REQUEST FOR ADDITIONAL INFORMATION
PACIFIC GAS AND ELECTRIC COMPANY
DOCKET NO. 72.-26
MATERIALS LICENSE NO. SNM-2511
AMENDMENT NO. 1

By application dated April 7, 2008, Pacific Gas and Electric Company (PG&E) requested approval of an amendment to Materials License No. SNM-2511, for the Diablo Canyon Independent Spent Fuel Storage Installation (ISFSI). The Diablo Canyon ISFSI will use the Holtec HI-STORM dry cask storage system, which employs multi-purpose canisters placed inside overpacks to safely store the spent nuclear fuel. The license amendment request, which is located in the Agencywide Documents Access and Management System (ADAMS) at ML081070073, proposed the following changes to the technical specifications (TS):

1. Clarification of the required helium leak rate condition and the leak rate testing requirements of TS 3.1.1, "Multi-Purpose Canister (MPC),"

2. Elimination of TS 3.1.4, "Spent Fuel Storage Cask (SFSC) Time Limitation in Cask Transfer Facility (CTF),"

3. Revision of TS 3.2.1, "Dissolved Boron Concentration," to modify the dissolved boron concentrations required for MPC-32 canisters and to allow linear interpolation for some fuel enrichments,

4. Revision of TS 3.2.1 to add a note to both surveillance requirements to limit the monitoring requirement,

5. Revision of TS 4.1, "Design Features Significant to Safety," to allow use of Metamic as a neutron absorber,

6. Revision of TS 4.3.4.a, "Permanent Load Handling Equipment," to change the title to "Weldment and Reinforced Concrete,"

7. Clarification of TS 4.3.4.b, "Mobile Load Handling Equipment," by identifying the "permanent load handling equipment" as "the cask transporter," and

8. Clarification of the requirements of TS 5.1.3, "MPC and SFSC Loading, Unloading, and Preparation Program" with regards to the maintenance conditions in the annular gap between the MPC and the transfer cask during the moisture removal process.

This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the amendment. The requested information is listed by review discipline. Applicable regulatory requirements are specified in the individual question or comment.

The staff's technical review was carried out in accordance with the applicable NRC regulations in 10 CFR Parts 20 and 72, and the NRC guidance contained in NUREG–1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," and in NUREG–1536, "Standard Review Plan for Dry Cask Storage Systems (NRC, 1997)." Note that RAI items may refer to the Division of Spent Fuel Storage and Transportation's (SFST) Interim Staff Guidance (SFST-ISG). The

ISGs were developed as a result of management decisions on several key issues related to the review and approval of spent fuel storage systems and represents positions discussed in meetings with the Nuclear Energy Institute. The current ISGs will be incorporated into the next revisions of NUREG-1567 and NUREG-1536.

The following questions are related to the thermal review:

1 Provide the thermal models of the proposed HI-STORM system and the computer files related to the design change, including the analysis for the HI-STORM in the CTF.

Holtec International Report HI-2053376, "Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI-STORM System Design," lists thermal model related computer files generated during the evaluation of design change. The staff needs these files to review the accuracy of these calculations and perform confirmatory calculation if necessary.

This information is necessary for determining compliance with 10 CFR 72.24(d) and 72.122(h)(1).

2 Clarify the purpose of the hypothetical reflecting cylinder and evaluate the impact of diameter reduction on the thermal performance.

In Section 5.1 of Holtec International Report HI-2053376, for the evaluation of the loaded HI-STORM in CTF, the applicant reduced the diameter of the hypothetical reflecting cylinder that surrounds the cask to match the CTF cylinder inner diameter. The purpose of this hypothetical reflecting cylinder was not clearly stated in the application. The applicant needs to clarify the purpose of diameter reduction and the impact to thermal performance.

This information is necessary for determining compliance with 10 CFR 72.24(d) and 72.122(h)(1).

3 Explain and/or revise, as necessary, the pressure evaluation in Section 5.1.7 of Holtec International Report HI-2053376 for the 100% Blockage of Air Inlets Accident for the following phenomena and/or physical characteristics.

a. Clarify the inconsistency of P1 and T1 and re-evaluate the temperature if necessary.

In Section 5.1.7, the applicant evaluates the final pressure based on the temperature change in the event. The initial pressure (P_1) and temperature (T_1) used in this analysis are from Table 9 and Table 10. The initial pressure (P_1) of 189.9 psia is based on a storage scenario with 100% rods ruptured. The initial cavity temperature (T_1) of 509 ºK, which should correlate to P_1=189.9 psia, instead correlates to an internal pressure of 73.48 psia.

Re-evaluate the temperature in section 5.1.7, using a T_1 that corresponds to P_1=189.9 psia. Alternatively, justify why using an initial cavity temperature of 509 ºK is appropriate for an initial pressure of 189.9 psia.

b. Refer to the Proprietary Enclosure.

c. Refer to the Proprietary Enclosure.

d. Clarify the cavity average temperature calculation to address how the calculation accounts for the void space within the cell.

Table 10 of Holtec Report HI-2053376 lists the MPC cavity average temperature from the Fluent model. Since the fuel basket cell is modeled with the porous media K_{eff} approach, the cavity volume within the cell is averaged out in the porous media. It is not clear how the cavity average temperature calculation accounts for the void space within the cell.

e. Refer to the Proprietary Enclosure.

This information is necessary for determining compliance with 10 CFR 72.24(d) and 72.122(h)(1).

4 Provide the inlet flow condition, geometry configuration, assumptions, initial and boundary conditions, and temperature history in the evaluation of the HI-STORM in CTF described in Section 5.1.10 of Holtec Report HI-2053376.

a. Describe the inlet flow boundary condition in details.

In Section 5.1.10 of Holtec Report HI-2053376, the applicant states “the flow of air to the bottom inlet vents would be restricted.” The flow reduction was not clearly stated in the model. A quantitative description is necessary.

b. Refer to the Proprietary Enclosure.

c. Present the initial conditions and temperature history of key parameters in the evaluation of the HI-STORM in the CTF.

This scenario is a transient problem. The initial conditions were not described in the application and no temperature history was presented for the key parameters in Table 6. Detailed initial conditions and time history plots are needed to ensure the temperature converges to steady state values which comply with the temperature limits.

This information is necessary for determining compliance with 10 CFR 72.24(d), 72.122(h)(1), and 72.128(a)(4).

5 Explain the allowable temperature limits for fuel cladding at different fuel ages for storage under normal conditions.

Table 2 of Holtec Report HI-2053376 lists the computed and allowable fuel cladding temperatures at various fuel ages during storage under normal conditions. Clarify how the allowable temperatures are derived for different fuel ages. Due to the small margins (4-7 ºF) between the computed and allowable fuel cladding temperatures, this

information is necessary for the staff to make a determination of safety and regulatory compliance.

This information is necessary for determining compliance with 10 CFR 72.24(d), and 72.128(a)(4).

The following question is related to the criticality review:

6 Justify that there is no chemical or other mechanism that could change the boron concentration in the MPC if the MPC is filled with borated water, as required by TS 3.2.1, for longer than 48 hours.

The note in both SR 3.2.1.1 and SR 3.2.1.2 specifies that a surveillance of the dissolved boron concentration must be performed "if the MPC is submerged in water or if water is to be added to or recirculated through the MPC." This note reduces the surveillance requirement from what it previously required. While the staff recognizes that this note is consistent with the surveillance requirements in the TS for the Holtec design, this amendment request must be evaluated on its own merits so that the staff may make its regulatory determination regarding the safety of the use of the system at the Diablo Canyon facility.

Justify that the dissolved boron concentration will not change if the MPC is filled with borated water, as required by TS 3.2.1, for longer than 48 hours. Specifically, state whether there are any chemical or other mechanisms that could potentially result in an unsafe concentration of dissolved boron. For example, explain if there are any mechanisms, such as boron precipitation, for the boron concentration to decrease if the MPC is filled with borated water, as required by TS 3.2.1, for greater than 48 hours.

This information is necessary for determining compliance with 10 CFR 72.124.

The following questions are related to the confinement review:

7 Revise TS 3.1.1 to require three weld passes for the structural-lid-to-shell weld.

The application states that, with respect to TS 3.1.1, “Multi-Purpose Canister (MPC),” the structural-lid-to-shell weld can be exempted from the helium leak test if the associated welds are performed with at least two weld passes and with liquid penetrant examinations of the root and final weld passes.

To ensure the integrity of the independent field weld important to safety, and to provide an acceptable method for meeting applicable requirements of 10 CFR 72.122(h) and 72.104, Interim Staff Guidance (ISG) - 18 (Rev. 1), "The Design and Testing of Lid Welds on Austenitic Stainless Steel Canisters as the Confinement Boundary for Spent Fuel Storage," may be applied. However, to exempt the structural-lid-to-shell weld from the helium leak test, the associated welds must be performed with at least three weld passes, and at least three different weld layers must be dye penetrant test (PT) examined.

The two-weld pass, described in LAR 08-001, is not consistent with the acceptable guidance of ISG-18 to meet the applicable regulatory requirements and to qualify for exemption from the helium leakage test. Provide a proposed revision to TS 3.1.1 requiring three weld passes for the structural-lid-to-shell welds.

The information is necessary for determining compliance with 10 CFR 72.122(h) and 72.104.

8 Specify whether the reduced height of the MPC impacts the leaktight criteria of the MPC vent and drain port welds and/or the confinement integrity of the canister.

With the reduction of the MPC height, and the resulting changes of MPC cavity pressure, the applicant needs to confirm that no over-pressurization may exist in the MPC cavity. This information is required to ensure that the leak rate through these welds will not exceed the leaktight criteria of ANSI N14.5, specified in S.R. 3.1.1.3, for any size MPC.

This information is necessary for determining compliance with 10 CFR 72.104.

9 Clarify how the allowable MPC internal pressure limits were derived under normal, off-normal, and accident conditions, for the shortened MPC.

The applicant lists the calculated pressures for all conditions (0%, 1%, 10% and 100% rods ruptured) and allowable internal pressure limits (normal, off-normal, and accident conditions), in Table 9 of Holtec Report HI-2053376. The applicant should clarify how the allowable MPC internal pressure limits are defined, or derived under different conditions, for the shortened MPC. Provide the analyses and/or calculations for determining the MPC pressures for all conditions. This information is needed to assure that the defined pressure limits are adequate and that confinement integrity is preserved.

This information is necessary for determining compliance with 10 CFR 72.104.

10 Provide a calculation showing that the reduced height of the MPC will not result in an internal pressure resulting in a change to the design basis limit for the MPC internal pressure.

For normal storage conditions, the MPC uses multiple confinement barriers provided by the fuel cladding and the MPC enclosure vessel to assure that there is no release of radioactive material to the environment. The applicant informed the staff, in PG&E Letter DIL-08-004, that the height of HI-TRAC 125D transfer cask, containing the MPC-32, was reduced by approximately 9 inches, permitting the transfer cask to be handled in the vertical orientation during all operations.

For this reduced height of MPC, the applicant needs to provide additional analyses to clarify the pressure calculations in Holtec Report HI-2053376 and to ensure the reduced height of MPC will not pose an internal pressure change to the design basis limit significant to safety for the MPC, as the MPC is a fission product barrier. With the height of MPC reduced by 9 inches, the staff needs to review the model or the calculation package of the HI-STORM with reduced height of MPC to evaluate the predicted MPC internal pressures, (particularly under fire, 100% fuel rod rupture, and 100% blockage of

air inlets), to ensure the overpressurization in the MPC will not occur and that confinement integrity is preserved.

This information is necessary for determining compliance with 10 CFR 72.104.

11 Revise Holtec Report HI-2053376 or otherwise clarify that the equation $P_1T_2 = P_2T_1$ is valid between the 100% rod rupture condition and the 100% blockage of air inlet accident.

Page 11 of Holtec Report HI-2053376 uses the equation $P_1T_2 = P_2T_1$, which is only valid if the amount of gas remains unchanged between condition 1 (100% rod rupture) and condition 2 (100% blockage of air inlet accident). Revise the calculation to clarify that the amount of gas does not change during the 100% blockage of air inlet accident.

This information is necessary for determining compliance with 10 CFR 72.104.

The following questions are related to the materials review:

12 Revise SAR Chapter 5 and propose a revision to the TS to address protection of the cladding from degradation, due to excessive oxidation of exposed fuel pellets, during loading and unloading operations.

Page 5.1-7 of SAR chapter 5.1.1.2 mentions maintaining an inert gas in the space above the water level in the loaded fuel cask during welding operations to avoid problems with any combustible gas generation. Protection of the cladding from the effects of fuel pellet oxidation is also important but not addressed. Oxidation of the fuel pellets due to excessive oxidation during loading and unloading operations can lead to fuel cladding degradation. Protection of the cladding from degradation that leads to gross ruptures is required by 10 CFR 72.122(h).

Fuel oxidation may be avoided by maintaining an inert gas cover during draining and flooding operations, or other means, as detailed in the SFST-ISG No. 22, "Potential Rod Splitting Due to Exposure to an Oxidizing Atmosphere During Short-Term Cask Loading Operations in LWR or Other Uranium Oxide Based Fuel."

Provide a discussion in SAR chapter 5.1.1.2 to address that an inert gas cover must be maintained during draining and flooding operations to ensure that no excessive oxidation of fuel pellets will occur during loading and unloading operations.

Additionally, propose a revision to TS 5.1.3, or add a new TS, to require backfilling with an inert gas, such as helium, during loading and unloading operations.

This is necessary for determining compliance with 10 CFR 72.122(h).

13 Revise SAR operating procedure section 5.1.1.2 and propose a revision to the TS to require flammable (hydrogen) gas monitoring and mitigation during all canister lid welding or cutting operations during spent fuel loading or unloading.

The SAR language and TS as presently written do not address unloading operations and do not require hydrogen mitigation measures during these operations. Failure to provide adequate hydrogen monitoring/mitigation measures have resulted in unanticipated hydrogen ignition events while welding canister lids.

In addition to revising SAR section 5.1.1.2, provide a proposed revision to TS 5.1.3, or add a new TS, to require flammable (hydrogen) gas monitoring and mitigation during all canister lid welding or cutting operations during spent fuel loading or unloading.

This information is necessary for determining compliance with 10 CFR 72.122(c).

14 Revise SAR Section 4.2.3.3.6 to address how 10 CFR 72.126(d) will be met for two different situations:

1. For spent fuel canisters which have been fabricated and delivered but not yet loaded, and,
2. For canisters yet to be fabricated or delivered.

The staff is aware that the canister vendor may not perform helium leakage rate testing of the canister shell welds (shop welds) at the fabrication shop. Without this helium leakage rate testing, and in the absence of a dose calculation, the staff does not have assurance that the dose limits of 10 CFR 72.104 will be met, that adequate inspection of the canister was performed, or that the canister will reasonably maintain confinement.

A dose limit calculation is required by 10 CFR 72.126(d), which states, in part: “Analyses must be made to show that releases to the general environment during normal operations and anticipated occurrences will be within the exposure limit given in 10 CFR 72.104. Analyses of design basis accidents must be made to show that releases to the general environment will be within the exposure limits given in 10 CFR 72.106.”

To meet these requirements, the staff has accepted the performance of a helium leakage rate test of all canister shell welds (shop welds), per ANSI N14.5, to show that the “leak-tight” (leakage rate less than or equal to $1x10^{-7}$ ref·cm^3/sec) criteria has been satisfied. This satisfies performing the dose limit calculations required by 10 CFR 72.126(d).

Otherwise, in accordance with SFST-ISG-5, Rev.1, "Confinement Evaluation," a dose calculation based on a higher leakage rate must be performed to demonstrate compliance with Part 72 dose limits and the requirement to maintain sufficient helium for cooling and inerting purposes over the operational lifetime of the canister.

This requirement is necessary for determining compliance with 10 CFR 72.126(d), 72.104, and 72.106.