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November 14, 2012

Ms. Anne Holden
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150

Re: Hinkley Groundwater Project Independent Review Panel (IRP) Manager Comments Regarding PG&E's Chromium Background Study Work Plan[1] of February 22, 2012

Dear Ms. Holden:

This letter describes *General and Detailed Comments*[2] the Independent Review Panel (IRP) Manager is submitting to the Water Board regarding PG&E's February 2012 Proposed Chromium Background Study Work Plan ("the Proposed Work Plan").

The function of the IRP Manager is to assist the CAC and Community in their technical understanding of topics regarding PG&E's programs associated with the remediation of the Hinkley Cr6 groundwater plume. The IRP Manager also submits comments to PG&E and the Water Board on proposed programs, with the general goal of improving the quality of any program. These comments on the planned Background Study are submitted in this spirit.

The IRP Manager acknowledges the importance of the Proposed Work Plan, appreciates the opportunity to comment, and understands the results will be used as part of the process to eventually establish a hexavalent chromium (Cr6) clean up goal for the Hinkley Community affected by PG&E's Cr6 discharge. The IRP Manager wants to have verified that the procedures and protocols described in the Proposed Work Plan are in agreement with current industry standards and practices. In this regard, the IRP Manager has conducted a review of the Proposed Work Plan. The IRP Manager has provided some suggestions and recommendations to the Community Advisory Committee (CAC) which they in turn would like to see addressed. The IRP Manager also conducted a review of

[1] Work Plan Evaluation of Background Chromium in the Groundwater of the Upper Aquifer in the Hinkley Valley, Pacific Gas and Electric Company, Hinkley California, Submitted to California Regional Water Quality Control Board, Lahontan Region, by PG&E; Prepared by Stantec, Lafayette, CA, February 22, 2012.

[2] A draft, prior version of the IRP Manager's Background Study Comments was provided in a hard copy version to Ms. Kemper on June 28, 2012 during the Hinkley Monthly Community Meeting. This latest version of the Background Study Work Plan Comments now has the opportunity to add Comments regarding other related and relevant topics which have arisen during recent months. It maybe, that some of these more recent topics can also be addressed during what could be termed as Background Study activities.

the 2007 Background Study Report[3] to identify if all of the prior identified deficiencies were incorporated into the Proposed Work Plan of February 2012.

The comments are divided into **General Comments** and **Detailed Comments**.

The IRP Manager has three **General Comments** in the areas of (1) Cr6 speciation, (2) the possible need to consider multiple clean up levels (derived from background) for ultimate plume remediation and (3) the possible use of some planned Background Study wells, those appropriately located relative to the In-Situ Reactive Zone(IRZ), for also measuring manganese and arsenic.

General Comments are:

1. The Need for Continued Cr6 Speciation in the Background Study Analytical

The IRP Manager is very much aware of the importance of the Background Study and its role in assisting the formulation of final clean up goals for the Hinkley Cr6 groundwater impacts. The CAC and the IRP Manager also understand the parallel track underway where the State will adopt a Maximum Contaminant Level (MCL) for Cr6. The CAC and the IRP Manager, of course, will be maintaining a strong interest in the relative magnitude of these two numbers, and how they will eventually be applied by the Water Board to the Hinkley site.

As I am sure you are aware, the CAC, and to some degree the Hinkley Community, have come a long way in the past few months in our understanding of the plume's location(s), seeming migration patterns, and the fact that finite background concentrations of Cr6 do exist naturally in the aquifer in the area. In order, then, to more instructively develop the clean up targets for the plume, the IRP Manager believes that the analytical ability to speciate natural background Cr6 from PG&E's discharged Cr6 continues to be a project necessity. Section 3.a. of the original Amended Water Replacement Order[4] required PG&E to explore and implement Cr6 speciation analytical techniques. While the Amended Water Replacement Order[5] of June 7, 2012 suspended Section 3.a. with regard to the whole house water replacement program, the IRP Manager feels that the need for the intended spirit of Section 3.a. remains in the remediation program. As described in the letter[6] of April 20, 2012, the CAC and IRP Manager

[3] Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, CA, Submitted to the California Regional Water Control Board, Lahontan Region, by PG&E'; Prepared by CH2MHILL, Oakland, CA, February 28, 2007

[4] Whole House Replacement Order No. R6V-2011-0005A1, October 11, 2011

[5] Whole House Replacement Order No. R6V-2011-0005A2, June 7, 2012

[6] CAC Letter to Harold J. Singer, Regarding Lahontan Water Board's Consideration of Amendment of Order No. R6V-2011-0005A1 (Order) Issued to Pacific Gas and Electric Company (PG&E), as Described in Your "Comments Requested by April 23, 2012" Letter of March 22, 2012. Comments submitted by the Community Advisory Committee (CAC.), April 20, 2012.

recommend that Cr6 speciation analytical techniques are further investigated, developed and applied in the analysis of groundwater samples collected during the proposed Background Study. Via conversations with PG&E, the CAC and IRP Manager understand they are thinking similarly.

2. The Need to Consider Applying More than a Single Background Number When Formulating Cr6 Plume Clean up Goals

The IRP Manager also understands that with the size of the Cr6 plume, and the heterogeneity of the hydrogeology, it is conceivable that a range of Cr6 background numbers exists in and around the "affected area." Therefore, to set a single clean up goal for the entire PG&E Cr6 release may not be appropriate. The IRP Manager understands that setting a single "marker Cr6 number" (such as the current applied 3.1ppb Cr6 upper maximum) is convenient for current plume delineation and remediation planning purposes. However, in practical application, I hope that the Water Board and PG&E will work to formulate, protective clean up standard(s) for the plume using the information derived in the Background Study.

3. Consider Obtaining Data via the Background Study, (if Efficient, Possible and Appropriate), to Address the CAC and Community's Concerns Regarding COCs (Mn and As) in the Areas Immediately Adjacent to the IRZ

The Community is presently concerned about the possibility that releases of manganese and arsenic, which are known to be generated during the *in situ* reductive treatment of Cr6 to Cr3 at the IRZ Systems Area, are occurring. While PG&E has made numerous presentations to CAC Members describing how the Mn and As generation is localized within the IRZ Area and essentially the 3.1ppb Cr6 plume boundary, the CAC remains unconvinced. The CAC has even gone on record, via the IRP Manager's Comments on the EIR Letter[7], to state that the IRZ Systems should be "shut down" until the groundwater data (both monitoring and domestic wells), and transport issues are better understood.

Presently there appears to be four avenues to the collection of more groundwater data in the area of concern to address the above, namely:

1. Continued quarterly sampling of existing monitoring wells,

2. Installation and sampling from new monitoring wells which could be installed in the area as a result of efforts resulting from work under the Proposed CAO No. R6V-2008-0002-A4

3. Data collected from existing domestic wells from the program associated with the installation of the whole house water treatment

[7] PNL. 2012. *Comments on the Draft Hinkley Groundwater Remediation EIR (dated August 2012). Submitted by the Hinkley Community Advisory Committee (CAC) and the Independent Review Panel (IRP) Manager*. November 5, 2012.

systems, and finally, *of relevance to the Background Study and these Comments*

4. Via any new monitoring wells which could be installed under the Background Study that are close enough to, or within, the so called, Mn and As area of concern on the west side of the IRZ.

It is this last set of monitoring wells which the CAC wishes the Water Board to consider now, not only for defining what background Cr6 concentrations could be, but also for investigating As and Mn impacts close to, but out with the currently defined Cr6 plume.

While the Background Study was originally proposed as a background study focusing exclusively on Cr6, there appears to be enough justification to expand the study to also assess what the background concentrations of manganese and arsenic are in the proximity of the IRZ. In that the IRZ reductive processes liberate manganese and arsenic, and that PG&E is required to manage the amounts they release into groundwater, it is therefore also necessary for remediation compliance purposes, to measure the local background concentrations of arsenic and manganese. This is especially true in the area to the immediate west of the IRZ.

This completes our General and most significant comments.

Detailed Comments now follow and are:

The deficiencies identified by the Water Board Peer Review Team regarding the 2007 Background Study Report were encompassed in the 5 areas listed below[8]:

1. Sampling was performed using wells which were not constructed for discrete sampling in the upper aquifer.

2. The spatial distribution of wells was uneven.

3. The statistical analysis of data was inappropriate.

4. Laboratory analytical methods were inconsistent, and quality control was inadequate.

5. Areas thought to be outside the plume may have been affected by historic pumping for agriculture.

On the recent technical front, PG&E has acknowledged and addressed several of the issues that were presented by the Water Board Peer Review Team regarding

[8] Deficiencies are further discussed in *Stantec Work Plan for Evaluation of Background Chromium in the Groundwater of the Upper Aquifer in the Hinkley Valley, Pacific Gas and Electric Company, Hinkley, CA, February 22, 2012*

the 2007 Background Study. However, the IRP Manager's Technical Team in our recent review has also identified several **Detailed Issues** pertaining to the Proposed Work Plan, and we are therefore respectfully requesting further clarifications and modifications, (as appropriate), to the Plan as follows:

- Quality Assurance/ Quality Control (QA/QC) protocol/guidelines.
- Further detail regarding the sampling and analysis plan (SAP).
- Further detail clarification of the proposed statistical approach.
- Applicability of chromium isotopic analysis and its ability to speciate between anthropogenic and geogenic hexavalent chromium.

Our Detailed Comments now follow:

1. SAP and Quality Controls

1. Provide a section in the main body of the text to describe the Quality Assurance protocol (e.g. Data Quality Objectives (DQO) and processes) for the Study.
2. Provide a section in the main body of the text to describe the sampling and analysis plan (SAP) provided in Appendix B of Stantec's Work Plan.
3. The Sampling and Analysis Plan (SAP) should be developed within the framework of the DQO process.
4. Discuss sample handling, chain-of-custody records (sample containers and preservation, shipment etc.), groundwater sample quality control trip blanks, equipment rinsates, field blanks and field duplicates/splits.
5. Provide a Table summarizing groundwater quality control objectives, e.g. constituent, analytical procedures, laboratory specific measurement quality objectives (MQOs), type of container, preservative and analytical holding times.
6. Provide a Table summarizing field collection quality control requirement e.g. number of trip blanks, field blanks, field duplicate etc.
7. Provide a Table summarizing laboratory quality assurance requirements e.g. testing method, calibration method, calibration/qc sampling frequency and acceptance criteria.
8. Discuss documentation protocol and records keeping.

9. Discuss how corrective actions will be handled during the background study.

10. Provide a decision matrix of the criteria for groundwater monitoring (e.g. what happens if a well cannot be sampled, when sampling will stop for particular wells, when to add additional wells for background study, data gaps, etc).

11. Both Quality Assurance Project Plan (QAPP) and SAP should be discussed in the main body of the text. A detailed description of the QAPP and SAP should be written as standalone Appendices.

12. Provide a section describing data validation protocols.

13. Provide a preliminary Gantt chart (schedule) for all activities that will be conducted during the background study. Identify what are milestone and critical path tasks.

14. Provide an organizational chart of key personnel and subcontractors. Describe key roles of each personnel in the main text.

15. Provide the name of the laboratory (or laboratories) that will be conducting all analyses.

16. Provide general/conceptual engineering drawings of a typical short screen well that will be installed in the upper aquifer.

17. The Background analysis should be based on a well-defined data quality objective (DQO) decision-making framework and data quality assessment (DQA) process. The current Work Plan is not clear on describing how the quality of the data will affect and influence, the computed, background measurements.

18. Related to 17, describe the results of the background analysis, statistical testing and documentation of each step in the DQO process in sufficient detail so as to allow the Work Plan to “stand alone” as an independent document.

19. Discuss the rationale to demonstrate that the database generated during the study will be adequate for background analysis and statistical testing (validated through the DQO and DQA processes).

20. Indicate in the Section describing the Final Report that a list of statistical assumptions that will be provided along with conclusions and recommendations.

21. The Work Plan should clarify if chromium isotope analysis will be conducted for this particular background study? If so, please clarify the lowest Cr6 concentrations for which isotopic analyses can be conducted (e.g. 1 ppb). Describe some of the challenges with lower concentrations in achieving accurate results (e.g. presence of organics and trivalent chromium)? Help the reader gain a better grasp of the science of distinguishing between anthropogenic and geogenic Cr6 using isotopic analysis by adding a Section describing the state of the art. Include information such as: What are the standard $\delta^{53}Cr$ ranges to distinguish between natural and manmade Cr6? Will isotope data be used to evaluate the efficiency of natural attenuation that could be converting Cr6 to Cr3 at lower concentrations in the northern part of Hinkley Valley?

22. Will data collected from the background study only be from the shallow upper aquifer? Please clarify.

23. Are any of the *existing* short-screen monitoring wells to be included in the study? If existing short-screen monitoring wells will be included, please provide the ID number of the wells along with a map showing their locations.

24. Will all samples be assessed for sediment mineralogy and groundwater geochemistry, tracer and chromium isotopes analysis and chromium concentration?

25. Provide detail on how the soil and water from Investigation Derived Wastes (IDW) will be handled during the background study. What are the guidelines that will be utilized for this specific task?

26. Has any thought been given to (and if so, further describe) designing a leaching test on IDW materials to prove definitively for the Community that the natural soils can leach Cr6? See for example similar work performed at other California Cr6 groundwater sites[9].

27. Please discuss the rationale for using the 95 Upper Tolerance Limit (UTL) instead of the 95 Upper Prediction Limit.

[9] Steinpress, M.G., et al, Naturally Occurring Chromium (VI) in Groundwater, in Chromium VI Handbook, Guertin, J., et al, Editors, Chapter 3, pp. 93-141, CRC Press, Boca Raton, FL, 2005.

2.0 Background Information

Provide a Section to summarize the historical Site activities which led to today's Cr6 groundwater impacts.

3.1 Installation of Short Screened Monitoring Wells

The SAP should be discussed in the main body of the text, but should also be a *standalone* section. While the SAP is referenced in Appendix B it would be helpful to briefly discuss the groundwater sampling specific to this background study, instead of referring to a very general SOP. As mentioned in the General comments above, this section should discuss sampling specifics, including the following:

- Samples to be collected
- Quality control samples
- Sampling procedures
- Decontamination procedures, etc.

3.2 Laboratory Analysis of Groundwater Samples

Include a discussion regarding the DQO and DQA protocols in this section as outlined in the General comments. Discuss the Quality Assurance Plan in this section as well.

In this section it states that selected samples may be analyzed for additional parameters. Please elaborate on how these samples are selected.

3.3 Statistical Analysis of Chromium Data

First Paragraph, first line should read "In accordance with standard sampling frequency (USEPA, 2009) a minimum of four…"
The Proposed Work Plan states that four quarterly samples will be collected from each well for the study. However, collecting samples over several years (even at a subset of the initially planned wells), while costly, would provide a better idea of the long term groundwater conditions over the hydrologic cycle and potential weather anomalies (e.g. wet year vs. dry year).

Discuss the type of statistical plots that will be generated during the analysis.

3.3.2 Testing for Normality

Include a statement in the main text stating that one-half the detection limit is the maximum likely estimate of the mean, for a population of measurement values uniformly distributed along the interval (0 to reporting limit).

Define the difference between a parametric (method that relies on a known probability distribution for the population from which the data are reflected) and non-parametric (a distribution free statistical method that does not depend on knowledge of the population distribution) methods.

Prepare a flowchart to summarize the procedures for testing for normality and the Shapiro-Wilk Test.

Will all wells be combined in a single group before testing for normality or, will each well be treated separately to compute the Shapiro-Wilk analysis?

List the possible non-parametric method that might be used if none of the transformation leads to normally distributed data.

3.3.3 Outliers

Discuss in more detail the outlier identification method along with drawbacks of using Dixon's test (e.g. the test can be vulnerable to masking, which is defined as the problem of an extreme outlier being missed because one or more additional extreme outliers are also present) and Rosner's test (swamping blocks of measurements all being labeled as outliers even through only some of the observations are actually outliers). Prepare a flowchart to summarize the procedure to identify outliers using Dixon's or Rosner's Tests.

3.3.5 Evaluation of Multiple Data Populations

Provide further detail in this section regarding which methods are proposed to be utilized in the study.

Statistical comparative methods are used to (a) compare a dataset representing chemical concentrations in potentially impacted groundwater, to (b) a dataset representing background conditions, to determine whether differences between the two datasets are statistically significant. Will PG&E screen site data against background data to evaluate the need for statistical comparative analysis?

Will intrawell comparison methods be used to access whether temporal concentration trends indicate that a particular monitoring well has been impacted by site-related chemicals release. For example, Shewart-

cumulative sum (CUSUM) control chart procedures[10], provide a statistical and visual tool capable of detecting both sudden and gradual changes in groundwater chemistry among samples collected from a single well. This procedure, however, requires a minimum of 8 sampling events, so this very valuable procedure could be computed at Hinkley if 4 additional rounds of sampling were performed together with the initial 4 rounds.

4.1.2 Groundwater Geochemistry

Discuss the Redox (Eh) vs. pH plots and Chromium lifespan cycle in the environment (e.g. see Chromium VI Handbook). Metal dissolution, precipitation and adsorption are strongly related to redox and pH conditions. Eh-pH diagrams are useful to evaluate equilibrium partitioning in the groundwater environment and determine whether the metals will tend to exist in the solid or aqueous phase. Include pH and Eh as parameters to measure during sampling events.

Discuss the relative half lives of hexavalent and trivalent chromium.

5.0 Schedule

Provide a detailed Gantt chart schedule for the background study and associated tasks.

Table 1

Include pH and Eh on the list of parameters to be measured.
Also add Arsenic and Manganese for wells near the IRZ (See General Comment 3, above). Given the recent measurements for Uranium, consideration and discussion should occur regarding the appropriateness of testing for this species at some yet to be defined locations.

Figure 13

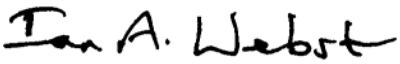
From the IRP Manager's review of the groundwater data supplied by PG&E, the proposed location at grid block J may have elevated concentrations of Cr6, possibly related to PG&E's discharge. So the results of grid block J may not be representative of natural occurring (i.e., background) Cr6. Please discuss why grid block J should be a sampling location candidate.

This concludes our Detailed Comments.

[10] PNL is responsible with the role of the statistical reporting of groundwater data for major Superfund Sites in Los Angeles, and fully employs this method to evaluate issues such as statistical confidence, statistical significant trends, statistical exceedances and constituent forecasting.

Should you have any questions or comments, please feel free to contact either of the undersigned[11].

Very Truly Yours



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