



California Regional Water Quality Control Board

Lahontan Region



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Edmund G. Brown Jr.
Governor

MEMORANDUM

TO: Dr. Gerald Bowes
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

FROM: *for:* 
Lauri Kemper
Assistant Executive Officer

DATE: MAY 19 2011

SUBJECT: REQUEST TO INITIATE SCIENTIFIC PEER REVIEW PROCESS FOR RESULTS OF PACIFIC GAS AND ELECTRIC COMPANY'S CHROMIUM BACKGROUND STUDY REPORT, HINKLEY COMPRESSOR STATION

Lahontan Water Board staff request that you begin the process for selection of scientific peer reviewers for PG&E's *Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, California* (hereafter, 2007 Background Study Report). The purpose of conducting the Background Study was to estimate the concentration of naturally occurring total chromium [Cr(T)] and hexavalent chromium [Cr(VI)] in groundwater near the PG&E natural gas compressor station in Hinkley, California. The data contained in the 2007 Background Study Report are intended to assist the Lahontan Water Board in setting cleanup goals for chromium pollution in groundwater in the Hinkley area. Appropriate peer reviewer disciplines would be aqueous geochemistry, hydrogeology and statistics.

In November 2003, PG&E's 2002 proposed workplan to conduct the Background Study was submitted to three University of California professors for scientific peer review. Through the current Cal/EPA interagency agreement with the University of California, Berkeley Institute of the Environment (BIE), we recognize that it is BIE's responsibility to identify appropriate peer review candidates; however, Water Board staff suggests it would be beneficial to retain those same three professors to review the 2007 Background Study Report, since they have context and background regarding the study with which to review the results. Those reviewers are identified in Attachment 4 of this request.

California Environmental Protection Agency

The document to be reviewed is the 2007 Background Study Report, enclosed with this request. At issue is whether the deviations in carrying out the Background Study from the conditionally approved Background Study Workplan were appropriate or whether the deviations resulted in biased estimates of background chromium levels.

I understand from the Cal/EPA's November 2006 peer review guidance document that, after reviewing this request, you will contact the University of California to arrange for identification of potential peer reviewers. Once reviewers have been identified and approved, communication with them will be the Lahontan Water Board staff's responsibility. I request that the peer review period be 30 days, if possible.

This request includes the following attachments:

Attachment 1: A summary of PG&E's Hinkley Compressor Station chromium contamination history and issues related to the 2007 Background Chromium Study Report.

Attachment 2: Focus for peer reviewers.

Attachment 3: A chronology of the development of the 2007 Background Study Report.

Attachment 4: A list of scientists and engineers involved in studies related to the PG&E Hinkley chromium groundwater cleanup, including 2003 peer reviewers.

Attachment 5: List of documents to be made available to reviewers.

Please contact Anne Holden if you have any questions or need further information. You may reach her at (530) 542-5450 and via email at aholden@waterboards.ca.gov.

cc: Kim Niemeyer, Office of Chief Counsel, SWRCB

Attachments: Attachments 1 through 5

Enclosures: 2007 Background Study Report

ALH/adw/T: PGE Background results peer request (5 18 11 Final).doc
File: PGE WDID 6B369107001

Attachment 1: Summary of PG&E Compressor Station Chromium Contamination and Issues Related to the Background Chromium Study

The PG&E Compressor Station is located in the town of Hinkley in San Bernardino County. The Compressor Station has operated since 1952. From 1952 to 1965, hexavalent chromium-based corrosion inhibitor was added to water used in the cooling towers. The untreated cooling-tower water was discharged to unlined evaporation ponds and percolated to groundwater. The unlined ponds have since been closed, covered, and replaced by lined evaporation ponds. Total chromium [Cr(T)] and hexavalent chromium [Cr(VI)] concentrations exceeding the California drinking water standard of 50 parts per billion (ppb) total chromium have been detected in groundwater beneath and down gradient of the site since 1987. Currently, the plume extends about three miles northward from the Compressor Station.

The contaminated groundwater plume is within the Centro sub-area of the Mojave River Groundwater Basin. The geology of the Hinkley Valley consists of more than 200 feet of sediments overlying granitic and metamorphic bedrock. Two aquifers are identified in the valley fill: the upper unconfined aquifer and the lower confined aquifer. The aquifers are separated by an aquitard composed of fine-grained clay and silts, laid down as a lacustrine deposit. This aquitard pinches out in the northwestern portion of the plume; however, chromium pollution is primarily limited to the upper aquifer. The water table in the upper aquifer is approximately 80 to 90 feet below ground surface. In general, groundwater flows in a north-northwest direction at the site, but is locally affected by pumping from agricultural wells. In the Centro sub-area, groundwater is pumped primarily for agricultural irrigation. Groundwater from wells is also the sole source of water for the public's domestic water supply, but this accounts for only a small percentage of the total amount of water withdrawn in the area.

Groundwater remediation has been ongoing since 1991. Primary components of the current remediation actions are groundwater extraction and land treatment using crop irrigation, where the Cr(VI) is reduced to trivalent chromium [Cr(III)] in the soil zone. In-situ treatment involving injecting ethanol directly into the contaminated groundwater to promote microbial breakdown of Cr(VI) to Cr(III) within the aquifer is employed at the higher-concentration plume core area.

In July 2002, PG&E submitted a study proposal for determining background levels of naturally occurring Cr(T) and Cr(VI) in groundwater in the Hinkley area, entitled *Scope of the Background Chromium Study* (hereafter, the 2002 Background Study Plan). Background chromium concentrations determined from the Background Chromium Study will be considered when the Water Board sets cleanup levels at the site. There is currently no drinking water standard set specifically for Cr(VI), but in December 2010, the Office of Environmental Health Hazard Assessment proposed a draft Public Health Goal for Cr(VI) in drinking water of 0.02 ppb.

The 2002 Background Study Plan proposed collecting groundwater samples from twelve monitoring locations over four quarters in a year. Monitoring locations were current and new monitoring wells situated upgradient and crossgradient to the

Compressor Station and groundwater plume, up to 6,000 feet away. No samples were proposed in the lower aquifer, since data at the time indicated it was not impacted by chromium contamination.

In November 2003, Water Board staff sent the 2002 Background Study Plan to three University of California professors for review. The reviewers agreed that the approach contained in the 2002 Background Study Plan was generally appropriate, but each reviewer had suggestions regarding the plan. As a result of the peer review, the criteria for selecting wells for the study was refined, depth-discrete sampling was added, an assessment of groundwater flow paths was added, and additional statistical methods to address spatial trends was included. The 2002 Background Study Plan was revised in accordance with the reviewers' comments, and re-submitted in September 2004 as the *Revised Background Chromium Study at the PG&E Compressor Station, Hinkley, California* (hereafter, the 2004 Revised Background Study Plan). In November 2004, Water Board staff conditionally approved the 2004 Revised Background Study Plan, including the proposal to sample from fifteen to twenty wells over four consecutive quarters.

PG&E conducted sampling and field work for the Background Study throughout 2006. For the first two quarters, sampling followed the 2004 Revised Background Study Plan. The first and second quarter sampling event consisted of seventeen well locations. Sampling over the last six months deviated from the 2004 Revised Background Study Plan by adding a significant number of wells concentrated in one area, without the specific locations or numbers accepted in advance by Water Board staff. By the Study's end, a total of forty-eight wells in the Hinkley area were sampled. Of these forty-eight wells, thirty-one were added after the first two sampling events, with twenty-three of those wells concentrated in one area.

At issue is whether these deviations from the 2004 Revised Background Study Plan resulted in biased estimates of background chromium values. A map of sampling locations (Figure 4-1 of the 2007 Background Study Report) shows that twenty-three of the additional wells added after the second quarter sampling event appear clustered around well BGS-04, which contained some of the highest concentrations of total and hexavalent chromium during the first two quarters of sampling.

In February 2007, PG&E submitted the *Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, California*, prepared for PG&E by CH2MHill, dated February 28, 2007 (hereafter, the 2007 Background Study Report). The 2007 Background Study Report presented the sampling data and the results of statistical analysis of the data. The final calculated mean background values are 1.52 ppb for Cr(T) and 1.19 ppb for Cr(VI), and the maximum background threshold values based on the 95th percent upper tolerance limits are 3.23 ppb for Cr(T) and 3.09 ppb for Cr(VI).

In November 2008 at a public hearing, the Lahontan Water Board adopted amended Cleanup Order No. R6V-2008-0002A1, establishing the following background chromium concentrations for the Hinkley area as found in the 2007 Background Study Report:

- Maximum background Cr(VI) = 3.1 ppb
- Maximum background Cr(T) = 3.2 ppb

- Average background Cr(VI) = 1.2 ppb
- Average background Cr(T) = 1.5 ppb

In 2011, concerns were raised that the results of the Background Study were questionable for two reasons:

1) The chromium plume had expanded beyond the previously delineated boundaries, prompting concerns that the background study had incorporated wells that did not, at the time, represent natural background chromium, but rather were affected by waste chromium discharges. In addition, in early 2011, a consultant hired by Erin Brockovich sampled approximately 180 domestic wells in the Hinkley Valley for chromium. He discussed the results of his sampling during a March 2011 Water Board public meeting, and stated that chromium concentrations above the adopted background values were detected in numerous wells in areas outside the defined plume boundaries. He asserted that this indicates that the chromium plume in groundwater is more widespread than currently depicted.

2) The addition of wells into the Background Study after sampling for the Study began were clustered around an area where initial background sampling showed the highest results, prompting questions on the integrity of the background study sampling regime.

In response to public concerns, the Lahontan Water Board has requested this peer review of the 2007 Background Study Report.

Attachment 2: Focus for Peer Reviewers

Consistent with Health and Safety Code section 57004, the reviewer's responsibility is to determine whether the scientific portion of the 2007 Background Study Report is based upon sound scientific knowledge, methods, and practices. Although the 2007 Background Study Report is not a proposed rule, the quality of the product should be measured with respect to the same exacting standards as if it were subject to Health and Safety Code section 57004.

We request that you make this determination for each of the following. An explanatory statement is provided for each topic.

1. Quality of spatial sampling of background chromium

The first two Background Study sampling events consisted of seventeen well locations. Of the forty-eight well locations ultimately included in the background study, thirty-one wells were added after two sampling events had already occurred. Twenty-three of these wells were added in the vicinity of a sampled well that showed some of the highest total chromium levels in the first two sampling events, well BGS-04. The area where the twenty-three wells were added encompassed less than one square mile, while the entire study area is more than twenty-one square miles. See the 2007 Background Study Report, page 1-4, Table 3-1 on page 3-2, and Figure 4-1 on page 4-2.

2. Quality of temporal sampling of background chromium

The 2007 Background Study Report acknowledges that the expansion of the well network after the second sampling event has the potential to introduce bias into the overall summary statistics due to the temporally unbalanced nature of the data set (i.e., four quarters of data are not available for all wells). To address this bias, the arithmetic average value of Cr(VI) and Cr(T) concentrations from each well were used in the statistical analysis. Therefore, each well is represented by one arithmetic mean result instead of by the actual number of samples taken at that well. See the 2007 Background Study Report, pages 5-5 through 5-7, and page 7-1.

3. Assumption of statistical normality

Much of the statistical analysis done for the 2007 Background Study Report relies on the assumption that the data collected for the Background Study are normally distributed. Within the dataset, 25 percent and 15 percent of the samples were non-detect for Cr(T) and Cr(VI), respectively. Non-detect values of chromium were assigned a proxy value of one-half the detection limit for statistical testing. The assumption of normality was rejected for the entire dataset largely due to repeated proxy values. Instead, the Shapiro-Wilk normality test was applied to a subset of the data (only the detected chromium values in the dataset). P-values for the Shapiro-Wilk

test on this data subset were both higher than 0.05, suggesting that the data subset (all detections of chromium, leaving out the non-detect values) are normally distributed. See the 2007 Background Study Report, page 5-7, Table 6-1 on page 6-2, and Appendix I, pages I-1 through I-3.

4. Quality of groundwater modeling

Groundwater monitoring data for October 2007 show that total and hexavalent chromium concentrations increased above the drinking water standard of 50 ppb total chromium in monitoring wells MW-38A and MW-45A. See PG&E's *Groundwater Monitoring Report, October 2007 Sampling Event*, Table 1, pages 15 and 16 of the Tables Section, and Figure 3. The information suggests that the plume core, consisting of concentrations of 50 ppb or greater, migrated approximately 300 feet to the west along at least a one-half mile length of the northwestern plume boundary. PG&E's July 30, 2010 *Second Quarter 2010 Groundwater Monitoring Report* contains data indicating that hexavalent and total chromium concentrations exceeded background concentrations at three residential supply wells and four shallow monitoring wells in the north and east of the formerly defined plume boundaries.

The migration of the plume since 2007 raises the issue of whether the groundwater models contained in Appendix B of the Background Study Report, and Appendix B of the 2004 Revised Background Study Plan provide reasonable assurance that the background study wells are representative of naturally occurring chromium, given the data showing plume expansion.

The Big Picture

Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following questions:

(a) In reading the 2007 Background Study Report, are there any additional scientific issues that not described above?

(b) Taken as a whole, is the scientific portion of the 2007 Background Study Report based upon sound scientific knowledge, methods and practices?

Attachment 3: Chronology of Development of the Background Study Report

Items in **bold font** will be made available to peer reviewers, and are also listed in Attachment 5.

- 1) July 2002: PG&E submits a proposal entitled *Scope of the Background Chromium Study at the PG&E Compressor Station, Hinkley, California* (the 2002 Background Study Plan). The purpose of the 2002 Background Study Plan is to estimate the range of concentrations of naturally occurring total and hexavalent chromium in the groundwater near PG&E's Hinkley Compressor Station to determine background conditions as a cleanup goal for groundwater remediation.
- 2) November 2003: Water Board staff submits the 2002 Background Study Plan for scientific peer review to three University of California professors.
- 3) February 2004: **Results of peer review** are transmitted to Water Board staff.
- 4) April 2004: Water Board staff requests that PG&E submit a revised Background Study Plan, and provides direction on addressing peer review recommendations.
- 5) September 2004: PG&E submits the **Revised Background Chromium Study Work Plan (the 2004 Revised Background Study Plan)**.
- 6) November 2004: **Lahontan Water Board staff conditionally accepts the 2004 Revised Background Study Plan**, and notes that it adequately responds to Board staff's comments, including recommendations by peer reviewers.
- 7) Calendar Year 2006: PG&E conducts groundwater sampling for the Background Study to determine background chromium concentrations in the Hinkley Valley.
- 8) February 2007: PG&E submits the **Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, California (the 2007 Background Study Report)**.
- 9) October 2007: **PG&E's quarterly groundwater monitoring report** contains data indicating plume migration occurring along the northwest boundary.
- 10) August 2008: Water Board staff prepare a **summary report on the 2007 Background Study Report** for an upcoming Water Board hearing to adopt background chromium concentrations to set a cleanup goal for groundwater remediation.
- 11) November 2008: The Water Board holds a public hearing to consider the 2007 Background Study Report. The Water Board adopts maximum and average background chromium concentrations for hexavalent chromium and total chromium in groundwater in the Hinkley Valley, as recommended by Water Board staff based on the results of the 2007 Background Study Report.
- 12) August 2009: The State of California's Office of Environmental Health Hazard Assessment (OEHHA) releases a draft Public Health Goal for hexavalent chromium in drinking water of 0.06 ppb.

- 13) July 2010: **PG&E's July 30, 2010 Second Quarter 2010 Groundwater Monitoring Report** contains data indicating that hexavalent and total chromium concentrations exceeded background concentrations at three residential supply wells and four shallow monitoring wells in the north and east of the formerly defined plume boundaries.
- 14) September 1, 2010: PG&E submits a Feasibility Study to evaluate comprehensive cleanup options for chromium in groundwater due to historic waste discharges at the Hinkley Compressor station. The Feasibility Study recommends the maximum background chromium concentrations as a cleanup level.
- 15) November 2010: Water Board staff circulates a Notice of Preparation of an Environmental Impact Report (EIR) pursuant to the California Environmental Quality Act (CEQA). The EIR will evaluate the impacts of implementing a comprehensive cleanup strategy for PG&E's chromium groundwater pollution in Hinkley.
- 16) December 1, 2010: Water Board staff holds a public CEQA scoping meeting in Hinkley. Public comments indicate lack of support for the background chromium values in the 2007 Background Study Report.
- 17) December 2010: OEHHA releases a revised draft Public Health Goal for hexavalent chromium of 0.02 ppb.
- 18) March 9, 2011: Lahontan Water Board holds a public meeting to discuss the groundwater cleanup, and hear Hinkley resident's concerns related to background study. Erin Brockovich's consultant addressed the Board to discuss the results from sampling approximately 180 domestic wells in early 2011. He asserts that hexavalent chromium contamination exists in areas outside the defined plume, at concentrations up to 5 ppb. Several Hinkley area residents also expressed written and verbal concerns regarding the 2007 Background Study Report. At the meeting, Lahontan Water Board members request that the results of the Background Study be peer reviewed to address concerns.
- 19) April 1, 2011: A **PG&E staff letter to Lahontan Water Board members** contains information and a map showing historical chromium concentrations outside 2008 plume boundary.

Attachment 4: Scientists and Engineers Involved in Studies Related to the PG&E Hinkley Chromium Groundwater Cleanup

University of California 2003 peer reviewers

Thomas C. Harmon, UC Merced

James R. Hunt, UC Berkeley

Timothy R. Ginn, UC Davis

PG&E

Kevin Sullivan, PE

Robert Doss, PE

Eric Johnson

CH2MHill

Dennis Maslonkowski, PG

Tess Byler, PG

Stantec

Chris R. Maxwell, PG

Haley and Aldrich, Inc

Thomas J. Holden, PE

Beth Breitenbach, PG

Scott Zachery

Lahontan Water Board staff

Lauri Kemper, PE

Chuck Curtis, PE

Lisa Dernbach, PG

Anne Holden, PG

Attachment 5: List Of Documents To Be Provided to Reviewers

Document To Be Reviewed:

- 1) Groundwater Background Study Report, Hinkley Compressor Station, Hinkley, California. Prepared for PG&E by CH2MHill. February 2007.

Additional Materials That Will Be Made Available To Reviewers:

Water Board staff is not requesting peer review of these documents, but they will be available to provide context and background for the peer reviewers.

- 1) Comments from three University of California peer reviewers on PG&E's 2002 Groundwater Chromium Background Study Plan. February 2004.
- 2) Revised Background Chromium Study Plan, prepared for PG&E by CH2MHill, September 2004. Revised study plan reflects peer reviewer's and Lahontan Water Board staff comments.
 - a. Appendix B contains the numerical groundwater flow model water balance, 2004 calibration, and evaluation of historical pumping
- 3) Conditional approval letter from Lahontan Water Board staff for PG&E's 2004 Revised Background Study Plan. November 16, 2004.
- 4) Groundwater Monitoring Report, October 2007 Sampling Event. Site-wide Groundwater Monitoring Program, PG&E Hinkley Compressor Station, Hinkley, California. Prepared for California Regional Water Quality Control Board, Lahontan Region on behalf of PG&E by CH2MHill. December 20, 2007.
- 5) Lahontan Water Board Staff Report: Background Chromium Study, Pacific Gas and Electric Company Compressor Station, 35863 Fairview Road, Hinkley. California Regional Water Quality Control Board, Lahontan Region. August 2008.
- 6) Second Quarter 2010 Groundwater Monitoring Report. Site-Wide Groundwater Monitoring Program, PG&E Hinkley Compressor Station, Hinkley, California. Prepared for California Regional Water Quality Control Board, Lahontan Region on behalf of PG&E by CH2MHill. July 30, 2010.
- 7) Letter dated April 1, 2011, from PG&E to the Lahontan Water Board, with map showing historical chromium concentrations outside 2008 plume boundary.

Additional information, including maps of the chromium plume in groundwater since August 2006, is available at the Lahontan Water Board's webpage at http://www.waterboards.ca.gov/lahontan/water_issues/projects/pge/index.shtml.