Diablo Canyon ISFSI TS are met.~~

5.1.1.3 Transfer to the ISFSI Storage Site

The cask transporter and associated ancillaries, described in Section 4.3, are positioned outside the FHB/AB doors to receive the transfer cask. The transporter receives preoperational testing and maintenance and is operated in accordance with the Cask Transportation Evaluation Program in the Diablo Canyon ISFSI TS, which evaluates and controls the transportation of loaded MPCs between the DCPP FHB/AB to the CTF and ISFSI. The transfer cask on the LPT is positioned under the lift beam of the cask transporter and the transfer cask lift links are rigged to the cask. The transporter lift system engages the transfer cask while the transfer cask is unbolted from the LPT. The transporter than raises the transfer cask and~~,~~ it is secured within the transporter for the trip to the CTF~~, and if required the SCS returned to service~~. The LPT is than rolled out of the way and the transporter transports the transfer cask to the CTF along the approved transportation route as described in Section 4.3.3 and shown in Figure 2.1-2.

The overpack is prepared for loading, which involves general visual inspections and cleaning. Following the visual inspection and cleaning, the overpack is positioned in the CTF by the transporter. In preparation for receiving the loaded MPC, the overpack lid is removed (if previously installed). The mating device is secured to the overpack. To restrain the cask against seismically-induced impact loads on the main shell of the CTF, seismic restraints are installed to transmit the load from the overpack to the CTF shell (Section 3.3.4.2.3).

At the CTF, the transporter positions the transfer cask over the mating device~~, the SCS is disconnected, if installed,~~ and the transfer cask is then secured to the mating device. During this connection process, subsequent to MPC transfer, HI-TRAC removal, and HI-STORM closure operation, temporary shielding is provided around the mating device as needed to minimize occupational dose. Use of the temporary shielding during these processes will be administratively controlled. The cask transporter seismic anchor (TSA) restraints connect the cask transporter to the CTF TSA pads. The TSA restraints are described in Section 4.2.1.2 and depicted in plan view in Reference 39 of Section 4.2. The TSAs function to prevent the transporter from seismically interacting with the

remotely-operated devices which do not require personnel to directly access the bottom of the transfer cask.

The CWA seismic restraint is released and the FHB crane then moves the transfer cask laterally away from the CWA. The transfer cask is positioned on and bolted down to the LPT. If not performed earlier, the transfer cask and LPT are surveyed to ensure that any fixed contamination is within acceptable limits. The loaded transfer cask and LPT are then rolled out of the Unit 2 FHB/AB to an area outside of the FHB/AB where the cask transporter can access the transfer cask.

~~If necessary, the SCS may be removed from service during the movement of the transfer cask from the CWA restraint to the cask transporter, provided the time limits set forth in the Diablo Canyon ISFSI TS are met.~~

5.1.1.3 Transfer to the ISFSI Storage Site

The cask transporter and associated ancillaries, described in Section 4.3, are positioned outside the FHB/AB doors to receive the transfer cask. The transporter receives preoperational testing and maintenance and is operated in accordance with the Cask Transportation Evaluation Program in the Diablo Canyon ISFSI TS, which evaluates and controls the transportation of loaded MPCs between the DCPP FHB/AB to the CTF and ISFSI. The transfer cask on the LPT is positioned under the lift beam of the cask transporter and the transfer cask lift links are rigged to the cask. The transporter lift system engages the transfer cask while the transfer cask is unbolted from the LPT. The transporter than raises the transfer cask and~~,~~ it is secured within the transporter for the trip to the CTF~~, and if required the SCS returned to service~~. The LPT is than rolled out of the way and the transporter transports the transfer cask to the CTF along the approved transportation route as described in Section 4.3.3 and shown in Figure 2.1-2.

The overpack is prepared for loading, which involves general visual inspections and cleaning. Following the visual inspection and cleaning, the overpack is positioned in the CTF by the transporter. In preparation for receiving the loaded MPC, the overpack lid is removed (if previously installed). The mating device is secured to the overpack. To restrain the cask against seismically-induced impact loads on the main shell of the CTF, seismic restraints are installed to transmit the load from the overpack to the CTF shell (Section 3.3.4.2.3).

At the CTF, the transporter positions the transfer cask over the mating device~~, the SCS is disconnected, if installed,~~ and the transfer cask is then secured to the mating device. During this connection process, subsequent to MPC transfer, HI-TRAC removal, and HI-STORM closure operation, temporary shielding is provided around the mating device as needed to minimize occupational dose. Use of the temporary shielding during these processes will be administratively controlled. The cask transporter seismic anchor (TSA) restraints connect the cask transporter to the CTF TSA pads. The TSA restraints are described in Section 4.2.1.2 and depicted in plan view in Reference 39 of Section 4.2. The TSAs function to prevent the transporter from seismically interacting with the

The cask transporter is disconnected from the overpack and the lift brackets are removed and lid studs installed on the overpack. The grounding cables are attached to the overpack. The overpack duct photon attenuators (also known as gamma shield cross plates) are installed in the upper and lower air ducts and screens are secured. The anchor studs and nuts are covered with a metal cap for protection from the elements.

5.1.1.4 Off-Normal Event Recovery Operations

The analysis of off-normal and accident events, as defined in ANSI/ANS-57.9 (Reference 6) and as applicable to the Diablo Canyon ISFSI, is presented in Chapter 8. Each postulated off-normal and accident event analyzed and discussed in Chapter 8 addresses the event cause, analysis, and consequences. Suggested corrective actions are also provided for off-normal events. The actual cause, consequences, corrective actions, and actions to prevent recurrence (if required) will be determined through the DCPP corrective action program on a case-specific basis. All corrective actions will be taken in a timely manner, commensurate with the safety significance of the event. Of primary importance in the early response to any event will be the verification of continued criticality prevention, the protection of fuel cladding integrity (that is, heat removal), and the adequacy of radiation shielding while longer-term corrective actions are developed. This may also involve the need for temporary shielding or cask cooling in accordance with the recommendations of PG&E technical staff personnel, based on the event conditions.

Should the need arise, the MPC can be returned to the SFP for unloading. To unload an overpack or transfer cask, the operations described above are effectively executed in reverse order from the point in the operation at which the event occurred. Should any MPCs loaded under Amendment 2 of this license require unloading, the use of the supplementary cooling system shall be utilized. Once the transfer cask is back in the FHB/AB, the transfer cask top lid is removed, and preparations are made to reopen the MPC in the SFP. This involves first grinding out the welds and removing the MPC closure ring and vent and drain port cover plates. A sample of the gas inside the MPC may be drawn to determine the extent of fuel cladding failure, if any. Then, the helium cooldown system is connected and used to recirculate the helium in the MPC to cool it to a temperature at or below the maximum-allowed temperature for reflooding in accordance with the Diablo Canyon ISFSI TS and Section 10.2. Cooling the helium allows the MPC to be reflooded with water (borated as necessary) with a minimal amount of flashing and the associated undesirable pressure spikes in the MPC cavity. (Using helium for cooling prior to reflood ensures the fuel is not exposed to an oxidizing environment during unloading operations.) Based on the time the cask has been in storage, a new time-to-boil may be determined using a lower decay heat value than was used when the cask was loaded. When the MPC has been reflooded, the time-to-boil clock is started. The weld removal system is used to cut the MPC lid weld, freeing the lid for subsequent removal.

personnel actions or equipment are required to respond to an off-normal pressure event. Therefore, no detection instrumentation is required.

8.1.1.3 Analysis of Effects and Consequences of Off-Normal Pressure

A newThe analysisevaluation of MPC pressure for this off-normal event was performed for two scenarios. The first scenario is for uniform loading and the second is for regional loading. In addition, the analysis used two normal ambient temperatures for specific configurations. A normal ambient temperature of (8065°F) was assumed for a loaded MPC contained in a HI-STORM overpack on the ISFSI pad and for a loaded MPC contained in a HI-STORM overpack within the CTF. All transport configurations with a loaded MPC contained within the HI-TRAC assumed a normal ambient temperature of 80°F. The analysis for both HI-STORM configurations also assume, 10 percent of the fuel rods ruptured, peak insolation, maximum decay heat, maximum backfill pressure, IFBA fuel and the effect of nonfuel hardware.

The MPC-32 was used as the bounding MPC in this analysis because it provides the maximum internal pressure for all MPCs to be used at the Diablo Canyon ISFSI (see Section 4.2.3.3.2.2 for justification). The resulting pressure for the MPC-32 with 8065°F ambient temperature is 76.391.6 psig for the storage condition (Reference 13, Table B.5.1410) and 87.9 psig for the transport condition (Reference 11, Table 9), respectively. The added effect of increasing the ambient temperature from 8065°F to the maximum off-normal temperature of 100°F on the internal pressure was included in the calculation in Reference 13 for both the HI-STORM configurations for the storage condition. For the transport condition , tFor the transport conditions the added effect of increasing the ambient temperature from 80°F to the maximum off-normal temperature of 100°F was conservatively evaluated using the Ideal Gas Law. Assuming the MPC cavity gas temperature increased by the full 20°F, the resulting absolute pressure P2 for the transport conditions -is computed as follows:

$$P2 = P1 \times [(T1 + \triangle T)/T1]$$

Where,

P_1 = Absolute pressure at T_1 = 87.979.0 psig (102.693.7 psia)

T_1 = Absolute bulk temperature of the MPC cavity gas with design basis fuel decay heat = 513.6504.2°K (Reference 13, Section 11.1.1.3Table C.5)

$\triangle T$ = Absolute bulk MPC cavity gas temperature increase = 20°F, or 11.1°K

The resulting absolute pressure (P_2) was computed to be 89.881.1 psig for the transport condition. Pressure values for both the storage and transport conditions are below the normal/off-normal MPC internal design pressure of 100 psig.

temperatures fall outside the off-normal temperature limits. Ambient temperature is available from thermometers used for the DCPP site meteorological measurement program.

8.1.2.3 Analysis of Effects and Consequences of Off-Normal Environmental Temperatures

There are no adverse safety effects resulting from off-normal environmental temperatures on the cask transporter, CTF, or concrete storage pads, since they are designed for these temperature ranges.

The off-normal event, considering a maximum off-normal ambient temperature of 100°F has been evaluated for the HI-STORM 100 System and is described in the HI-STORM 100 System FSAR Section 11.1.2.3. The evaluation was performed for the loaded transfer cask and the loaded overpack, assuming design-basis fuel with the maximum decay heat and the most restrictive thermal resistance. The 100°F environmental temperature was applied with peak solar insolation. Thermal analysis contained in the HI-STORM 100 System FSAR indicates that the MPC-32 has the highest design-basis decay heat load and always yields the highest cask system component and content temperatures. As such, only the MPC-32 is evaluated since the MPC-24 and MPC-24E thermal performance will be bounded by that of the MPC-32 under all conditions.

The HI-STORM 100 System maximum temperatures for components close to the design-basis temperatures are conservatively calculated at both ~~an~~ environmental temperatures of 65°F and 80°F as an initial condition for this off-normal event. These temperatures (for MPC-32 and the overpack) are shown in Tables B.5.2 and C.2 of Reference 13. The maximum off-normal environmental temperature is 100°F, which is an increase of 20°F to 35°F, depending on the configuration, over the normal design temperature. The limiting component maximum off-normal temperatures are shown in Table B.5.4 of Reference 13. The temperatures are all below the applicable material short-term temperature limits.

The off-normal event considering a limiting low environmental temperature of -40°F and no insolation for a duration sufficient to reach thermal equilibrium has been evaluated with respect to overpack material brittle fracture at this low temperature. The overpack and MPC are conservatively assumed to reach -40°F throughout the structure. The minimum off-normal environmental temperature specified for the transfer cask is 0°F and the transfer cask is conservatively assumed to reach 0°F throughout the structure. This evaluation is discussed in the HI-STORM 100 System FSAR Section 3.1.2.3 and the results are acceptable. Administrative procedures based on Diablo Canyon ISFSI TS 5.1.3 prohibit cask handling operations at environmental temperatures below 0°F.

8.1.2.4 Corrective Action for Off-Normal Environmental Temperatures

The HI-STORM 100 System is designed to withstand the off-normal environmental temperatures without any effects on its ability to maintain safe storage conditions. The

perforated plates (screens) ensure the air ducts are protected from the incursion of foreign objects. Each set of four air inlet and outlet air ducts are spaced 90 degrees apart around the circumference of the overpack and it is highly unlikely that blowing debris during normal or off-normal operation could block all of the air inlet ducts. It is conservatively assumed, as an off-normal condition, that two of the four air inlet ducts are blocked. Blockage of the inlet air ducts is assumed to be thermally equivalent to blockage of the outlet air ducts. The evaluation of this off-normal event is included in Section B.5.4 of Reference 13. In this evaluation this condition is defined as 50% blockage of all the inlet ducts. Per the evaluation the resulting decrease in flow area increases the inlet air flow resistance. The results in Table B. 5.4 of Reference 13, show that the fuel cladding, MPC and HI-STORM 100SA component temperatures are below their temperature limits. The MPC-32 pressure for this condition is provided in Table B.5.10 of Reference 13 and the result is below the off-normal design pressure specified in DC ISFSI UFSAR.
, as well as the blockage of three inlet ducts, is discussed in Section 11.1.4 of the HI-STORM 100 System FSAR. The blocked air inlet ducts are assumed in the HI-STORM 100 System FSAR to be completely blocked, with an ambient temperature of 80°F, peak solar insolation, and maximum spent fuel decay heat values. The HI-STORM 100 System FSAR generic assumption of an annual average temperature of 80°F and peak solar insolation value of 800 g-cal/cm^2, respectively, bounds the Diablo Canyon site annual average temperature of 55°F and peak solar insolation value of 766 g-cal/cm^2.

8.1.4.1 Postulated Cause of Partial Blockage of Air Inlets

It is conservatively assumed that all the affected air inlet ducts are 50%completely blocked, although the protective perforated plates (screens) prevent foreign objects from entering into the ducts. The perforated plates (screens) are inspected periodically, as required by the Diablo Canyon ISFSI TS. Any duct blockage would be detected by visual inspection and removed to restore the heat removal system to full operational condition. Depending on the size and number of debris pieces, it is possible that blowing debris may simultaneously block two air inlet ducts of the overpack.

8.1.4.2 Detection of Partial Blockage of Air Inlets

Detection of partial blockage of air inlet ducts would occur during the routine visual surveillance of the storage cask air duct perforated plates (screens) required by the Diablo Canyon ISFSI TS. The frequency of inspection is conservatively based on an assumed complete simultaneous blockage of all four air inlet ducts (Diablo Canyon ISFSI TS Bases).

8.1.4.3 Analysis of Effects and Consequences of Partial Blockage of Air Inlets

Blockage of the overpack air inlet ducts can affect the heat removal process of the dry storage system. The magnitude of the effect is dependent upon the rate of decay heat emission from the stored fuel (itself dependent upon the fuel burnup and cooling time) and the ambient air temperature. A bBounding evaluations was ere performed for 50%

~~the~~ blockage of all the ~~two~~ inlet air ducts with the MPC-32 inside the overpack, at its maximum decay heat load at the ambient air temperature of 65~~80~~°F. As stated above, the Diablo Canyon site-specific evaluation (Reference 13)~~HI-STORM 100 System FSAR~~ assumes an annual-average ambient air temperature of 65~~80~~°F, which bounds the actual annual-average ambient air temperature for the Diablo Canyon s~~S~~ite of 55°F. The MPC-32 decay heat load bounds the MPC-24, MPC-24E, and MPC-24EF heat loads due to the presence of eight additional fuel assemblies. Computed component temperatures for 50% blockage of all~~two~~ air inlet ducts ~~blocked~~ are less than the allowable component short-term temperature limits. Blocking of four ducts is treated as an accident in Section 8.2.15. The results are shown in Table B.5.~~4~~ 6 of Reference 13.

The MPC cavity pressure for ~~two~~ 50% blocked air ducts was also evaluated. The computed MPC internal pressure, using ~~a conservatively higher~~the maximum heat load and fill pressure, was ~~94.6~~77.3 psig, which is less than the normal condition MPC design pressure of 100 psig (Reference 13, Table B.5.10~~2~~).

8.1.4.4 Corrective Action for Partial Blockage of Air Inlets

The corrective action for the partial blockage of air inlet ducts is the removal of the cause of the blockage, and the cleaning, repair, or replacement, as necessary, of the affected perforated plates (screens). After clearing of the blockage, the cask heat removal system is restored to its design condition, and temperatures will return to the normal range. Partial blockage of air inlet ducts does not affect the ability of the H-STORM 100 System to safely store spent fuel for the long term.

Inspection of the overpack air duct perforated plates (screens) is performed at a 24-hour frequency as required by the Diablo Canyon ISFSI TS. This inspection ensures blockage of air inlet ducts is detected and appropriately corrected.

8.1.4.5 Radiological Impact of Partial Blockage of Air Inlets

For partial blockage of air inlet ducts, it is estimated that the removal, cleaning, and replacement of the affected perforated plates (screens) will take two people approximately 1 hour. The dose rate at this location is estimated to be 58 mrem/hr. The total exposure for personnel to perform these corrective actions is 0.116 man-rem.

8.1.5 CASK DROP LESS THAN ALLOWABLE HEIGHT

Cask drops outside the fuel handling building/auxiliary building (FHB/AB) are not credible due to the design of the cask transporter and LPT, as discussed in Section 8.2.4. The structural load path members of the cask transporter used in Diablo Canyon ISFSI operations are designed, operated, fabricated, tested, inspected, and maintained in accordance with the applicable guidelines of NUREG-0612 (Reference 6). The LPT has been designed to preclude tipover or drops of the transfer cask (Reference 12). In addition, an evaluation was performed for four short-term transient

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

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

~~13. Holtec International Document No. HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design", Revision 9.~~

13. Holtec International Document No. HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat", Revision 0.

for both the overpack and the transfer cask. Therefore, there is no release of the contained radioactive material from the MPC and no dose consequences in this regard. The shielding implications of a design basis fire for each of these components are discussed below.

8.2.5.3.1 HI-STORM 100 Overpack

Section 11.2.4.2.1 of the HI-STORM 100 System FSAR discusses the fire analysis for the overpack, including radiological implications. The design-basis fire for the HI STORM 100 overpack causes a small reduction in the shielding provided by the concrete. No portions of the steel structure of the overpack experience temperatures exceeding the short-term temperature limits. While the temperature in the outer 1-inch of concrete is shown to exceed the material short-term temperature limit, there is no significant reduction in the shielding provided by the overpack. All MPC component and fuel assembly temperatures remain within their short-term temperature limits as demonstrated by the Diablo Canyon ISFSI specific thermal analyses (Reference 63).

8.2.5.3.2 HI-TRAC Transfer Cask

Section 11.2.4.2.2 of the HI-STORM 100 System FSAR discusses the fire analysis for the transfer cask. The elevated local temperatures due to the fire will cause approximately 11 percent of the water in the water jacket to boil off and relieve as steam through the relief valves on the water jacket. However, it is conservatively assumed for the dose calculations that all of the water in the water jacket is boiled off. The fire could also heat the Holtite-A shielding material in the transfer cask top lid above its temperature limit. Therefore, it is conservatively assumed in the dose calculations that all of the Holtite-A in the transfer cask is lost.

The postulated losses of all neutron shielding, due to the loss of water in the water jacket and all Holtite-A in the transfer cask top lid, will not exceed the 10 CFR 72.106 dose limits at an assumed controlled-area boundary located 100 meters from the ISFSI pad for the 30-day duration of the accident, as discussed in Section 5.1.2 of the HI-STORM 100 System FSAR. The nearest controlled area boundary at Diablo Canyon is approximately 1,400 ft from the ISFSI storage pads, which would further decrease the estimated accident dose to well below the 10 CFR 72.106 limit.

Also, as shown in Tables C.3 and C.4 of Reference 63, the increase in fuel cladding and component material temperatures due to the fire and loss of water in the water jacket do not cause the short-term fuel cladding or material temperature limits to be exceeded. The internal MPC pressure also remains below the 200-psig accident design limit, as shown in Reference 63, Table C.54. Thus, there is no effect on the integrity of the MPC confinement boundary.

The ISFSI system is not affected by the postulated combustion of local fuel tanks, combustible materials outside the ISFSI storage pad perimeter or along the transport

will not go undetected because fuel condition will be verified as part of the loading process.

8.2.9.3 Conclusion

As discussed above, the use of procedures, which prescribe and verify the rigorous planning and loading activities, provides reasonable assurance that only fuel assemblies meeting Diablo Canyon ISFSI TS and Section 10.2 requirements will be loaded for storage.

8.2.10 EXTREME ENVIRONMENTAL TEMPERATURE

Extreme environmental temperature is classified as a natural phenomenon Design Event IV as defined in ANSI/ANS-57.9. The extreme environmental temperature accident involves the postulation of an unusually high ambient temperature at the Diablo Canyon ISFSI site. Unlike the off-normal high temperature evaluated in Section 8.1.2, the postulated, extreme-high temperature is beyond what can be reasonably expected to occur over the life of the ISFSI and represents a bounding, worst-case scenario.

8.2.10.1 Cause of Extreme Environmental Temperature

The extreme environmental temperature event for the HI-STORM 100 System is analyzed at an environmental temperature of 125°F in Reference 63 and at -40°F in Section 4.4.3 of the HI-STORM 100 System FSAR. To determine the effects of the extreme temperature, it is conservatively assumed that the temperature persists for a sufficient duration to allow the HI-STORM 100 System to achieve thermal equilibrium. Because of the large mass of the HI-STORM 100 System, with its corresponding large thermal inertia and the limited duration for the extreme temperature, this assumption is conservative.

8.2.10.2 Extreme Environmental Temperature Analysis

8.2.10.2.1 Upper Temperature Limit

The accident condition considered in Reference 63 assumes an extreme environmental temperature of 125°F for a duration sufficient to reach thermal equilibrium. This bounds the extreme-maximum-site ambient temperature for the Diablo Canyon ISFSI site of 104°F (Section 3.4.). This condition is evaluated with respect to accident condition component design temperatures listed in Table 2.2.3 of the HI-STORM 100 System FSAR. The evaluation was performed with considering baseline conditions (steady state conditions , normal ambient temperature, and the ~~HI-STORM 100 System FSAR design-basis fuel with the~~ maximum design decay heat load of 28.74 Kw ~~and the most restrictive thermal resistance~~) the temperatures of the HI-STORM 100SA system are conservatively assumed to rise by the difference between the extreme and normal ambient temperatures. ~~. The HI-STORM 100 site-specific evaluation of a 125°F environmental temperature is applied with the peak solar insolation as described in the~~

~~HI-STORM 100 System FSAR. The solar insolation assumed in the generic analysis bounds that for the Diablo Canyon ISFSI site.~~

~~The HI-STORM 100 System maximum temperatures for components close to the design-basis temperatures are discussed in the HI-STORM 100 System FSAR, Section 4.4.~~ These temperatures are calculated at a normal environmental temperature of 65~~80~~°F. The extreme environmental temperature is 125°F, which is an increase of ~~45~~60°F. This event is simplistically evaluated by adding the ~~45~~60°F difference to each of the limiting normal component temperatures. This yields conservatively bounding temperatures for all of the HI-STORM 100 System components because the thermal inertia of the HI-STORM 100 System is not credited. The resulting component temperatures under extreme environmental temperature condition are listed in Table B.5.7 of Reference 63. As illustrated by the table, all the temperatures are well below the accident-condition, design-basis component temperatures. Since the extreme environmental temperature is of a short duration (several consecutive days would be highly unlikely), the resultant temperatures are evaluated against short-term accident condition temperature limits. Therefore, the HI-STORM 100 System component temperatures meet design requirements under the extreme environmental temperature condition.

Additionally, the effect of extreme environmental temperature on MPC internal pressure was evaluated. The resultant pressure, from Table B.5.~~12~~ 10 of Reference 63, is calculated as ~~98.8~~83.3 psig which is below the accident design pressure of 200 psig.

8.2.10.2.2 Lower Temperature Limit

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 ISFSI is greater than or equal to 24°F (Table 3.4-1), the extreme low ambient temperature evaluation in the HI-STORM 100 System FSAR bounds the conditions at the Diablo Canyon ISFSI.

8.2.10.3 Extreme Environmental Temperature Dose Calculations

The extreme environmental temperature range at the Diablo Canyon ISFSI will not cause the overpack concrete to exceed its normal design temperature. Therefore, there will be no degradation of the concrete shielding effectiveness. The extreme temperature range will not cause a breach of the confinement system and the short-term fuel cladding temperature limit is not exceeded. Therefore, there is no radiological impact on the HI-STORM 100 System for the extreme environmental temperature range, and the dose rates under this accident condition are equivalent to the normal condition dose rates.

8.2.12.1 Cause of Accident

There is no credible accident that could completely stop heat transfer from the overpack to the environment. Even if the overpack were to be completely buried, with the inlet and outlet vent ducts blocked, some heat transfer would occur via conduction through the overpack structure and the material covering the overpack, and through convection at the surface of the outer material. The Diablo Canyon ISFSI site is located where a portion of the hill has been excavated (Figure 2.1-2). The slope protection of the hill adjacent to the storage pads (Section 4.2.1.1.9) precludes a landslide that completely covers one or more casks on the ISFSI pads. Should a slide occur, minor amounts of material could be removed before excessive heat up would occur. Also, there are no sources of volcanic activity or large amounts of debris located above, and sufficiently close to, the ISFSI site that could cause a complete covering of one or more casks on the ISFSI pads. This is a non-mechanistic accident and is evaluated to yield the most conservative response of the HI-STORM 100 System.

8.2.12.2 Accident Analysis

Section 11.2.14 of the HI-STORM 100 System FSAR discusses the "Burial-Under-Debris" accident, which is modeled as an adiabatic heat-up event. The analysis of this event is summarized below.

Burial of the loaded overpack does not impose a condition that would have more severe consequences for criticality, confinement, shielding, and structural analyses than that performed for the other accidents analyzed. The debris would provide additional shielding to reduce radiation doses. The accident external pressure encountered during the flooding accident (Section 8.2.3) bounds any credible pressure loading caused by the burial under debris.

Burial under debris can affect thermal performance because the debris acts as an insulator and heat sink. The insulating effect will cause the HI-STORM 100 System and fuel cladding temperatures to increase. A thermal analysis has been performed to determine the time for the fuel cladding temperatures to reach the short-term, accident-condition temperature limit during a burial under debris accident.

To demonstrate the inherent safety of the HI-STORM 100 System, a bounding analysis that considers the debris to act as a perfect insulator is considered. Under this scenario, the contents of the HI-STORM 100 System will undergo a transient heat up under adiabatic conditions. The minimum time required for the fuel cladding to reach the short-term, design, fuel-cladding-temperature limit depends on the amount of thermal inertia of the cask, the cask initial conditions, the spent nuclear fuel decay heat generation and the margin between the initial cladding temperature and accident temperature limit~~and the spent fuel decay heat generation~~.

This evaluation is performed in Section B.5.4 of Reference 63 and determined a substantial allowed burial time of 72.7 hours. In addition, Table B.5.6 of Reference 63

access. Administrative controls related to prudent, heavy-load movement will preclude personnel from access underneath the lifted cask inside the FHB/AB.

8.2.14 100 PERCENT FUEL ROD RUPTURE

This accident event postulates that all of the fuel rods in a sealed MPC rupture and that fission-product gases and fill gas are released from the fuel rods into the MPC cavity.

8.2.14.1 Cause of Accident

Through all credible accident conditions, the HI-STORM 100 System maintains the spent nuclear fuel in an inert environment while maintaining the peak fuel-cladding temperature below the short-term temperature limits, thereby ensuring fuel-cladding integrity. Although rupture of all the fuel rods is assumed, there is no credible cause for 100 percent fuel rod rupture. This accident is postulated to evaluate the MPC confinement boundary for the maximum possible internal pressure based on the non-mechanistic failure of 100 percent of the fuel rods.

8.2.14.2 Accident Analysis

The 100 percent fuel-rod-rupture accident has no thermal, criticality, or shielding consequences. The event does not change the reactivity of the stored fuel, the magnitude of the radiation source, which is being shielded, the shielding capacity, or the criticality control features of the HI-STORM 100 System. It only has the potential for affecting the internal pressure of the MPC and the leakage from the MPC. The determination of the maximum accident pressure due to a hypothetical 100 percent fuel rod rupture accident was evaluated for the MPC-32 as a bounding case for all MPCs that are licensed for use at the Diablo Canyon ISFSI.

The MPC-32 internal cavity pressure was calculated for the 100 percent rod rupture accident using the methodology from the HI-STORM 100 System generic analysis documented in Section 4.4.4 of the HI-STORM 100 System FSAR. Limiting input values were assumed for initial fuel rod fill pressure (715 psia), fuel burnup (70,000 MWD/MTU), decay heat load (~~24~~ 28.74 kW) and minimum MPC cavity volume. The presence of nonfuel hardware and the release of fission gases from the BPRAs was also accounted for. These assumptions bound the characteristics for fuel to be loaded in any MPC to be deployed at the Diablo Canyon ISFSI. The computed MPC internal pressure from the 100 percent rod rupture accident is ~~166.1~~181.5 psig (Reference 63, Table B.5.~~14~~9), which is less than the MPC accident design pressure of 200 psig (Reference 12, Table 2.0.2).

8.2.14.3 Accident Dose Calculations

thermosiphon internal convection phenomenon, as described in Chapter 4 of the HI-STORM 100 System FSAR enables the maximum, design-basis, PWR-decay-heat load to rise to about 37 kW. The thermosiphon effect also shifts the highest temperatures in the MPC enclosure vessel toward the top of the MPC. The peak, MPC-lid, outer-surface temperature, for example, is computed to be about 600°F in the thermosiphon-enabled solution compared with about 210°F in the thermosiphon-suppressed solution, with both solutions computing approximately the same peak cladding temperature. In the 100 percent, inlet-duct-blockage condition, the heated MPC lid and MPC shell become effective heat dissipaters because of their proximity to the overpack outlet ducts and because the thermal radiation heat transfer rises at the fourth power of absolute temperature. As a result of this increased heat rejection from the upper region of the MPC, the time limits for reaching the short-term peak fuel-cladding temperature limits calculated without thermosiphon (72 hours) remains bounding.

Under the complete, air-inlet-duct-blockage condition, it must also be demonstrated that the MPC internal pressure does not exceed its design-basis accident limit. The bounding MPC internal pressure was calculated at an ambient temperature of ~~80~~65°F, design-basis insolation, and maximum decay heat as part of the site specific thermal analysis (Reference 63). The analysis did not assume a simultaneous 100% rod rupture event, since the peak fuel cladding temperatures for the accident conditions never exceed the regulatory accident 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 (Reference 21), 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 same result is confirmed for all accidents evaluated for the Diablo Canyon ISFSI. Therefore, no coincident 100% rod rupture postulations with an accident are evaluated. This is supported by the HI-STORM 100 CoC, Amendment 5 (Reference 64). ~~-~~The resultant MPC internal pressure is calculated to be ~~112.4~~89.6 psig (Reference 63, Table B.5.~~12~~10), which is less than the accident design pressure of 200 psig (HI-STORM 100 System FSAR Table 2.2.1). ~~The HI-STORM 100 System FSAR generic assumption of an annual average temperature of 80°F bounds the Diablo Canyon site annual-average temperature of 55°F. The HI-STORM 100 System FSAR uses 800 g-cal/cm^2 per day for the full insolation level as recommended in 10 CFR 71 (averaged over a 24-hour period as allowed in NUREG-1567). 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 are therefore bounded by the analysis in the HI-STORM 100 System FSAR .~~

8.2.15.3 Dose Calculations for 100 Percent Blockage of Air Inlet Ducts

As shown in the analysis of the 100 percent blockage of air inlets accident in the HI-STORM 100 System FSAR, the shielding capabilities of the HI-STORM 100 System are unchanged because the section average concrete temperature does not exceed its short-term-condition design temperature limit for the duration of the accident. The Diablo Canyon ISFSI TS require the blockage to be cleared within 8 hours of declaring

The LS-DYNA computer simulation of the tower collapse at the ISFSI storage pad models the flat side of the "T" bar impacting the overpack top lid. The unfiltered impact force was computed to be 534 kips. To convert this to an equivalent g-load on the overpack, the 534 kips is divided by the weight of the loaded overpack:

$$534 / 360 = 1.48 \text{ g}$$

The overpack structure is designed to withstand a 45-g deceleration. Therefore, the impact of the force due to the transmission tower collapse is bounded with margin. The horizontal component of the impact force is less than 93 kips, which is bounded by the large tornado missile load of 122 kips described in Section 8.2.2. The overturning moments are also bounded for the effects on the anchorage to the ISFSI pad. MPC confinement boundary integrity related to tower impact discussed in Section 8.2.16.2.1 is applicable at the pad.

8.2.16.3 Dose Calculation for Transmission Tower Collapse

There are no offsite dose consequences as a result of this accident because the MPC confinement boundary remains intact. Potential damage to the overpack structure as a result of this event will vary based on the actual location and severity of the impact on the overpack. Based on the loads described above, no significant damage to the shielding effectiveness of the overpack is expected. If necessary, corrective actions will be implemented based on the nature of the damage in a time frame commensurate with safety significance.

8.2.17 SUPPLEMENTAL COOLING SYSTEM (SCS) FAILURE

The SCS system is a supplied fluid device used to provide supplemental HI-TRAC cooling during the unloading operation of any MPC loaded under Amendment 2 of this licence. The SCS system maintains water in the MPC/HI-TRAC annulus to cool the MPC shell in order to maintain the fuel cladding below the ISG-11 Rev. 3 temperature limit. Although an SCS System failure is highly unlikely, for defense-in-depth an accident condition that renders it inoperable for an extended duration is postulated herein.

8.2.17.1 Cause of SCS Failure

Because the SCS is a keep full system, the only failure mode is a complete loss of annulus water from an uncontrolled leak or line break, and SCS cannot be reestablished within the required restoration time because of equipment configuration.

8.2.17.2 Analysis of Effects and Consequences of SCS Failure

In the event of an SCS failure, a rapid water loss occurs and annulus water is replaced with air. For the condition of a vertically oriented HI-TRAC with air in the annulus, the

51. Probabilistic Risk Assessment, Calculation File No. PRA02-10, "Probabilistic Evaluation of Seismically Induced Cask Drop, Overturn of the Transporter, or Sliding of the Transporter Off the Transport Route."

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

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

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

55. ACI 349-01, Code Requirements for Nuclear Safety Related Concrete Structures, American Concrete Institute, 2001.

56. Regulatory Guide 1.142, Safety Related Concrete Structure for Nuclear Power Plants (Other than Reactor Vessels and Containment), USNRC, November 2001.

57. Regulatory Guide 1.199, Anchoring Components and Structural Supports in Concrete, USNRC, November 2003.

58. Holtec International Document No. HI-2043322, "Structural Evaluation of the HI-TRAC/HI-STORM Stack at the Diablo Canyon CTF," Revision 3.

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

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

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

62. Response to NRC Request for Additional Information Regarding Cask Transporter Lateral Restraints for the Diablo Canyon ISFSI (TAC No. L23399), PG&E Letter DIL-03-011, October 3, 2003.

63. Holtec International Document No. HI-2125191~~04625~~, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Decay Heat~~Design~~," Revision 0~~9~~.

64. 10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 5, July 14, 2008

10.2 DEVELOPMENT OF OPERATING CONTROLS AND LIMITS

This section provides an overview of, and the general bases for, operating controls and limits specified for the Diablo Canyon ISFSI.

10.2.1 FUNCTIONAL AND OPERATING LIMITS, MONITORING INSTRUMENTS, AND LIMITING CONTROL SETTINGS

To be consistent with the guidance contained in Interim Staff Guidance Document 11 (ISG-11), Revision 3, issued on November 17, 2003 (Reference 3), fuel assemblies to be stored initially at the Diablo Canyon ISFSI were 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).

Because the HI-STORM 100 System licensing and design basis incorporated by reference in this FSAR was originally taken from Revision 1A of the HI-STORM 100 System FSAR, many of the design and safety evaluations discussed in this FSAR were for bounding burnups exceeding those initially 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 were conservative and bounded the allowed cask contents.

The fuel burnup limit is specified in the Diablo Canyon ISFSI Technical Specifications. A review of Materials License SNM-2511 and it 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. However, PG&E will conservatively apply a 5 percent burnup uncertainty allowance when calculating the decay heat for each loaded MPC.

The NRC reviewed and accepted a generic HI-STORM System design that would allow higher fuel burnups for loading, consistent with the guidance of ISG-11, Revision 3. This approval has been included in CoC License Amendment 1014-2. License Amendment 2, issued by the NRC on January 19, 2012, updated the authorized contents for the Diablo Canyon ISFSI to store fuel with higher burnups consistent with HI-STORM CoC Amendment 3 in the MPC-32.

The NRC issued License Amendment 3 on [Later], updated the allowed content to a 28.74 kilowatt heat load for uniform loading and 25.572 kilowatt heat load for regionalized loading~~for both regional and uniform loading of MPC-32 to HBF with a maximum heat load of 28.74 Kw~~. This is supported by the Holtec International Document No. HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat," Revision 0

(Reference 5). That analysis also eliminated the requirement for a supplemental cooling system (SCS) during the transport process while loading.

This section provides requirements for the controls or limits that apply to operating variables classified as important to safety and are observable and measurable. The operating variables required for the safe operation of the Diablo Canyon ISFSI are:

- Spent fuel characteristics
- Spent fuel storage cask (SFSC) heat removal capability
- Multi-purpose canister (MPC) dissolved boron concentration level
- Annulus gap water requirement during moisture removal for loading and reflooding for unloading
- Water temperature of a flooded MPC
- MPC vacuum pressures
- MPC recirculation gas exit temperature
- Helium purity
- MPC helium backfill pressures
- Gas exit temperature of a MPC prior to reflooding
- Supplemental Cooling System (SCS)

Each of the specifications for these characteristics is provided below with the exception of the MPC dissolved boron concentration, and heat removal parameters, which are provided in the Diablo Canyon ISFSI TS and their bases. Although provided in the sections below, the TS and bases also provide Limiting Conditions for Operation and bases for maintaining the integrity of the MPC during loading and unloading. These include vacuum pressure, recirculation gas temperature, backfill pressure, and leak rate during loading, and exit gas temperature during unloading.

10.2.1.1 Fuel Characteristics

The Diablo Canyon ISFSI is designed to provide interim storage for up to 4,400 fuel assemblies, which accommodates the number of assemblies predicted to be used during the licensed operating life of the plant. The Diablo Canyon ISFSI storage system uses four MPC types for the storage of fuel assemblies, fuel debris and associated nonfuel hardware. The DCPP fuel is normally stored as nonconsolidated fuel

10.2.2.4 MPC Helium Backfill Characteristics and Purity

Having the proper helium backfill pressure or density ensures adequate heat transfer from the fuel to the fuel basket and surrounding structure of the MPC. During the loading operation, once the dryness limits are met, the MPC cavity is backfilled with helium to provide the inert environment required for long-term storage. To ensure the proper environment is established the helium used in the backfill process shall have a purity of ≥ 99.995 percent. In addition, the helium backfill pressure shall be verified during loading ~~for all MPCs~~ to be ≥ ~~29.3~~34 psig and ≤ ~~33.3~~40 psig corrected to a baseline temperature of 70°F. For MPCs loaded to Amendment 2 and earlier of this license, the helium backfill pressure was verified during loading to be ≥ 29.3 psig and ≤ 33.3 psig corrected to a baseline temperature of 70°F

If it has been determined that the helium backfill pressure limit has not been met, an engineering evaluation shall be undertaken to determine the actual helium pressure within the MPC cavity. Since too much or too little helium in the MPC cavity represents a potential overpressure or heat removal degradation concern, the engineering evaluation shall be performed in a timely manner commensurate with the safety significance of the condition (that is, if it is not addressed there is a possibility of a failure to adequately cool the contained fuel resulting in cladding damage).

Once the helium pressure 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 helium pressure estimated can range over a broad scale, different recovery strategies may be necessary. Completion times for the determined corrective actions will be controlled by the DCPP corrective action program and will be determined and controlled based on the safety significance of the condition.

10.2.2.5 MPC Leakage Characteristics

The MPC helium leak rate limit ensures there is adequate helium in the MPC for long-term storage and proper heat removal. Because the lid to shell weld is relieved from leak testing per ISG-18, "The Design/Qualification of Final Closure Welds on Austenitic Stainless Steel Canisters as Confinement Boundary for Spent Fuel Storage and Confinement Boundary for Spent Fuel Transportation," leak rate acceptance limit is limited to the vent and drain port closure welds which are verified to meet the mass-like leaktight criteria of 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.

During transport operations or storage operations if the vent and drain port closure weld helium leak rate limit is determined not to be met, an engineering evaluation shall be performed to determine the impact of increased helium leak rate on heat removal and offsite dose. Since the SFSC is a ventilated system, any leakage from the MPC is

transported directly to the environment. An increased helium leak rate represents a potential challenge to MPC heat removal and the offsite doses calculated in this FSAR confinement analyses, reasonably rapid action is warranted.

Once the cause and consequences of the elevated leak rate from the MPC are determined, a corrective action plan shall be developed and initiated to the extent necessary to return the MPC to an analyzed condition. Since the recovery mechanisms can range over a broad scale based on the evaluation performed, different recovery strategies may be necessary. An elevated helium leak rate represents a challenge to heat removal rates and offsite doses, reasonably rapid action and completion of the corrective actions shall be commensurate with the safety significance of the condition. Completion times for the determined corrective actions are controlled by the DCPP corrective action program and will be determined based on the safety significance of the condition

10.2.2.6 Returning MPC to Safe Condition

If for a loaded MPC the fuel cavity dryness, backfill pressure, or helium leakage rate cannot be successfully met or maintained for any reason, the MPC must be returned to a safe analyzed condition, which may ultimately require the fuel to be placed back in the SFP. The completion time for this effort shall be based on the safety significance of the condition. The completion time shall consider the time required to perform fuel cool-down operations, reflood the MPC, cut the MPC lid welds, move the transfer cask into the SFP, remove the MPC lid, and remove the spent fuel assemblies in an orderly manner and without challenging personnel.

10.2.2.7 Supplemental Cooling System Requirements

The Diablo Canyon ISFSI system thermal analysis (HI-2104625, Reference 5) demonstrates that the temperature of the MPC surface will be at the boiling temperature of water (~232°F), and the fuel cladding temperatures will be lower than the fuel cladding temperature limit of 752°F, if standing water is maintained in the MPC/HI-TRAC annulus space. To ensure standing water is maintained in the annulus, an annulus keep-full system is used for unloading operations of MPCs loaded under Amendment 2 of this license.

When the SCS is required, SCS operability is verified every two hours. The accident condition for a loss of SCS is discussed in Section 8.2.17.

10.2.3 MPC UNLOADING CHARACTERISTICS

In the event that an MPC must be unloaded, the transfer cask with its enclosed MPC is returned to the auxiliary building/fuel handling building to begin the process of fuel unloading. The MPC closure ring, and vent and drain port cover plates are then 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

operation during ~~loading and~~ unloading of MPCs loaded under Amendment 2 of the license.

The technical and operational considerations are to:

- Ensure proper internal MPC atmosphere to promote heat transfer, minimize oxidation, and prevent an uncontrolled release of radioactive material.

- Ensure that dose rates in areas where operators must work are ALARA and that all relevant dose limits are met.

- Ensure that the fuel cladding is maintained at a temperature sufficiently low to preclude cladding degradation during normal storage conditions.

Through the analyses and evaluations provided in Chapters 4, 7, and 8, this FSAR demonstrates that the above technical conditions and characteristics are adequate and that no significant public or occupational health and safety hazards exist.

10.2.6 SURVEILLANCE REQUIREMENTS

The analyses provided in this FSAR show that the Diablo Canyon ISFSI and the storage system fulfill its safety functions during all accident conditions as described in Chapter 8. Surveillance requirements are provided in the Diablo Canyon ISFSI TS. No continuous surveillance of the MPC is required during long-term storage. Surveillance of the SFSC duct screens is in the Diablo Canyon ISFSI TS and ensures freedom of air movement and adequate heat dissipation during long-term storage.

10.2.7 DESIGN FEATURES

The following storage system design features are important to the safe operation of the Diablo Canyon ISFSI and require design controls and limits:

- Material mechanical properties for structural integrity confinement and shielding

- Material composition and dimensional control for subcriticality

- Decay heat removal

Component dimensions are not specified here since the combination of materials, dose rates, criticality safety, and component fit-up define the operable limits for dimensions (that is, thickness of shielding materials, thickness of concrete, MPC plate thicknesses, etc.) The values for these design parameters are specified in the HI-STORM 100 System FSAR (Reference 1). Changes to any of these design features will be

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

4. 10 CFR 72 Certificate of Compliance No. 1014 for the HI-STORM 100 System, Holtec International, Amendment 3, May 29, 2007.

5. Holtec International Document No. HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," Revision 9.

6. Holtec International Document No. HI-2125191, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System with up to 28.74 Kw Decay Heat," Revision 0.

Reference 1 contains information related to MPC-32, MPC-24, MPC-24E, MPC-24EF, and the HI-STORM 100SA. General references to these documents are made in Chapter 10 as needed to supplement FSAR information.

TABLE 10.2-7

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) (BU ≤ 45,000 MWd/MTU) (Watts)	MPC-32 Assembly Decay Heat (Intact Fuel Assemblies) (BU > 45,000 MWd/MTU) (Watts)
≥ 5	1157	1173	1115	898	898~~750~~
≥ 6	1123	1138	1081	898~~873~~	898~~750~~
≥ 7	1030	1043	991	898~~805~~	898~~750~~
≥ 8	1020	1033	981	898~~800~~	898~~750~~
≥ 9	1010	1023	972	898~~794~~	898~~750~~
≥ 10	1000	1012	962	898~~789~~	898~~750~~
≥ 11	996	1008	958	898~~785~~	898~~750~~
≥ 12	992	1004	954	898~~782~~	898~~750~~
≥ 13	987	999	949	898~~773~~	898~~750~~
≥ 14	983	995	945	898~~769~~	898~~750~~
≥ 15	979	991	941	898~~766~~	898~~750~~

Note 1: Linear interpolation between points is permitted.

Note 2: Includes all sources of heat (i.e., fuel and nonfuel hardware).

TABLE 10.2-8

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) (Note3)	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 10.2.1.2.1. ~~with cladding made of ZIRLO is limited to 45,000 MWD/MTU or the value in this table, whichever is less.~~

TABLE 10.2-9

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.