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PG&E Letter HBL-14-007

U.S Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

10 CFR 50.90
10 CFR 50.82 (a)(9)

Docket No. 50-133, License No. DPR-7
Humboldt Bay Power Plant, Unit 3

Humboldt Bay Power Plant, Unit 3, License Termination Plan Responses to Requests for Additional Information (Chapter 6 and Supplemental Information)

Dear Commissioners and Staff:

On May 13, 2013, Pacific Gas and Electric Company (PG&E) submitted a proposed License Termination Plan (LTP) for Humboldt Bay Power Plant (HBPP), Unit 3, PG&E Letter HBL-13-007, "License Amendment Request 13-01, Addition of License Condition 2.C.5, 'License Termination Plan.'" On December 24, 2013, the NRC sent PG&E a Request for Additional Information (RAI) based on NRC review of the HBPP, Unit 3, LTP. On February 14, 2014, PG&E submitted a response to the RAIs except for RAIs associated with LTP Chapter 6 and Supplemental Information. The Enclosure to this letter contains the PG&E response to RAIs for LTP Chapter 6 and Supplemental Information. The Attachment to the Enclosure is the "Terms and Acronyms" section previously submitted in HBL-13-007.

PG&E makes no new or revised regulatory commitments (as defined by NEI 99-04) in this letter.

If you wish to discuss the information in the enclosure, please contact Mr. William Barley at (707) 444-0856.

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

Executed on May 13, 2014.

Sincerely,

Edward D. Halpin

Enclosures
cc: HBPP Humboldt Distribution
cc/enc: Marc Dapas, NRC Region IV
John B. Hickman, NRC
Gonzalo L. Perez, California Department of Public Health

Enclosure
PG&E Letter HBL-14-007

Pacific Gas and Electric Company Response to

NRC Requests for Additional Information for

License Termination Plan Chapter 6 and Supplemental Information

NOTE – Acronyms used in the PG&E responses are defined in the License Termination Plan (LTP) Section "Terms and Acronyms," Attachment to this Enclosure.

Chapter 6 and Supplemental Information

RAI 28

Basis for Request:

Chapter 6, Section 6.2.2.2 and Appendix F. In Section 6.2.2.2, it is stated that borehole data indicated that to a depth of 15-35 feet, the strata are compact clay, clayey sands, and clayey silt and that below this layer lies a sand body. Additionally, the document ENG-HB-001 (Tables 1A, 1 B, and 1 C) contains information on the soil type determination that shows that a variety of soil types were found on the site. In Appendix F, it is stated that a soil type of clay loam was selected based on the average density and porosity of the soil. The selection of a soil type is generally based on more than just its density and porosity. The expected transport of radionuclides is a lot less in a clay loam than in other types of soil because the sorption tends to be a lot higher and the flow is lower. If another type of soil is present on the site, then water dependent doses could be higher.

RAI

More information is needed regarding the soil types present on site and the basis for the soil type used to select parameters for the RESRAD modeling. Provide additional justification for the selection of clay loam as the soil type for the contaminated, unsaturated, and saturated zones in RESRAD.

PG&E RESPONSE

Data from the installation logs for 22 groundwater monitoring wells show that the vertical profile for soil across the Humboldt Bay site consists of alternating layers of different soil textures at non-uniform thicknesses. The soil type descriptions recorded on the log for each well location were compared to information regarding soil types and hydrogeological parameters (density and porosity) found in Attachment C to NUREG/CR-6697. The selection of a representative soil type in the contaminated, unsaturated, and saturated zones for site-wide modeling was driven by the averaging of the results from weighted analyses of the soil types identified in the vertical profiling at the individual well locations. This approach used the best available data and provided a reasonable basis for the selection of the prominent (and representative) soil types in the contaminated, unsaturated, and saturated zones to support site-wide modeling and DCGL development.

The impact of higher water dependent doses due to the potential presence of soil type with a higher transport rate was investigated. The first step in the investigation was to conduct a review of the existing RESRAD reports and identify 4 radionuclides from the

list of 24 radionuclides of concern (ROCs) to compare contributions from water dependent doses and water independent doses to the total dose used in DCGL development. The 4 radionuclides selected for this assessment were Am-241 as a representative alpha-emitting ROC, Co-60 and Cs-137 as representative beta/gamma-emitting ROCs, and Sr-90 as a representative beta-emitting ROC. The second step was to conduct new RESRAD executions for the 4 selected radionuclides using sand as the soil type in the contaminated, unsaturated, and saturated zones. Distributions for the hydrogeological parameters associated with sand (provided in Attachment C to NUREG/CR-6697) were used as RESRAD input. The water dependent doses and water independent doses were compared at 2 time periods: (1) the time of the peak of the mean dose and (2) the time when the water dependent doses are at their highest. The total doses, water independent doses, and water dependent doses from the existing (clay loam) and new (sand) RESRAD reports are presented in Table 1.

Table 1. Summary of Contributions from Water Independent Doses and Water Dependent Doses (in mrem/y) at Times of the Peak of the Mean Dose and Peak Water Dependent Doses

ROC	Soil Type	Time Period	Total Dose[a]	Water Independent Doses			Water Dependent Doses		
				Plant	Meat	Milk	Plant	Meat	Milk
Am-241	Clay loam	POM[b]	9.7E-01	8.9E-01	6.7E-03	1.3E-03	2.0E-12	2.0E-14	9.3E-15
		POWDD[c]	5.1E-01	4.6E-01	3.5E-03	6.9E-04	1.1E-04	6.1E-07	1.6E-07
	Sand	POM	9.7E-01	8.9E-01	6.7E-03	1.3E-03	3.2E-09	1.2E-11	1.1E-11
		POWDD	5.8E-01	4.6E-01	3.5E-03	6.9E-04	1.6E-02	5.8E-05	2.3E-05
Co-60	Clay loam	POM	6.6E+00	4.9E-01	4.3E-01	1.5E-01	6.8E-13	1.3E-12	7.8E-13
		POWDD	1.7E+00	4.3E-01	3.7E-01	1.3E-01	1.6E-08	3.5E-08	3.7E-09
	Sand	POM	6.6E+00	4.9E-01	4.3E-01	1.5E-01	8.3E-10	1.8E-09	1.0E-09
		POWDD	1.7E+00	1.3E-01	1.1E-01	3.8E-02	1.5E-05	4.8E-05	4.6E-06
Cs-137	Clay loam	POM	3.2E+00	5.2E-01	5.5E-01	8.7E-01	1.2E-12	3.0E-12	5.4E-12
		POWDD	2.8E-01	4.6E-02	4.9E-02	7.7E-02	1.5E-07	6.7E-07	9.9E-07
	Sand	POM	3.2E+00	5.2E-01	5.5E-01	8.7E-01	2.3E-11	4.1E-11	8.5E-11
		POWDD	2.8E-01	4.6E-02	4.9E-02	7.7E-02	1.9E-05	9.3E-05	1.4E-04
Sr-90	Clay loam	POM	1.7E+01	1.2E+01	1.7E+00	3.0E+00	1.6E-08	8.3E-09	7.9E-09
		POWDD	6.4E+00	4.6E+00	6.7E-01	1.2E+00	1.1E-04	6.8E-05	9.5E-05
	Sand	POM	1.7E+01	1.2E+01	1.7E+00	3.0E+00	2.6E-06	7.4E-07	9.1E-07
		POWDD	6.4E+00	4.5E+00	6.7E-01	1.2E+00	6.8E-03	4.0E-03	5.8E-03

[a] Total dose includes ground external dose, inhalation dose, soil ingestion dose, water ingestion dose, fish ingestion dose, water independent doses, and water dependent doses.
[b] POM = time of peak of the mean dose.
[c] POWDD = time of peak of water dependent doses.

The RESRAD results indicate that for the Humboldt Bay site water independent doses will likely have a significantly greater contribution to the total dose than water dependent doses whether the soil type is clay loam or sand, even at times when the water dependent doses are at their highest.

The following conclusions were reached based on the RESRAD results above:

(1) although a soil type that permits a higher transport rate for ROCs will result in higher water dependent doses, the contributions to total dose from the higher water dependent doses are likely to remain significantly smaller than those from water independent doses, and

(2) the use of clay loam as the soil type for the contaminated, unsaturated, and saturated zone is appropriate and the differences are negligible for the Humboldt Bay site.

A comprehensive review of I-129 was performed to determine if it indeed should be included in the list of potential radionuclides. The following conclusions were reached:

1. I-129 contributed less than 0.1 percent of the total activity (i.e., 8.80E-10 percent) as shown in Table 6-3 of the LTP.

2. I-129 was screened using the DandD default parameters and input values were determined as outlined in HBPP TBD "Radionuclide Selection for DCGL Development." The dose attributed to I-129 were 1.76E-07 mrem and 1.82E-07 mrem for Residential and Occupancy respectively.

3. I-129 values are entered on certain HBPP radwaste shipment manifests. Certain waste burial sites require that values for all 10 CFR 61 radionuclides be entered on the manifest. Review of values entered determined that the MDC values were used for the I-129 concentrations. I-129 concentrations in 10 CFR 61 analyses have not been observed in the past at HBPP greater than their MDA values.

4. I-129 concentrations have not been observed above the MDA value in characterization sample analyses when analyzed at HBPP.

5. NUREG-4289 lists I-129 residual radionuclide concentrations in HBPP reactor component systems as insignificant (Table C.2.3)

Based upon the above review of I-129 at HBPP, it is appropriate to exclude I-129 from the list of site-specific radionuclides potentially present at the HBPP site.

The HBPP LTP Tables 5-1 and 6-3, and Section 6.2.4, as well as TBD, "Radionuclide Selection for DCGL Development," will be revised to reflect this analysis.

RAI 29

Basis for Request:

Section 6.4.4.2. The model room assumed was selected because little remediation will be required in this room and because the room was slated to be occupied by administrative personnel on the most continuous basis. The model room is 8.47 m by 5.64 m. It is expected that a smaller room would lead to a higher dose. Because the use of rooms may change in the future, it is important to understand the potential dose implications if another room on site were to be used in a more continuous manner.

RAI

Provide information on whether there are smaller rooms on the site that could potentially be occupied by personnel on a more continuous basis in the future. Also provide the size of these rooms. If the rooms are significantly different in size than what was assumed in the model, provide an assessment of the DCGLs based on this room size.

PG&E RESPONSE

The primary basis for selecting the room in the General Office Building as a representative room for DCGL development was the expectation that administrative personnel occupying the selected room will spend much more of their time at their work space than other site personnel who may occupy smaller rooms. The few structures scheduled to remain at the Humboldt Bay Power Plant (HBPP) site at license termination include the General Office Building, Administration Annex, and the Count Room. Of these structures, the selected room in the General Office Building is the only room expected to house personnel continuously. This is the smallest room that will be continuously occupied.

PG&E will revise LTP Section 6.4.4.2 to include the last sentence above.

RAI 30

Basis for Request:

Chapter 6, Table 6-6. Table 6-6 presents area factors for building surfaces. The document "Gross Activity DCGL in Support of the Final Status Survey at HBPP" describes the gross beta/gamma DCGL for building surfaces.

RAI

Provide information on the method that will be used to assess the DCGLs for elevated areas on building surfaces (i.e., is a gross DCGL value going to be generated for the elevated areas using the area factors?).

PG&E RESPONSE

There are very few, if any, Class 1 building surfaces present at HBPP at license termination. If there is a Class 1 survey unit, then elevated areas will be evaluated using a gross $DCGL_{EMC}$ value. The area factor used will be the most conservative value (i.e., the most conservative value for the nuclides used to determine the Gross Activity DCGL).

PG&E will revise the document "Gross Activity DCGL in Support of the Final Status Survey at HBPP" to include the above information.

RAI 31

Basis for Request:

Chapter 6, Appendix C. The results of the sensitivity analysis for building surfaces indicate that certain parameters are sensitive for some walls, but not others. This result indicates that the sensitivity analysis may not have been run with enough observations because it is not logical for the sensitivity of a parameter to be different for different walls, particularly when the walls have the same geometry.

RAI

For key radionuclides, provide results of a sensitivity analysis that has been run for more observations to confirm that the results obtained were correct.

PG&E RESPONSE

The modeled room is 8.47 meter (m) long by 5.64 m wide with 2.49 m walls, which yields a rectangular footprint. Opposite walls have the same geometry; however, the geometries are not the same for all four walls. Additionally, a hypothetical receptor in the center of the room is closer to the large-area walls than to the walls with the smaller surface area. Therefore, it is possible that the four walls do not show the same sensitivity results based on the room geometry and proximity of a receptor to the walls. Three RESRAD-Build input parameters (i.e., deposition velocity, re-suspension rate, and source removal time) showed inconsistent sensitivities for the walls in the modeled room. The inconsistent sensitivity results are observed for only 4 of the 22 ROCs (Co-60, Eu-152, Eu-154, and Nb-94), indicating that use of 300 observations was sufficient in most cases.

Deposition velocity and re-suspension rate are parameters describing the properties of the building. RESRAD-Build accepts a single value as input for each parameter. The seventy-fifth percentile value of the deposition velocity distribution and the twenty-fifth percentile value from the re-suspension rate distribution were used as conservative single-value input in the development of the building surface DCGL values for Humboldt Bay because these parameters were identified as sensitive for some, but not all, walls.

The use of 300 observations was sufficient to determine the sensitivities of these 2 parameters.

RESRAD-Build executions with 600 observations were performed for Eu-152, Eu-154, and Nb-94 to assess the sensitivity results for source removal time with 300 observations. The criterion for identifying a parameter as sensitive was a PRCC value with an absolute value greater than 0.1. Table 2 below presents the absolute values of PRCC statistic obtained with 300 and 600 observations.

Table 2. Absolute values of PRCC Statistics

Area Source	Eu-152		Eu-154		Nb-94	
	300 Obs	600 Obs	300 Obs	600 Obs	300 Obs	600 Obs
Floor	0.49	0.31	0.48	0.31	0.30	0.10
North Wall	0.13	0.07	0.12	0.02	0.02	0.03
East Wall	0.08	0.02	0.02	0.06	0.12	0.11
South Wall	0.13	0.00	0.11	0.03	0.04	0.09
West Wall	0.5	0.01	0.03	0.06	0.20	0.05
Ceiling	0.44	0.22	0.33	0.21	0.16	0.10

For some walls, the source removal time was identified as sensitive with 300 observations due to an absolute value of the PRCC statistic that was very close to the sensitivity criterion and shown not to be sensitive with 600 observations. Therefore, the initial sensitivity results with 300 observations promoted the use of conservative input in the DCGL calculations. This assessment did not identify a case where the source removal time was initially identified as "not sensitive" with 300 observations but as "sensitive" with 600 observations.

RAI 32

Basis for Request:

Chapter 6, Appendix D. The basis for how the indoor fraction was determined was not clear from NUREG/CR-5512 Vol 3.

RAI

Provide additional information on how the indoor fraction was determined.

PG&E RESPONSE

The basis for the indoor fraction used in the calculations of the Humboldt Bay building surface DCGL values can be found in Sections 5.2.2.3.1 through 5.2.2.4 in Volume 3 of NUREG-5512. The indoor fraction value (0.267) was determined using an assumed 45-hour work week over a 52-week period. That assumption is consistent with the

default value for the occupancy period given in Section 5.2.2.4 of Volume 3 to NUREG-5512. The specific calculation of this parameter value is:

45h/w * 52w/y * 1d/24h * 1y/365d = 0.267

This fraction is conservative in that it assumes 5 overtime hours each week and no vacation or sick time is taken by the critical receptor.

RAI 33

Basis for Request:

Chapter 6, Appendix D. The deposition velocity for Am-241, Cm-243, Cm-244, Cm-245, Cm-246, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241 was based on the 25% of the distribution. However, the results of the sensitivity analysis indicated that this was not a sensitive parameter for these radionuclides. Therefore, the value should be set at the 50%, rather than the 25%.

RAI

Provide the basis for using the 25% for these parameters or provide updated results reflecting the use of the 50% value. Alternatively, provide a justification for why the particular value selected for this parameter is not significant to the dose.

PG&E RESPONSE

The results of the sensitivity analysis for RESRAD-Build input parameters did not identify deposition velocity as a sensitive parameter for Am-241, Cm-243, Cm-244, Cm-245, Cm-246, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241. The "non-sensitive" attribute of deposition velocity for these ROCs provided confidence that the uncertainty associated with the actual deposition velocity would not have a significant impact on dose or resulting DCGL values. Nevertheless, RESRAD-Build code executions were repeated using the fiftieth percentile value as input for the deposition velocity. The results from the repeated RESRAD-Build executions confirm insignificant differences (i.e., less that 10 percent) in dose results based on use of the twenty-fifth percentile and fiftieth percentile values as input for deposition velocity. Moreover, as shown in Table 3 below, the inadvertent use of the twenty-fifth percentile value in the calculations of DCGLs actually resulted in slightly more conservative DCGL values in some cases.

Table 3. Percentile Value Comparison

Nuclide	25th Percentile Value[a]		50th Percentile Value[b]	
	mrem/y	DCGL	mrem/y	DCGL
Am-241	1.84E-04	3.0E+03	1.84E-04	3.0E+03
Cm-243	1.27E-04	4.3E+03	1.27E-04	4.3E+03
Cm-244	9.98E-05	5.5E+03	9.22E-05	6.0E+03
Cm-245	2.48E-04	2.2E+03	2.36E-04	2.3E+03
Cm-246	2.04E-04	2.7E+03	1.92E-04	2.8E+03
Np-237	2.27E-04	2.4E+03	2.11E-04	2.6E+03
Pu-238	1.60E-04	3.4E+03	1.48E-04	3.7E+03
Pu-239	1.78E-04	3.1E+03	1.65E-04	3.3E+03
Pu-240	1.78E-04	3.1E+03	1.65E-04	3.3E+03
Pu-241	3.83E-06	1.4E+05	3.49E-06	1.5E+05

[a] **Deposition velocity = 1.52E-05 m/s.**
[b] **Deposition velocity = 8.52E-05 m/s.**

PG&E will revise LTP Chapter 6, Appendix D, to include the above information.

RAI 34

Basis for Request:

Chapter 6, Appendix D. A value of 0.1 was assumed for the removable fraction in the calculation of building surface DCGLS.

RAI

What method is going to be used to confirm that the removable fraction in the building is 0.1 or less?

PG&E RESPONSE

Smears will be taken at each fixed-point location on building surfaces to verify that the removable fraction is 0.1 or less. This will be addressed in the FSS report for each Survey Area. The individual smear results will not be included in the FSS report, but will be available if requested.

RAI 35

Basis for Request:

Chapter 6, Appendix G, Appendix I. The thickness of the contaminated zone assumed in the RESRAD model is based on the 75% a site specific distribution (2.67 m) that

ranges from the depth of the soil mixing layer (0.15 m) to the maximum depth of a sample that had plant related radioactivity (3.51 m).

RAI

If residual radioactivity is found at a greater depth than the 2.67 m assumed in the model, what method will be used to evaluate if the dose results are still applicable?

PG&E RESPONSE

The dose from residual radioactivity that may be present at depths greater than 2.67 m was investigated. The first step was to determine doses associated with potential contamination below the depth of the modeled contaminated zone. Four radionuclides were selected for this assessment: Am-241 as a representative alpha-emitting ROC, Co-60 and Cs-137 as representative beta/gamma-emitting ROCs, and Sr-90 as a representative beta-emitting ROC. The RESRAD code was used to calculate doses resulting solely from a 1 m thick contaminated zone located directly below the modeled contaminated zone; that is, the 1 m thick contamination zone was assumed to exist from 2.67 m to 3.67 m below the surface. With the exception of the location of the 1 m thick contaminated zone, values for RESRAD parameters were the same as those listed in ENG-HB-003, Revision 0, "Humboldt Bay Soil Derived Concentration Guideline Levels."

The next step was an evaluation of the potential doses from deep contamination (i.e., deeper than the modeled contamination zone). The dose results from this assessment and the dose bases for DCGL values are shown in Table 4 below. The "peak of the mean" doses from residual radioactivity hypothetically located between 2.67 m and 3.67 m below the surface represent small fractions of the doses associated with residual radioactivity present between the surface and 2.67 m below the surface (or the dose bases for the Humboldt Bay DCGL values).

Table 4. Dose Comparison for Deeper Contamination

	Peak of the mean dose (mrem/y) due to soil contamination in specified depth range:	
ROC	surface to 2.67 m[a]	2.67 m to 3.67 m
Am-241	9.68E-01	7.46E-03
Co-60	6.55E+00	7.39E-07
Cs-137	3.15E+00	1.19E-05
Sr-90	1.66E+01	6.27E-04

[a] Dose basis for DCGL value.

ENG-HB-003 describes the approach taken in the development of Humboldt Bay DCGL values. That approach included a downward rounding of calculated DCGL values to 2 significant digits for practical application. The downward rounding sufficiently

captures the small doses from potential radioactivity that may be present below the depth of the modeled contaminated zone. For example, the calculated DCGL for Am-241 is 25.8 pCi/g was rounded down to 25 pCi/g for application in the field. The summed dose value for Am-241 contamination present from the surface to 3.67 m below the surface rounds to the same DCGL value. Therefore, if residual activity is found at a depth greater than 2.67 m the dose results are still applicable.

RAI 36

Basis for Request:

Chapter 6, Appendix I. There are some aspects of the RESRAD modeling that may be resulting in an underestimation of the water dependent doses. For example, parameters that are expected to be correlated are not (such as the Kd values in the contaminated, unsaturated and saturated ones). Additionally, because parameters were not correlated, some realizations of the probabilistic analysis had combinations of parameters that are physically impossible (e.g., an effective porosity that is higher than the total porosity).

RAI

Provide an assessment to determine whether these modeling artifacts are resulting in an underestimation of the water dependent doses.

PG&E RESPONSE

NUREG/CR-6697 states that a few input parameters, such as effective porosity and total porosity, are clearly related and the NUREG provides a table that lists the potential correlations among the RESRAD and RESRAD-BUILD parameters assigned distributions. Correlation of distribution coefficients (Kd values) in the contaminated, unsaturated, and saturated zones is not listed among those potential correlations. In the sensitivity analysis, correlations were established for the total porosity and effective porosity, total porosity and bulk density, and effective porosity and bulk density and those correlations were maintained in the DCGL calculations.

RESRAD results indicate that for the Humboldt Bay site water independent doses will likely have a significantly greater contribution to the total dose than water dependent doses. This is true even with a soil type with a high transport rate, such as sand, and at times when water dependent doses are at their highest.

See the response to RAI 28 for additional information regarding the potential impact of water dependent doses on the total dose, and for justification for excluding I-129 from the list of site-specific radionuclides potentially present at the HBPP site.

RAI 37

Basis for Request:

"Gross Activity DCGL in Support of the Final Status Survey at HBPP," Section 3.0. The beta/gamma gross activity DCGL is based on Cs-137 and Co-60 because these were the only radionuclides identified as being significant for building surfaces. The elimination of insignificant radionuclides from further consideration is consistent with NRC guidance; however, the dose impact of the insignificant radionuclides still needs to be considered.

RAI

Provide an explanation of how the dose from the insignificant radionuclides is going to be accounted for in the use of the gross activity beta/gamma DCGL.

PG&E RESPONSE

See response to RAI 42.

RAI 38

Basis for Request:

"Gross Activity DCGL in Support of the Final Status Survey at HBPP," Section 3.0, Table 3-1. Table 3-1 presents information on the measured activities of Cs-137 and Co-60 inside buildings and on their roofs.

RAI

Provide a description of analytical information available for other radionuclides. Also describe any plans to reconfirm the relative fractions of Cs-137 and Co-60 during the Final Status Survey.

PG&E RESPONSE

There are few structures scheduled to remain at the HBPP site at license termination and none of these is expected to yield samples with sufficiently high activity to determine an appropriate nuclide fraction. Characterization samples of trenches and drains of Units 1 and 2 were analyzed for Pu-239/240 and Am-241 with no activity detected above their lower limits of detection. Unless unexpected areas of elevated activity are found, there are no plans to reconfirm the radionuclide relative fractions on standing buildings. There may be cases where laboratory analyses of building construction media may be used to bound the dose contribution from other nuclides, but the most likely approach will be to utilize continuing characterization data to establish an appropriate nuclide fraction.

PG&E will revise "Gross Activity DCGL in Support of the Final Status Survey at HBPP," Section 5.0, to include the above paragraph.

RAI 39

Basis for Request:

"Gross Activity DCGL in Support of the Final Status Survey at HBPP," Section 4.0. This section states that because there is limited information on the fractional composition of alpha emitters at HBPP, the DCGL for the most limiting alpha emitter will be used.

RAI

Are there plans to obtain fractional compositions of the alpha emitters at a later time?

PG&E RESPONSE

The continuing characterization process, described in Section 2.4, is the planned method for addressing insufficient characterization data.

RAI 40

Basis for Request:

"Radionuclide Selection for DCGL Development," Section 5.0. Radionuclides that were potentially present were evaluated from NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials" and NUREG/CR-4289, "Residual Radionuclide Contamination Within and Around Commercial Nuclear Power Plants," and the Humboldt Bay Historical Site Assessment. Because of failed fuel at Humboldt Bay, there may be differences between the radionuclides at that power plant and the radionuclides commonly observed elsewhere. The Historical Site Assessment focuses primarily on Cs-137 and Co-60.

RAI

Provide an explanation of how the approach used captured all radionuclides potentially present, including those that may be present due to fuel failure (and associated ingrowth). Also, provide a description of characterization performed for radionuclides other than Cs-137 and Co-60.

PG&E RESPONSE

Section 5.3 deals with a historical site assessment with regards to radionuclides that may be present based on previous analyses performed. For this reason the assessment included the actinides of Cm-243, Cm-244, Am-241, Pu-238, Pu-239,

Pu-240 and Pu-241, which would be present in a fuel failure and has been either present in past analyses or potentially present.

For a description of characterizations performed see the responses to RAIs 03 through 10 submitted in PG&E Letter HBL-14-008, "Humboldt Bay Power Plant. Unit 3, License Termination Plan Responses to Requests for Additional Information," dated February 14, 2014.

RA1 41

Basis for Request:

"Radionuclide Selection for DCGL Development,"Section 5.2.2. Based on the description in Section 5.2.2 of "Radionuclide Selection for DCGL Development," it is not clear to the NRC staff how the input concentrations were developed for the DandD code.

RAI

Provide an explanation of the methodology used to develop these concentrations, including how the radionuclides present from failed fuel were accounted for in the development of these concentrations.

PG&E RESPONSE

Section 5.2.2 deals with the screening of radionuclides with respect to their potential to be present on structure surfaces, in soils and in groundwater. As stated in Section 5.2.2, soil concentrations were normalized as their percent total in pCi/g and surface concentrations were normalized as 1000 times their percent total in dpm/100cm^2. This process allowed for the determination of which radionuclides would be potentially present at license termination. Radionuclides present from failed fuel were included in the suite of potential radionuclides present and DCGLs were developed for them.

RAI 42

Basis for Request:

"Radionuclide Selection for DCGL Development," Section 5.2.2. The dose from the radio nuclides that could not be evaluated using DandD should be included as part of this dose.

RAI

Provide information on the method that will be used to account for the dose from the discounted radionuclides.

PG&E RESPONSE

The radionuclide selection to determine what nuclides would be potentially present on HBPP soils, building surfaces and in groundwater starts with the nuclides presented in NUREG/CR-3474 and NUREG/CR-4289. However, many of these would not be potentially present due to their abundance, short half-lives, etc. These nuclides were screened out using the criteria of less than 0.1 percent and that the total dose from all would be less than 1 percent. The remaining radionuclides, combined with nuclides that have been seen in historical samples make up the suite of nuclides that will be potentially present at HBPP. This process is based on previously approved methodologies at commercial U.S. decommissioning sites.

Samples will be taken of soils and building surfaces in areas deemed to have the highest activity present in those media. The samples will be analyzed for all the radionuclides in the site-specific suite. If any of the nuclides are not identified in the analyses then they may be deselected from the survey, however, the potential dose from the deselected nuclides will be determined using their MDC values decayed to a license termination date of September 5, 2019, as compared to their respective DCGLs.

PG&E will revise LTP Section 6.2.5 and "Radionuclide Selection for DCGL Development," Section 5.2.2, to include the above paragraph.

RAI 43

Basis for Request:

"Radionuclide Selection for DCGL Development," Table 5-5 and Table 6-1. Fe-55 was listed as not being discounted in Table 5-5, but it was not included in Table 6-1 "HBPP Site-Specific Suite of Radionuclides."

RAI

What was the basis for eliminating Fe-55 from the site-specific suite of radionuclides?

PG&E RESPONSE

Based on a license termination date of 2016 the total fraction was 0.13 percent, which exceeded the screening value of potentially present radionuclides by 0.03 percent. A revised license termination date of September 2019 further decays the Fe-55 to 39.29 Ci resulting in a fraction of 0.06 percent, which meets the screening criteria.

PG&E will revise "Radionuclide Selection for DCGL Development," Table 5-5 to include the latest data.

RAI 44

Basis for Request:

"Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP." The conceptual model assumed for the pipes does not correspond to the actual configuration of the system.

RAI

Provide an assessment of the dose from the residual radioactivity in the pipes that is consistent with the actual expected configuration or provide additional justification for the conceptual model assumed.

PG&E RESPONSE

PG&E will revise the TBD to reflect the actual piping inventory present at license termination (see response to RAI 47) and will resubmit to the NRC for review and approval. In the revised TBD, PG&E will utilize a different methodology that calculates the dose contribution assuming all of the piping were contaminated to the DCGL and deposited at one location. Thus, aside from positing a cover depth, the actual configuration of the piping will not affect the calculation.

RAI 45

Basis for Request:

"Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP."

RAI

Provide information on how the dose contribution from residual radioactivity in the pipes is going to be considered when evaluating the other DCGLs in the same area.

PG&E RESPONSE

The calculated dose contribution from the piping will be subtracted from the dose limit (25 mrem/y TEDE) for the survey units that lay atop the piping system/segment being evaluated.

RAI 46

Basis for Request:

"Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP." The activities of radionuclides used in the calculation of dose from the residual radioactivity in pipes were based on an analysis of one sample.

RAI

Provide more information on the representativeness of this sample for the material in the pipe and a description of what analyses will be performed in the future to verify the relative ratios of the radionuclides in the pipes.

PG&E RESPONSE

The sample taken in the off-gas tunnel is one of the higher activity samples. This sample was selected because the beta and alpha activities were sufficiently present to allow for development of ratios from positive data. Buried piping to be surveyed will have analyses performed on scrapings/sediment present in the piping to assess that the ratios used are still representative.

PG&E will revise "Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP" to include the above information and resubmit to the NRC for review and approval.

RAI 47

Basis for Request:

"Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP." The dose from the residual radioactivity in the pipes was evaluated deterministically, while similar RESARAD calculations for the soil DCGLS were performed probabilistically.

RAI

What is the reason for the use of a different approach for the pipe DCGLs? Also, provide information on whether the use of mean values from the probabilistic distributions in a deterministic assessment may be non-conservative.

PG&E RESPONSE

DCGLs for buried piping were reassessed using the probabilistic mode in RESRAD.

The new assessment:

- Accounts for all buried pipes currently identified to remain in place;
- Accounts for initial soil activities based on the surface area of all buried pipes currently identified to remain in place,
- Includes a contaminated zone equal to 100 m^2 in area and 1m in thickness, which adds approximately 20 percent conservatism to the size of a contaminated zone based on the dimensions of all buried pipes currently identified to remain in place;
- Addresses RESRAD parameters identified as sensitive in ENG-HB-001, Revision 0, "RESRAD Input Parameter Sensitivity Analysis – Humboldt Bay," through the use of twenty-fifth and/or seventy-fifth percentile values as appropriate for Am-241, Co-60, Cs-137, and Sr-90;
- Uses the distributions from NUREG/CR-6697 as input for RESRAD parameters not identified as sensitive in ENG-HB-001; and
- Uses input values for contaminated fractions for plant food, meat, and milk that are consistent with the area-adjusted values in ENG-HB-005, Revision 0, "Area Factors for Use with Humboldt Bay Soil DCGLs."

The peak of the mean dose resulting from the new assessment for buried pipe is 1.37 mrem/y. The dose results from the new assessment demonstrate that a DCGL value equal to 100,000 dpm/100 cm^2 ensures compliance with 10 CFR 20.1402. The dose associated with all buried pipes currently identified to remain in place will be taken into account during FSS activities (see response to RAI 45).

PG&E will revise, "Derived Concentration Guideline Levels for Embedded and Buried Piping in Support of the Final Status Survey at HBPP," to reflect this information and resubmit to the NRC for review and approval.

Matrix of RAIs and Associated Changes to the License Termination Plan and Technical Basis Documents

RAI Number	Change to LTP?	Location of Change(s)
28	Yes	LTP Tables 5-1 & 6-3 and Section 6.2.4; TBD also to be revised
29	Yes	LTP Section 6.4.4.2
30	No	TBD to be revised
31	No	N/A
32	No	N/A
33	Yes	LTP Chapter 6, Appendix D
34	No	N/A
35	No	N/A
36	Yes	LTP Tables 5-1 & 6-3 and Section 6.2.4; TBD also to be revised
37	Yes	LTP Section 6.2.5; TBD also to be revised
38	No	TBD to be revised
39	No	N/A
40	No	N/A
41	No	N/A
42	Yes	LTP Section 6.2.5; TBD also to be revised
43	No	TBD to be revised
44	No	TBD to be revised
45	No	N/A
46	No	TBD to be revised
47	No	TBD to be revised

TERMS AND ACRONYMS

TERMS AND ACRONYMS

Action Level—The numerical value that will cause the decision maker to choose one of the alternative actions. It may be a regulatory threshold standard (*e.g.*, Maximum Contaminant Level for drinking water), a dose- or risk-based concentration level (*e.g.*, *DCGL*), or a reference-based standard.

AEC—Atomic Energy Commission

AF—Area Factor

AL—ALARA action level

ALARA—"as low as reasonably achievable," which means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical.

alpha (α)—The specified maximum probability of a Type I error. This means the maximum probability of rejecting the null hypothesis when it is true. Alpha also is referred to as the size of the test. Alpha reflects the amount of evidence the decision maker would like to see before abandoning the null hypothesis.

ANL—Argonne National Laboratory

Area of elevated activity—An area over which residual radioactivity exceeds a specified
value $DCGL_{EMC}$.

beta (β)—The probability of a Type II error, i.e., the probability of accepting the null hypothesis when it is false. The complement of beta (1-β) is referred to as the power of the test.

bgs—below ground surface

BMP—Best Management Practice

BWR—Boiling Water Reactor

CAB—Citizens Advisory Board

Caisson—An underground concrete structure at HBPP that houses the underground nuclear reactor.

CCC—California Coastal Commission

CDP—Coastal Development Permit

CEC—California Energy Commission

CFR—Code of Federal Regulations

CIRP—Caisson In leakage Repair Project

COC—Chain of Custody refers to an unbroken trail of accountability to ensure the physical security of samples, data, and records.

Conceptual site model—A description of a site and its environs and presentation of hypotheses regarding the contaminants present, their routes of migration, and their potential impact on sensitive receptors.

Control charts—A plot of the results of a quality control action that demonstrates control is being maintained within expected statistical variation or to indicate when control is or may be lost unless intervention occurs.

CPUC— California Public Utilities Commission

Critical Group—The average group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

CWT—Concentrated Waste Tank

D&D—Decontamination and Decommissioning

Data Quality Assessment (DQA)—The scientific and statistical evaluation of data used to determine if the data are of the right type, quality, and quantity to support their intended use.

Data Quality Objective (DQO)—Qualitative and quantitative statements derived from the DQO process that clarify technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

DAW—Dry Active Waste

DCF—Dose Conversion Factor

DCGL—Derived Concentration Guideline Level

$DCGL_{EMC}$—A DCGL scaled, through the use of area factors, to obtain a DCGL that represents the same dose to an individual for residual radioactivity in a smaller area within a survey unit.

DCGLw—A DCGL for the average residual radioactivity in a survey unit.

delta (δ)—The amount that the distribution of measurements for a survey unit is shifted to the right of the distribution of measurements of the reference area. This term is used in the evaluation of elevated areas.

delta (Δ)—The width of the gray region. Δ divided by σ, the arithmetic standard deviation of the measurements, is the relative shift expressed in multiples of standard deviations.

Derived Concentration Guideline Levels (DCGLs)—Derived radionuclide-specific activity concentration that corresponds to the release criterion (25 mrem/y) within a survey unit.

DOE—U.S. Department of Energy
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DP—Decommissioning Plan

DPM— disintegrations per minute

DPR—Decommissioning Project Report

DQO—Data Quality Objective

DSAR—Defueled Safety Analysis Report

DTSC—Department of Toxic Substances Control

Elevated Measurement Comparison (EMC)—This comparison is used to determine if there are any measurements that exceed a specified value $DCGL_{EMC}$.

EPA—U.S. Environmental Protection Agency

ETD—Easy to detect (for this purpose, nuclides that are detectable by gamma analysis)

Exposure Scenario—A description of the future land uses, human activities, and behavior of the natural system as related to a future human receptor's interaction with (and therefore exposure to) residual radioactivity. In particular, the exposure scenario describes where humans may be exposed to residual radioactivity in the environment, what exposure group habits determine exposure, and how residual radioactivity moves through the environment.

ft^3—cubic foot

FGEIS—Final Generic Environmental Impact Statement

FGR—Federal Guidance Report

FSS—Final Status Survey

GEIS—Generic Environmental Impact Statement

Gross Activity DCGLs—DCGLs established, based on the representative radionuclide mix, for gross (non-radionuclide-specific) alpha/beta surface radioactivity measurements. Field assessments will typically consist of these gross radioactivity measurements.

GTCC—Greater than Class C

HABS—Historic American Building Survey

HAER—Historic American Engineering Record

HBGS—Humboldt Bay Generating Station

HBPP—Humboldt Bay Power Plant

HEPA—High Efficiency Particulate Air filter

Historical Site Assessment (HSA)—The identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted.

HPGe—High Purity Germanium

HSE—Health, Safety, and Environment

HTD—Hard to detect (for this purpose, nuclides that are not detectable by gamma analysis).

Investigation level—A derived media-specific, radionuclide-specific concentration or activity level of radioactivity that: (1) is based on the release criterion, and (2) triggers a response, such as further investigation or cleanup, if exceeded.

ISFSI—Independent Spent Fuel Storage Installation

ISOCS—In Situ Object Counting System

Judgmental measurement/biased measurement—A measurement performed at locations selected using professional judgment based on unusual appearance, location relative to known contaminated areas, high potential for residual radioactivity, general supplemental information, etc. Judgmental measurements are not included in the statistical evaluation of the survey unit data because they violate the assumption of randomly selected, independent measurements. Instead, judgmental measurements are individually compared to the DCGL.

LA—License Amendment

LAR—License Amendment Request

LHS—Latin Hypercube Sampling

LLRW—Low-level Radioactive Waste

LLW—Low-level Waste

Lower Bound of the Gray Region (LBGR)—Refers to the minimum value of the gray region. The width of the gray region (*DCGL-LBGR*) is also referred to as the shift, Δ.

LPG—Liquid Propane Gas

LRW—Liquid Radwaste

LTP—License Termination Plan

m^2—square meter

m^3—cubic meter

MARSSIM—The *Multi-Agency Radiation Site Survey and Investigation Manual (NUREG–1575)* is a multi-agency consensus manual that provides information on planning, conducting, evaluating, and documenting building surface and surface soil final status radiological surveys for demonstrating compliance with dose- or risk-based regulations or standards.

MDC—Minimum Detectable Concentration

MDCR—Minimum Detectable Count Rate

Measurement—For the purpose of MARSSIM, the term is used interchangeably to mean: (1) the act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated or, (2) the quantity obtained by the act of measuring.

MEPPS—Mobile Emergency Power Plant Station

MeV— Mega electron Volts

Minimum Detectable Concentration (MDC)—This term means the *a priori* radioactivity concentration level that specific instrument or technique can be expected to detect 95% of the time; the value that should be used when stating the detection

capability of an instrument for a given measurement technique. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of radioactivity concentration.

Minimum detectable count rate (MDCR)—The minimum detectable count rate is the *a priori* count rate that a specific instrument and technique can be expected to detect.

MLLW —mean lower low water, which is the average height of the lowest tide recorded at a tide station each day during the recording period.

mrem/y (millirem per year)—One one-thousandth (0.001) of a rem per year.

MSL—mean sea level

NAVD88—North American Vertical Datum 1988

NCUAQMD—North Coast Unified Air Quality Management District

NDCTP—Nuclear Decommissioning Cost Triennial Proceeding

NEI—Nuclear Energy Institute

NIST— National Institute of Standards and Technology

Non-impacted Area—An area where there is no reasonable possibility (extremely low probability) for residual radioactivity to exist.

Nonparametric test—A test based on relatively few assumptions about the exact form of the underlying probability distributions of the measurements. As a consequence, nonparametric tests are generally valid for a fairly broad class of distributions. The Wilcoxon Rank Sum test and the Sign test are examples of nonparametric tests.

NRC—Nuclear Regulatory Commission

Null Hypothesis (H0)—A statistical scenario set up to be nullified, refuted or rejected ('disproved statistically') in order to demonstrate compliance with the release criteria.

ODCM—Offsite Dose Calculation Manual

OWS—Oil/Water Separator

PCB—Polychlorinated Biphenyl

pCi/g—Picocurie per gram, a concentration scale typically used in the measurement of radioactivity in soil.

PG&E—Pacific Gas and Electric

PM_{10}—particulate matter of 10 microns

Power (1-β)—This term refers to the probability of rejecting the *null hypothesis* when it is false. The power is equal to one minus the *Type II* error rate, *i.e.* (1-β).

PRCC—Partial Rank Correlation Coefficient

Precision—A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Probabilistic—Refers to computer codes or analyses that use a random sampling method to select parameter values from a distribution. Results of the calculations are also in the form of a distribution of values. The results of the calculation do not typically include the probability of the scenario occurring.

PSDAR—Post-Shutdown Decommissioning Activities Report

QAPP—Quality Assurance Project Plan

QC—Quality Control

RA—Restricted Area

RCA—Radiological Control Area

RCRA—*Resource Conservation and Recovery Act of 1976*

Reference area—Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific

survey units at remediation site. A site radiological reference area (background area) is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical, radiological, or biological variability.

Reference coordinate system—A grid of intersecting lines referenced to a fixed site location or benchmark. Typically, the lines are arranged in a perpendicular pattern dividing the survey location into squares or blocks of equal areas. Other patterns include three-dimensional and polar coordinate systems.

Relative shift (Δ/σ)—Δ divided by σ, the standard deviation of the measurements.

Release criterion—A regulatory limit expressed in terms of dose or risk.

REMP—Radiological Environmental Monitoring Program

Replicate—A repeated analysis of the same sample or repeated measurement at the same location.

RESRAD Code—A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in soils.

RESRAD-BUILD Code—A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in BUILDings.

Restricted Area—Any area to which access is limited by a licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

RGWMP—REMP Ground Water Monitoring Program

RWP—Radiation Work Permit

SAFSTOR—The alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use.

Scanning—An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

SCM—Site Conceptual Model (same as Conceptual Site Model)

Scoping Survey—An initial survey performed to evaluate: (1) radionuclide contaminants, (2) relative radionuclide ratios, and (3) general levels and extent of contamination.

SFP—Spent Fuel Pool

Sign Test—A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is not present in background or present in a small fraction of the DCGL, and the distribution of data is not symmetric.

Single nuclide DCGL—A radionuclide-specific activity concentration that would result in an annual total effective dose equivalent (TEDE) of 25 mrem with no other radionuclides present.

S_o—Sensitivity Threshold

Source Term—Refers to a conceptual representation of the residual radioactivity at a site or facility.

Split Sample—A sample that has been homogenized and divided into two or more aliquots for subsequent analysis.

Standard normal distribution—A normal (Gaussian) distribution with mean zero and variance one.

Survey Area—An area established and classified based on a common radiological history, logical physical boundaries, and site landmarks for the purpose of documenting and conveying radiological information.

Survey Area Report—A report including all the survey units within a survey area providing a complete and unambiguous record of the radiological status of each survey unit relative to the established DCGLs.

Survey Package—A document developed by the DQO process providing the methodology by which to perform the final status survey.

Survey Unit—A geographical area consisting of structures or land areas of specified size and shape at a site for which a separate decision will be made as to whether or not the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are generally formed by grouping contiguous site areas with similar use histories and having the same contamination potential (classification). Survey units are established to facilitate the survey process and the statistical analysis of survey data. One, or more, survey units makeup a survey area.

Systematic error—An error of observation based on system faults which are biased in one or more ways, *e.g.*, tending to be on one side of the true value more than the other.

TBD—HBPP Technical Basis Documents

TCP—Traffic Control Plan

Total Effective Dose Equivalent (TEDE)—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (CEDE) (for internal exposures).

Triangular sampling grid—A grid of sampling locations that is arranged in a triangular pattern.

Turnover Survey—A final operational radiological survey performed by the Radiation Protection (RP) Department after the completion of decommissioning activities in an area to verify that the area is ready for Final Status Survey.

Type I error—A decision error that occurs when the null hypothesis is rejected when it is true. The probability of making a Type I decision error is called alpha (α).

Type II error—A decision error that occurs when the null hypothesis is accepted when it is false. The probability of making a Type II decision error is called beta (β).

Unity rule—A rule applied when more than one radionuclide is present at a

concentration that is distinguishable from background and where a single concentration comparison does not apply. In this case, the mixture of radionuclides is compared against default concentrations by applying the unity rule. This is accomplished by determining: 1) the ratio between the concentration of each radionuclide in the mixture, and 2) the concentration for that radionuclide in an appropriate listing of default values. The sum of the ratios for all radionuclides in the mixture should not exceed 1.

VSP—Visual Sample Plan software used for plotting sample/measurement locations.

Wilcoxon Rank Sum (WRS) test—A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is present in background.

Wr—This represents the sum of the ranks of the adjusted measurements from the reference area, used as the test statistic for the Wilcoxon Rank Sum test.

Ws—The sum of the ranks of the measurements from the survey unit, used with the Wilcoxon Rank Sum test.

WWI—Wastewater Impoundments