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BY ELECTRONIC AND U.S. MAIL

Harold Singer
Executive Officer
California Regional Water Quality Control Board
Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150-7704

Re: Request for Comments regarding Consideration of Amendment to Order No. R6V-2011-0005A1

Dear Mr. Singer:

Pacific Gas & Electric Company (PG&E) appreciates the recent discussions regarding our voluntary Whole House Replacement Water (WHRW) program. As stated in our April 16, 2012 letter, PG&E is committed to providing WHRW to all residents within 1 mile of the plume boundary that have chromium 6 in their domestic wells above non-detect levels. PG&E is currently offering our program to eligible residents based on the 4th quarter 2011 plume maps; however, we will update the program to incorporate any residents that may become eligible as a result of future monitoring events (as represented on the quarterly plume maps). PG&E has initiated our outreach to eligible residents and will provide the Regional Board with periodic updates and a final summary of our community engagement efforts by the end of August 2012.

The purpose of this letter is to provide PG&E's perspective on the letter submitted by the Regional Board Prosecution Team on April 12, 2012. We believe that comments received in response to your March 22nd letter are no longer relevant in light of our voluntary program which significantly expands and fully meets the intent of Paragraph 3 of the 2011 Order making this issue moot. However, we are providing the attached technical responses for purposes of maintaining a complete record on the subject.

If you have any questions or concerns regarding this letter, please contact me at (415) 973-8843.

Sincerely,

Sheryl Bilbrey
Pacific Gas & Electric
Director, Chromium Remediation

Technical Response to Prosecution Team April 12, 2012 Comment Letter

Prosecution Team Comment 1:

Combining multiple statistical tests to determine a trend in chromium levels would not excessively increase the false positive rate.

PG&E Response 1:

a. Increasing The Rate Of False Positive Results Is Not Appropriate In This Context.

The 2007 Background Study applied established statistical methods to determine an Upper Tolerance Limit (UTL) for hexavalent chromium for the study area of 3.1 parts per billion (ppb). As explained in PG&E's letter dated December 22, 2011, under this conservative UTL approach, there will be a false positive rate (FPR) (or type-I error rate) of 5%, meaning that 5% of the time, natural concentrations of hexavalent chromium in a background well, wholly unrelated to any PG&E release, will exceed 3.1 ppb.

The Prosecution Team acknowledges that application of a second statistical method in addition to the UTL will further increase the FPR. It argues, however, that an increase in the number of false positive results to 10% – double that of the approved UTL – is appropriate due to the potential for human health impacts from chromium in groundwater. As the Regional Board is aware, the California Office of Environmental Health Hazard Assessment (OEHHA) has determined that ingestion of impacted groundwater is the only potentially significant exposure pathway for Hinkley residents. Since 2010, PG&E has provided replacement drinking water to residents near the plume in Hinkley. In addition, PG&E has agreed to provide, and is now beginning the process of providing, whole-house replacement water for every well user with detectable levels of hexavalent chromium within one mile of the plume. These actions have eliminated the single potential source of human health risk identified by OEHHA from the existing groundwater. Alleged human health impacts, therefore, do not justify the substantial increase in testing error proposed by the Prosecution Team for future groundwater analysis.

California's applicable regulations also support this assertion. Title 23 of the California Code of Regulations, Section 2550.7(e), states that when a background study is performed that produces a 95% UTL (as is the case with the Hinkley background study) monitoring data are to be compared to the UTL rather than to some other parameter for background. Section 2550.7(e)(8)(C) clarifies this standard, requiring that the value for each constituent of concern at each monitoring point should be compared to that 95% UTL or prediction limit. The regulations do not provide for adding additional calculations or statistical methods that increase the rate of false positives.

b. Even Were The Regional Board To Ignore Existing Regulations And Mandate Procedures That Would Double The FPR To 10%, The Methodology Proposed By The Prosecution Team Would Lead To Per-Well FPR Values That Will Substantially Exceed 10% And With The Passage Of Time Would Ultimately Create A High Likelihood That A Large Share Of Non-Impacted Wells Would Fail This Test.

The Prosecution Team states that testing whether "a given Hinkley drinking water well has been impacted" by applying an additional statistical method over and above the UTL method used to determine background concentrations would create a method of analysis for which "the overall false positive rate is, at most, the sum of both false positive rates for each individual statistical test," that is in this case, at most 10%. This claim is statistically incorrect. Specifically, the Prosecution Team fails to identify and account for the increase in the overall FPR ($FPR_{overall}$) that occurs when multiple, independent tests are analyzed. That increase causes the $FPR_{overall}$ to exceed the sum of the FPRs for the individual statistical tests, as explained below. This multiple comparison problem is extensively discussed in the EPA Unified Guidance document *Statistical Analysis Of Groundwater Monitoring Data At RCRA Facilities* (EPA, March 2009) (*see* Section 6.2) and standard textbooks in Groundwater Monitoring (*e.g. Statistical Methods for Groundwater Monitoring*, Robert D. Gibbons, *et al.*, Wiley, 2009).

Simply put, repeated concentration measures for a single well for a test (*e.g.* trend based or not) on independent data will tend to yield uncorrelated, random, independent results. To the extent multiple trend tests with a false positive rate of 5% for each time the test is conducted are conducted for each single well, the true FPR value for the repeated test (FPR_{trend}) associated with applying this procedure to each well will significantly increase over time as more and more trend tests are conducted for that well.[1] Under the procedure described by the Prosecution Team at page 5 of their comment letter, therefore, it will inevitably and rapidly be the case that FPR_{trend} significantly exceeds 5% for each and every well, and therefore that $FPR_{overall}$ significantly exceeds 10% for each and every well. In reality this procedure would lead to a high likelihood that a large share of non-affected wells would eventually fail this screening test – not because of an underlying trend but because of a design flaw in the trend test.

Prosecution Team Comment 2:

Feasible statistical methods to evaluate intra-well concentration trends require only four samples over as little as 8 weeks.

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[1] Specifically, if a total of n independent tests are performed each with $FPR_1 = 100\alpha\%$, then statistical independence guarantees that the overall FPR ($FPR_{trend} = FPR_n$) for such an n-test procedure is $FPR_{trend} = FPR_n = 100[1-(1-\alpha)^n]\%$. If α is an upper bound on the FPR for each test, then, to ensure that $FPR_{trend} \leq 5\%$, the required α value may be found by what is known as the Šidák correction, as $\alpha = 1-(1-FPR_n)^{1/n}$, which in this case is $\alpha = 1-(0.95)^{1/n}$. For example, if $n = 5$, then a FPR value (FPR_1) of $\alpha \leq 0.0102$ for each of the 5 trend tests would be required to assure that $FPR_{trend} \leq 5\%$. If the number of samples were 10 (*i.e.* $n = 10$), then a FPR value (FPR_1) of $\alpha \leq 0.00512$ for each of the 10 tests would be required to assure that $FPR_{trend} \leq 5\%$.

PG&E Response 2:

a. Sample Sizes Of Less Than 8 Samples Provide Results Of Little Benefit.

As detailed in PG&E's December 22, 2011 letter, though rank-based methods such as Spearman's and Mann-Kendall can technically be performed based on only four observations, their power properties with such small sample sizes are poor. Independent of the sample size concern, those tests are unable to differentiate between a rapid and/or substantial concentration increase and a very slow and/or negligible increase, leading to yet more false positive results with respect to environmental significance.

b. The Two-Week Sampling Interval Proposed By The Prosecution Team Would Not Result In Independent Samples and Would Therefore Add No Meaningful Data.

The trend tests proposed by the Prosecution Team all rely on independence of the samples. Groundwater at the site moves at a rate of only 1-4 feet per day. (Haley & Aldrich, 2010. Feasibility Study, Pacific Gas and Electric Company Hinkley Compressor Station. August 30, 2010). Distinguishing a significant trend tied to this limited plume movement over a two week time scale would carry a high level of uncertainty given the short travel distance, analytical uncertainty and natural variation. From a hydrogeological and geochemical perspective, samples taken within this short time frame may not be considered independent samples. In the absence of such independence, the methods proposed by the Prosecution Team cannot be properly applied and, if applied, can yield no meaningful conclusions. Appropriate sampling procedures would have the samples drawn no more frequently than quarterly.

c. Statistical Methods Used To Determine Impacted Wells Should Be No Less (Statistically) Stringent Than Those Allowed Under Section 3.D Of The Amended Order To Determine That A Well Is No Longer Impacted.

Section 3.d of the Order specifies that "The Discharger may remove a well that was determined to be impacted due to an evaluation using the accepted methods in 3.a. above from impacted status if the results of hexavalent chromium from four (4) consecutive quarters demonstrate that the well is no longer impacted based on the approved methods described in 3.a. above."

In contrast, the Prosecution Team's comments propose that the minimum data set for each trend test can consist of just four samples "conducted at least 2 weeks apart." Thus, under the proposed scheme, a data series lasting as few as eight weeks could be used to determine that a well is potentially impacted, whereas under the Order the potentially-impacted status could not be altered for an entire year, even if subsequent data obtained within that same year indicate absence of a trend by the very same statistical criteria as those used initially to establish the trend. If four consecutive quarters of data are required to demonstrate that a well is no longer impacted, at least the same period should be required to establish that a well is potentially impacted to, at a minimum, adequately address issues pertaining to sample independence and seasonality.

Prosecution Team Comment 3:

It is not necessary for the Prosecution Team's proposed screening methods to distinguish between a mere statistical trend and an environmentally significant trend, since other evidence and "common sense" will be applied to the result.

PG&E Response 3:

a. The Inability To Distinguish Between A Mere Statistical Trend And An Environmentally Significant Trend Fatally Undermines The Prosecution Team's Proposed Screening Methods.

The methods proposed by the Prosecution Team address only whether a trend is statistically significant, not whether the underlying conditions are environmentally significant. A quarterly change in concentrations of 0.01 ppb, for example, is fundamentally different from a quarterly change of 10 ppb. The proposed tests do not, and are not designed to, differentiate between the two. The proper goal is to screen for environmentally significant increases of concentrations at the well level, such as are indicated by the UTL comparison method. The Prosecution's Team's proposed tests cannot achieve this goal. (See also PG&E Response 2.a.)

b. The Analyses Shed No Light On The Key Issue Of Causation.

The question identified in Section 3.a of the Order, and highlighted in Harold Singer's letter of March 22, 2012, is whether detectable levels of hexavalent chromium between the maximum background level and the PHG represent background conditions or are attributable to a discharge from PG&E. The proposed analyses do not do this. Instead, they determine, in a very limited way, whether concentrations in a well are increasing in a statistically meaningful manner. They do not answer the more fundamental question regarding whether an apparent increase is the natural result of random or seasonal fluctuations or rather is caused by anthropogenic sources. The Prosecution Team asserts that this point does not matter because the statistical screening is just the first step and that common sense will be applied following the statistical work. The Order, however, simply requires that PG&E create a methodology (including statistical tests) to determine whether hexavalent chromium levels below 3.1 ppb are caused, in whole or in part, by PG&E. There is no language regarding how the statistical results will be applied or may be offset by other factors.