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June 8, 2011

PG&E Letter DIL-11-003

10 CFR 72.56 and 72.7

ATTN: Document Control Desk
Director, Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Materials License No. SNM-2511, Docket No. 72-26
Diablo Canyon Independent Spent Fuel Storage Installation
Supplement to License Amendment Request 11-001
Revision to Technical Specifications 1.1, 2.0, 3.1.1, 3.1.2, 4.1.2, and 5.1.3; Addition of Technical Specifications 2.3 and 3.1.4; and, Request for an Exemption from the Requirements of 10 CFR 72.236(f)

Dear Commissioners and Staff:

Pacific Gas and Electric Company (PG&E) Letter DIL-11-001, dated January 31, 2011, submitted PG&E's request for an amendment to Materials License No. SNM-2511, Docket No. 72-26, for the Diablo Canyon Independent Spent Fuel Storage Installation (DC ISFSI).

By NRC letter dated April 14, 2011, "Diablo Canyon Independent Spent Fuel Storage Installation Materials License No. SNM-2511, Amendment Request No. 2 - Acceptance Review (TAC NO. L24515)," the NRC staff performed an acceptance review of the application to determine if the application contains sufficient technical information in scope and depth to allow the staff to complete the detailed technical review. The letter acknowledged acceptance of PG&E's application.

The NRC staff included observations that may be asked at a later date noting that responses to observations are not required for the staff to begin a detailed technical review. PG&E has reviewed the NRC observations and is providing a supplement to License Amendment Request 11-001 to assist the NRC review process.

The Enclosure to this letter provides PG&E's response to NRC Observation questions. Attachment 1 of the Enclosure contains Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI STORM System Design," Revision 4 – Proprietary Version, with one

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Withhold from public disclosure under 10 CFR 2.390

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disc of proprietary data files on optical storage medium (OSM) DVD-ROM. Attachment 2 of the Enclosure 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 Attachment 1 of the Enclosure, 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. Attachment 3 of the Enclosure contains Holtec International Report HI-2104625, "Three Dimensional Thermal-Hydraulic Analyses for Diablo Canyon Site-Specific HI STORM System Design," Revision 4 (non-proprietary version).

Correspondence with respect to the proprietary aspects of the application or the Holtec affidavit provided in Attachments 1 and 2 of the Enclosure should be addressed to Ms. Kelly Kozink, Holtec International, 555 Lincoln Drive West, Marlton, New Jersey 08053.

This supplement does not affect the conclusions or the "no significant hazards consideration" of LAR 11-001.

Enclosure 1 contains the following new regulatory commitment (as defined in NEI 99-04): PG&E will provide a supplement as an appendix to HI-2104625 to address the FLUENT issue by July 30, 2011.

If you have any questions or require additional information, please contact Mr. Tom Baldwin at 805-545-4720.

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

Executed on June 8, 2011.

Sincerely,

James R. Becker
Site Vice President

MJRM/50334775
Enclosures
cc: Diablo Distribution
cc/enc: Gary W. Butner, Branch Chief, California Department of Public Health
Elmo E. Collins, NRC Region IV
John M. Goshen, NRC Project Manager
Michael S. Peck, NRC Senior Resident Inspector
James T. Polickoski, NRR Project Manager
Alan B. Wang, NRR Project Manager

Attachment 1 of the Enclosure Contains Proprietary Information
Withhold from public disclosure under 10 CFR 2.390

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

NRC Observation Question 1

Please refer to "DOSE EVALUATION FOR THE ISFSI AT DIABLO CANYON POWER STATION" (HI-2002563)

a. *Provide an explanation for difference between offsite dose rates for the normal and off-normal condition when comparing the 10 CFR 72.104 (a) limit for 32,500* [megawatt days per metric ton uranium] *MWD/MTU and high burnup (69,000 MWD/MTU) fuel. (Table P.4 and the table on pg. 27 of the main report).*

b. *Provide the basis for using 2,080 hours per year for calculating dose at the site boundary versus 8,760 hours (full year).*

For the 32,500 MDD/MTU(sic.) case the dose rate (from release or Total) is based on 8,760 hr/year and direct dose based on 2,080 hr/year, but in Table P.4 for high burnup the dose rate is based on 2,080 hr/year, and direct dose rate is based on 8,760 hr/year.

This information is needed in order for the staff to determine if the DC ISFSI meets the criteria for radioactive materials in effluents and direct radiation from an ISFSI of 10 CFR 72.104.

PG&E Response to Observation Question 1

a. The explanation of the difference in the dose rates for normal and off-normal conditions reported in Table P.4 of HI-2002563 Revision 8, license amendment request (LAR) 11-001 Enclosure Attachment 6, compared to the table on page 27 of the same report is due to the change requested in LAR 11-001 to increase the maximum burnup of the fuel from 32,500 MWD/MTU to 69,000 MWD/MTU, and additional conservative assumptions described below.

The original table (page 27), which supports the currently approved license, reports dose rates for normal and off-normal conditions for fuel with the specific combination of burnup, enrichment, and cooling time of 32,500 MWD/MTU, 2.9 percent by weight (wt%), and 5 years cooling, respectively. This combination resulted in the highest source term (see Assumption 7 of the main report (HI-2002563 Revision 8)) of the fuel population permitted for loading.

Since LAR 11-001 requests loading high burnup fuel up to 69,000 MWD/MTU, the source term was changed to reflect the more bounding condition of burnup. Note that the cooling time (5 years) is assumed to remain the same, however the initial enrichment is increased to reflect a more realistic value (4.8 wt%) for this burnup. In addition to the change in source term requested in this LAR, it is further assumed that the canisters already loaded on the pad have this combination of burnup, cooling time, and enrichment as well. The assumption of a cask fully loaded with fuel assemblies with a burnup of 69,000 MWD/MTU and 5 years cooling is conservative from a dose perspective since this combination would not be permitted in every cell of the multipurpose canister due to the limit applied on the total heat load.

Therefore, use of the higher burnup to determine the source term and these conservative assumptions results in the differences in the site-boundary dose rates for normal and off-normal conditions between the original table and Table P.4.

b. The basis for using 2080 hr/yr for calculating dose at the site boundary versus 8760 hr/yr is described in both Assumption 2 of the main report (HI-2002563 Revision 8) and Section 7.5 of the Diablo Canyon ISFSI (DC ISFSI) Updated Final Safety Analysis Report (UFSAR) . To summarize here, the area outside of the Diablo site boundary is uninhabited. The nearest resident is 1.5 miles from the ISFSI pad, as described in the DC ISFSI UFSAR Section 2.1.3.1. The population distribution within 10 miles of the site is shown in Figure 2.1-3 of the DC ISFSI UFSAR. This data is taken from the 2000 census data. Also included in the DC ISFSI UFSAR are population projections for 2010 and 2025 (Figures 2.1-4 and 2.1-5). The projections remain the same as the census data from 2000.

In accordance with ISG-13, as explained in the DC ISFSI UFSAR Section 7.5, the approach to determine the "maximally exposed real individual" considers the geographical location of the ISFSI and time estimates of their maximum radiological exposure. Since the area within 1.5 miles contains no inhabitants who could potentially be exposed for the full 8760 hr/yr, the "maximally exposed real individual" is considered to be exactly on the site boundary working 40 hr/week for 52 weeks/yr, for a total of 2080 hr/yr. Therefore the calculated dose at the site boundary uses the dose rate associated with occupancy of 2080 hr/yr instead of 8760 hr/yr. The calculation methodology by which the dose rates are determined and reported in Table P.4 is not changed by this amendment request as is stated on page P-1 of the report. The first column of Table P.4 represents the total direct dose rate from storage operations to the real individual at the site boundary.

> *"For the 32,500 MDD/MTU(sic.) case the dose rate (from release or Total) is based on 8,760 hr/year and direct dose based on 2,080 hr/year, but in Table P.4 for high burnup the dose rate is based on 2,080 hr/year, and direct dose rate is based on 8,760 hr/year."*

In Report HI-2002563 Revision 8, the column from the table on page 27 labeled "Dose Rate from Effluent Release (mrem/yr)" is calculated based on 8760 hours/yr. Table P.4 does not include this information because it is not applicable to the canisters tested to leak tight criteria, where a non-mechanistic release does not need to be postulated. None of the P.4 information is based on 8760 hours/yr.

The column from the table on page 27 labeled "Direct Dose Rate (mrem/yr)" corresponds to the column in Table P.4 labeled "Total Dose Rate (mrem/year)" with the P.4 column calculated based on the difference in source term discussed above in response to 1.a. Both are calculated based on 2080 hrs/year.

In summary, due to a significant increase in burnup, the dose rates in Tables P.4 and P.5 are higher when compared to the dose rates in Section 9 of the main report, which include the effluent contribution. Therefore, Tables P.4 and P.5 present the limiting offsite dose configuration for the Diablo Canyon ISFSI.

Observation Question 2

Please refer to Holtec Report HI-2104625. It is not clear if computational fluid dynamics (CFD) best practice guidelines (BPG) were used to perform the thermal evaluation of the HI-STORM in the Cask Transfer Facility configuration for design basis heat load and ambient conditions and to obtain the discretization error. It is not clear that the thermal analysis results provided in Table B.5.9 of Holtec Report HI-2104625 include adequate margins. In order to facilitate the review, the analysis results should include an estimate of the numerical uncertainty, grid convergence, and sensitivity of the performed CFD analyses. To assist in the technical review, please provide an estimate of the numerical uncertainty and provide a response to the following questions:

a. *Has a sensitivity analysis been performed concerning turbulence modeling, boundary conditions, grid independence and grid convergence?*

b. *Was grid convergence index (GCI) used to assess uncertainty of the predicted results?*

Provide results such as percentage of the calculation discretization error and analysis files used to obtain the GCI. The applicant may consult the following documents for further information on CFD BPG: (1) Best Practice Guidelines for the use of CFD in Nuclear Reactor Safety Applications, NEA/CSNI/R(2007)5, (ADAMS accession number ML071581053); and (2) Policy of Journal of Fluid Engineering of ASME about CFD analyses.

This information is necessary to verify the requirements of 10 CFR 72.122 and 72.128.

PG&E Response to Observation Question 2

In accordance with the above referenced ASME Journal procedure, a grid sensitivity study had been performed for the normal long term storage condition (i.e., HI-STORM internal) and reported in Subsection B.5.1.2 of Holtec Report HI-2104625 Revision 3. The sensitivity calculations addressed the principal mechanism of heat dissipation, namely annulus cooling of the multipurpose canister (MPC). As required by the ASME Journal procedure, grid-refined thermal solutions are computed and results are post-processed to obtain the GCI and added to Subsection B.5.1.2 of Holtec Report HI-2104625 Revision 3. For this purpose the following discrete sensitivity analyses were performed using the peak cladding temperature (PCT) as the telltale output to infer convergence:

a. The number of radial cells in HI-STORM annulus is increased until convergence is established.
b. The mesh density in the axial direction is increased in steps to identify the converged configuration.

The principal result that is used to determine the converged mesh is the PCT. The grid sensitivity studies focus on the PCT computed by the FLUENT model of the HI-STORM system as the target output for checking convergence.

The converged mesh used for the long-term storage condition (as discussed in Sub-section B.5.1.2 of Holtec Report HI-2104625 Revision 3) was therefore used for the thermal analysis of HI-STORM in the Cask Transfer Facility (CTF) and results had been reported in Table B.5.9 of Holtec Report HI-2104625 Revision 3. The airflow outside the HI-STORM system was modeled as turbulent flow using the k-ω turbulence model to incorporate the effect of air turbulence on the systems thermal performance. The adequacy of the k-ω model was addressed in the licensing of the HI-STORM 100 System in Certificate of Compliance Amendment #5 in Docket No. 72-1014 and NRC acceptance obtained. For the k-ω turbulence model, y^+ should be less than 4 or 5 to ensure an adequate level of mesh to resolve the viscosity affected region near the wall (Reference 1). The mesh between the CTF and HI-STORM was constructed with a y^+ less than 2 towards HI-STORM external surface.

However, to provide an additional assurance to the staff, a grid sensitivity study has been performed to evaluate the condition of a HI-STORM 100SA system placed in the CTF. Since the airflow between the CTF and HI-STORM system is critical to the thermal performance of the system, the mesh in this region is modified. Two additional meshes are constructed – one coarser and another mesh finer than that presented in Table B.5.9 of Holtec Report HI-2104625 Revision 3. A brief summary of the different sets of grids evaluated is provided in Section B5.5 of the report.

The results from the study are post-processed in accordance with the guidance in the ASME Journal procedure cited by the staff (specifically, the GCI) and evaluated in the Holtec Report HI-2104625, Revision 4.

The thermal solution presented in Table B.5.9 of Holtec Report HI-2104625 Revision 4 is on a converged mesh. To provide further assurance of convergence, the sensitivity results are evaluated in accordance with the ASME Journal procedure for control of numerical accuracy. The GCI, which is a measure of the solution uncertainty, is computed in Appendix F of the report. The GCI for the fine grid (i.e., 18 radial cells between the CTF and HI-STORM 100SA System) computes to be 0.4 percent which provides further assurance of grid convergence.

The heat transfer coefficient on the HI-STORM 100SA external surfaces for the thermal model of the HI-STORM in the CTF is calculated by FLUENT itself. Therefore, no other specific boundary condition is required to be applied by the user of the code for these surfaces.

The revised Holtec Report supporting this supplement was prepared using ANSYS FLUENT Version 6.3.26. PG&E was recently notified by Holtec International who had been notified by ANSYS, of a "potential non-conservatism in the radiation solver of FLUENT 6.3.26 which would require emissivity of the storage basket walls facing the fuel region to be set to zero." The applicable ANSYS Error Number is FLUENT2011-04.

To address this issue, Holtec performed an additional analysis to determine the impact of this parameter on the thermal evaluations in the report. The steady state evaluation of the loaded HI-STORM placed in the CTF was re-performed since that analysis had the least margin to the PCT limit. The results indicate a three-degree Celsius reduction in margin to the limit for the MPC Basket and Fuel Cladding temperatures reported in Table B.5.9 of Holtec Report HI-2104625 Revision 4. The MPC Shell temperature was not affected.

Holtec International has concluded that the issue in the FLUENT code has a small effect on the predicted component temperatures present in the report and all components will remain below their respective temperature limits for all evaluated conditions. Holtec International is addressing this issue in their corrective action program. PG&E will provide a supplement as an appendix to HI-2104625 to address the FLUENT issue by July 30, 2011.

References:

1. FLUENT Manual, Version 6.3.26