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# Gross Activity DCGL in Support of the Final Status Survey at HBPP

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# Executive Summary

When surveying building surfaces for release it is most appropriate to use the actual site radionuclide mixture gross activity derived concentration guideline level (DCGL). HBPP site characterization data was used to determine the radionuclide fractions and in turn, used to derive the appropriate beta/gamma gross activity DCGL. Alpha fractions are unknown at this time so the most conservative DCGL for the predominant alpha emitters will be used as the alpha gross activity DCGL. As always, when determining the release of a unit where both beta/gamma and alpha emitters are present, the unity rule will be used to determine if the survey unit meets the release criteria.

# 1.0 INTRODUCTION

Humboldt Bay Power Plant (HBPP) is undergoing a site decommissioning with the ultimate goal of terminating the 10 CFR 50 license. The final state of the site at license termination will consist of mostly open land areas with a few structures remaining. In order for the site to achieve license termination both the soils and structures remaining must meet the release criteria as outlined in the HBPP license termination Plan (LTP).

Residual levels of radioactive material that correspond to the allowable dose standards were derived by analysis of various pathways and scenarios through which exposures to a member of the critical group at HBPP could occur. These derived levels, known as DCGLs, are radionuclide specific and are expressed in units of picocuries per gram (pCi/g) for soils and disintegrations per minute per 100 centimeters squared (dpm/100 $cm^2$) for building surfaces.

Determining if the HBPP soils meet the release criteria is relatively straightforward insofar as the analysis of the soils is a radionuclide specific analysis. Individual nuclides are compared to their respective DCGL using the unity rule. In the case of building surfaces, however, the portable hand held instrumentation utilized at HBPP are not nuclide specific and read out in a gross activity reading. In this instance a gross activity DCGL must be calculated based on a site specific radionuclide mixture.

# 2.0 METHODOLOGY

Surface contamination DCGLs apply to the total of fixed plus removable surface activity. For surfaces where the radionuclide fractions are unknown the conservative approach would be to compare the measurements to the most conservative DCGL assuming that all activity present was due to the presence of that nuclide. The most realistic approach would be to determine a gross activity DCGL based upon the fractions of nuclides present at the site. The gross activity DCGL is calculated as follows:

1. Determine the relative fraction (*f*) of the total activity contributed by the radionuclide from previous radionuclide-specific analyses.
2. Obtain the $DCGL_W$ for each significant radionuclide present at the time of the final status survey (FSS).

3. Substitute the values of *f* and DCGL in the following equation

$$Gross\ Activity\ DCGL = \frac{1}{\left[\frac{f_1}{DCGL_1} + \frac{f_2}{DCGL_2} + \ldots \frac{f_n}{DCGL_n}\right]}$$

# 3.0 HBPP CHARACTERIZATION DATA

A characterization was performed on the HBPP site in 2008 to include site soils and structures. Contained within this characterization were samples taken in drains and trenches inside buildings and on their roof tops. The samples of the drains and trenches were analyzed using a nuclide-specific gamma spectroscopy. Samples with identifiable amounts of plant-related activity were found on Class 1 and Class 2 structures, presently designated for demolition. While the structures identified as remaining at license termination are classified as Class 3, using the data from the other class structures would be a conservative approach. The sample results for the positively identified nuclides are contained in Table 3.1.

**Table 3- 1 Radionuclides and Percent Total**

| Location | Cs-137 (pCi/g) | % total Cs | Co-60 (pCi/g) | % total Co |
|---|---|---|---|---|
| U3 Gen/Exciter | 25.20 | 92.5 | 2.05 | 7.5 |
| Unit 3 Roof | 4.27 | 93 | 0.32 | 7.0 |
| | 5.40 | 92 | 0.45 | 8.0 |
| | 2.11 | 100 | ND | 0.0 |
| | 17.1 | 93 | 1.30 | 7.0 |
| Unit 1 Second Floor | 0.82 | 91 | 0.08 | 9.0 |
| | 7.79 | 95 | 0.42 | 5.0 |
| Unit 2 Ground | 7.53 | 96 | 0.30 | 4.0 |

| Location | Cs-137 (pCi/g) | % total Cs | Co-60 (pCi/g) | % total Co |
|---|---|---|---|---|
| Floor | | | | |
| | 15.20 | 97 | 0.52 | 3.0 |
| Unit 2 Second Floor | 2.12 | 94 | 0.14 | 6.0 |
| | 3.79 | 93 | 0.27 | 7.0 |

As can be seen Cs-137 represents approximately 94% of the total activity with Co-60 contributing approximately 6%. As was stated earlier only significant radionuclides should be considered, Significant radionuclides are typically based on the guidance provided in NUREG-5849 and DG-4006 which states that only radionuclides that contribute greater than 10% of the radiation dose from all contamination, or which are present at concentrations exceeding 10% of their respective guideline values are considered as significant. While Co-60 could be considered as insignificant contributing 6% to the total activity it is appropriately conservative to include the nuclide, with its more restrictive DCGL, in the gross activity DCGL derivation. As further decay occurs the fraction of Co-60 to Cs-137 is reduced, thus the calculated gross activity value will be conservative over the course of the decommissioning project.

# 4.0 GROSS ACTIVITY DCGL CALCULATION

Based on the analysis of the data presented in Table 3-1, the following calculation for the gross activity DCGL can be determined:

$$Gross\ Activity\ DCGL = \frac{1}{\left[\frac{0.94}{4.66E+04} + \frac{0.06}{1.36E+04}\right]} = 4.06E+04\ dpm/100cm^2$$

Where:

0.94 is the fraction for Cs-137

4.66E+04 is the DCGL for Cs-137

0.06 is the fraction for Co-60

1.36E+04 is the DCGL for Co-60

Since there is limited data concerning the fractional composition of alpha emitters at HBPP, when surveying for alpha the DCGL of 3,000 dpm/100 $cm^2$ (i.e. the DCGL for Am-241 which is the most limiting prevalent alpha emitter at HBPP) will be used for alpha readings.

# 5.0 CONCLUSION

Based on the characterization data taken at HBPP, a gross activity DCGL of 4.06E+04 dpm/100 $cm^2$ for beta/gamma emitters should be used. A gross activity DCGL of 3E+04 dpm/100 $cm^2$ should be used for alpha emitters. When surveying for both beta/gamma and alpha activity the unity rule will be used for determining if the survey unit meets the release criteria.

# 6.0 REFERENCES


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