Enclosure
Attachment 3
PG&E Letter DIL-13-004

Appendix R of calculation HI-2002563, "Dose Evaluation for the ISFSI at Diablo Canyon Power Station," Revision 10 – Non-Proprietary Version and cover pages

(Only revised pages of calculation HI-2002563 and the cover page are included)

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DOSE EVALUATION FOR THE ISFSI AT DIABLO CANYON POWER STATION

FOR

Pacific Gas and Electric Company

Holtec Report No: HI-2002563

Holtec Project No: 1073

Report Class : SAFETY RELATED

NON-PROPRIETARY VERSION

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DOCUMENT ISSUANCE AND REVISION STATUS[1]

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DOCUMENT CATEGORIZATION

In accordance with the Holtec Quality Assurance Manual and associated Holtec Quality Procedures (HQPs), this document is categorized as a:

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☐ Technical Report (Per HQP 3.2) (Such as a Licensing Report)

☐ Design Criterion Document (Per HQP 3.4)

☐ Design Specification (Per HQP 3.4)

☐ Other (Specify):

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3. Revisions to this document may be made by adding supplements to the document and replacing the "Table of Contents", this page and the "Revision Log".

Summary of Revisions

Revision 0

Original Issue

Revision 1

1. All changes noted with revision bars.
2. Added Section 1.2 in accordance with Holtec administrative memos. The introduction from Revision 0 has been moved into Section 1.1.
3. Made changes per PG&E comments.
4. A footnote was added to the reference section in accordance with Holtec administrative memos.
5. Four was changed to three in Figure 2 caption.
6. The table of contents was changed appropriately.

Revision 2

1. All changes noted with revision bars. Revision bars from rev 1 have been removed.
2. Fixed an incorrect reference to a section.
3. Removed a paragraph discussing analysis of the dose at the nuisance fence behind and on the sides of the array. This analysis is not contained in the appendices that were referenced.

Revision 3

1. The HI-STORM 100S drawings were updated to include design changes. The significant change from the perspective of this report was the removal of the inner shield shell and the increase in the concrete density of the body to compensate. The lid design was also changed to include the shear bar as part of the lid design. This affected the calculation of the dose from a HI-STORM without a lid. All analyses of the HI-STORM 100S in this report were updated accordingly. In some cases the previous models of the overpacks were used but justification is appropriately provided.
2. Revision bars mark all revisions to text. The following pages of results were completely replaced: A2-A9, D4-D7, E2-E14, F3-F11, G3-G14, H5-H14, I2, K2-K11, L5-L7, M19-M21.

Revision 4

1. Appendix N was added to discuss the determination of the allowable burnup and cooling times for the BPRAs and TPDs.
2. The approved computer code list in Attachment A was updated to show the report number in the footer and the version of the code used.

Revision 5

1. The duration for step 47 during loading operations in App. K and step 19 during unloading operations in App. K was increased from 1.5 hours (90 minutes) to 3.0 hours (180 minutes). This resulted in a change to the total dose rates in App. K.

Revision 6

1. Appendix O was added to discuss the effect on shielding of changing the HI-STORM, HI-TRAC and MPC designs.

Revision 7

1. Appendix P is added to discuss site boundary dose rates for high burnup fuels to support a license amendment to the Diablo Canyon ISFSI.
2. Storage of ITTRs and neutron sources are also discussed in Appendix P.

Revision 8

1. Revised to incorporate client's comments.

Revision 9

1. All previous changes are accepted. Added Appendix Q which includes near dose rate calculations for HI-STORM 100S with high burnup fuel. Section 7.5.2 is updated to address Appendix Q. All changes in the main part of the report are marked with revision bars, but not Appendix Q.

Revision 10

1. Appendix R is added as it contains source term comparisons to confirm that the source terms used in the main body of the report are bounding.
2. Reference 19 is added.

Appendix R: Source Term Comparisons

This appendix presents a source term comparison between the source terms used in the main body of the report and the fuel inventory of the Diablo Canyon Power Plant (DCPP). The objective is to prove that the source terms, which were used in the main body of the report, bound the fuel inventory provided by Diablo Canyon.

Reference [19] provides the completed burnup/enrichment data for the Diablo Canyon Power Plant (DCPP). In Table R.1 below, 3 burnup/enrichment combinations are shown for a 15X15 B&W fuel. The cooling time is fixed at 5 years. The approach is to pick a combination of minimum enrichment and maximum burn up that bound a range of assemblies.

In Table R.1 below, Source Term A is chosen from the main body of the report. Source Term B is taken as a theoretical source term which bound all fuel with enrichments less than 3.2 %. The upper burnup limit for this group is 45,000 MWD/MTU as there are no assemblies, with enrichments between 2%-3.2%, which exceed this burnup.

Source Term C covers assemblies with enrichments higher that 3.2% and burnup up to 57,500 MWD/MTU. There is one assembly with 57,800 MWD/MTU burnup, this assembly is not covered by source Term C. But since Source Term A is based on a higher burnup and lower enrichment than the above mentioned assembly, it is clear that Source Term A is bounding.

Table R.1: Bounding Source Terms A, B, and C

Source Term	Burnup (MWD/MTU)	Cooling Time (years)	Enrichment (wt.% ^{235}U)
A	69,000	5	4.8
B	45,000	5	2.0
C	57,500	5	3.2

Page R-2 shows the neutron and photon strength for Source Terms A, B, and C. The neutrons per second, emitted from each energy group for Source A, exceed that of Sources B and C. The same applies to the photon source term; the number of photons per second, emitted from each energy group for Source A, exceeds that of Sources B and C. The only exception is photons in the energy range of 2.5-3.0 MeV and 3.0-4.0 MeV. However, these groups don't contribute significantly to the dose rate as number of photons emitted in these groups is very low. In addition, the difference between the source strengths is minor.

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neutrons **5 YEAR COOLING**

lower energy (MeV)	upper energy (MeV)	69,000 MWD/MTU 4.80%	45,000 MWD/MTU 2.0%	57,500 MWD/MTU 3.20%
6.43	20.00	2.60E+07	1.84E+07	2.46E+07
3.00	6.43	2.92E+08	2.07E+08	2.76E+08
1.85	3.00	3.21E+08	2.27E+08	3.02E+08
1.40	1.85	1.82E+08	1.29E+08	1.72E+08
0.90	1.40	2.48E+08	1.76E+08	2.34E+08
0.40	0.90	2.71E+08	1.92E+08	2.56E+08
0.10	0.40	5.31E+07	3.76E+07	5.01E+07
Total		1.39E+09	9.87E+08	1.32E+09

photons **5 YEAR COOLING**

lower energy (MeV)	upper energy (MeV)	69,000 MWD/MTU 4.80%	45,000 MWD/MTU 2.0%	57,500 MWD/MTU 3.20%
0.01	0.02	1.10E+15	7.61E+14	9.38E+14
0.02	0.03	6.23E+14	4.43E+14	5.36E+14
0.03	0.05	7.81E+14	5.44E+14	6.66E+14
0.05	0.07	4.97E+14	3.48E+14	4.24E+14
0.07	0.10	3.49E+14	2.47E+14	2.99E+14
0.10	0.15	3.94E+14	2.82E+14	3.39E+14
0.15	0.30	3.11E+14	2.24E+14	2.68E+14
0.30	0.45	1.63E+14	1.25E+14	1.45E+14
0.45	0.70	5.67E+15	3.82E+15	4.83E+15
0.70	1.00	1.44E+15	9.43E+14	1.23E+15
1.00	1.50	2.15E+14	1.46E+14	1.84E+14
1.50	2.00	8.08E+12	6.53E+12	7.41E+12
2.00	2.50	3.36E+12	3.19E+12	3.32E+12
2.50	3.00	1.29E+11	1.34E+11	1.36E+11
3.00	4.00	1.62E+10	1.68E+10	1.71E+10
4.00	6.00	5.99E+07	4.26E+07	5.67E+07
6.00	8.00	6.90E+06	4.91E+06	6.53E+06
8.00	11.00	7.94E+05	5.65E+05	7.51E+05
Total		1.16E+16	7.89E+15	9.87E+15