

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION**

**MEETING OF JUNE 8, 2011  
Barstow**

**ITEM: 1**

**SUBJECT: FACILITATED STUDY SESSION: UPDATE ON ACTIONS BY  
PACIFIC GAS AND ELECTRIC COMPANY TO REMEDIATE  
GROUNDWATER CONTAMINATION AND ADDRESS THE  
EFFECTS ON BENEFICIAL USES DUE TO A HISTORIC  
RELEASE OF HEXAVALENT CHROMIUM FROM ITS HINKLEY  
COMPRESSOR STATION, SAN BERNARDINO COUNTY**

**CHRONOLOGY: Date Water Boards Actions**

1987	CAO 6-87-160 required PG&E to complete site investigation, reporting and remedial action plan.
1994	CAO 6-87-160A1 required reporting of site conditions and current cleanup actions and required remedial action plan phase II.
1998	CAO 6-87-160A2 set cleanup level at 10 ppb Cr(T) and prescribed monitoring and reporting program.
2001	CAO 6-01-50 required abatement of nuisance conditions of air-born chromium and reporting.
2008	CAO R6V-2008-0002 set a deadline for plume containment, required in-situ remedial actions, and set monitoring and reporting program. It also required preparation of a Feasibility Study by September, 2010 to evaluate alternatives to complete groundwater cleanup to background levels.
2008	CAO R6V-2008-0002A1 set chromium background values.
2009	CAO R6V-2008-000A2 allowed minor plume boundary expansion for corrective actions.
2011	CAO R6V-2011-0005 required PG&E to provide alternate water supply for affected domestic wells and conduct domestic well sampling and reporting.

- ISSUES:**
1. Plume boundary identification
  2. Plume containment
  3. Groundwater remediation
  4. Replacement water for domestic use
  5. Feasibility Study and Alternatives for Groundwater Remediation (Subsequent Environmental Impact Report)

**DISCUSSION: BACKGROUND**

The Water Board has been requiring investigation and cleanup actions for hexavalent chromium in groundwater at PG&E's Hinkley compressor station since 1987. Various interim groundwater cleanup methods have been employed at the site, including extraction and land treatment and in-situ (below ground) treatment. Early 2011 monitoring activities included sampling 154 monitoring and extraction wells.

At the March 2011 Water Board meeting, staff described the status of containment and remedial activities by PG&E. The discussion also included staff's progress towards preparing a draft subsequent environmental impact report evaluating cleanup alternatives including, as a minimum, the alternatives proposed in PG&E's 2010 Feasibility Study. The Water Board provided direction to staff on the following topics: (1) peer review of the Background Chromium Study, (2) technical review of the 2010 Feasibility Study, (3) administrative civil liability complaint, and (4) whole-house replacement water for affected domestic wells. These items were discussed in a staff memorandum, dated April 13, 2011 (Enclosure 1) and staff is pursuing completion of actions on all four topics and will provide a quick update at the June Water Board Meeting.

**PG&E'S DISCUSSION**

PG&E requested an opportunity to address some of the comments, concerns and issues described at the March 9, 2011 Water Board Meeting (Enclosure 2). PG&E plans to provide information on the development and content of the 2010 Feasibility Study. PG&E also plans to summarize remedial actions and plume dynamics over the past few years. PG&E will describe efforts to comply with directives in Water Board cleanup and abatement orders and investigative orders (Enclosure 3 – Summary of Required Actions). Finally, PG&E plans to discuss actions to address actual and potential effects to domestic water supplies in Hinkley, including the Hinkley School.

## **WATER BOARD STAFF'S DISCUSSION**

Water Board staff has pursued action on the Water Board's direction from the March 2011 Water Board Meeting (Enclosure 1).

1. Peer Review of Background Chromium - Water Board staff has completed a peer review request and the State Water Board staff has submitted this request to the University of California contractor who will now seek independent peer reviewers. Results are expected in two to three months.
2. Technical Review of Feasibility Study - Department of Toxic Substances Control has provided its review (Enclosure 4). The key points of DTSC's review are that PG&E should provide additional information on:
  - Site investigation activities conducted to date,
  - The current status and disposition of all source areas,
  - Criteria for remedy selection should discuss long and short term beneficial use, impacts (including impacts on domestic water supply), and timeframe for uses to be revitalized or as a parameter of the remedy selection.
  - Additional presentation of calculations and assumptions made during the remedy alternative evaluation and conceptual design,
  - More in-depth discussion to demonstrate through site studies how capture zones will be maintained year round,
  - Define sectional or operable units to be treated as separate sites throughout the remediation process, and
  - A solid contingency plan (in case of problems with disposal of extracted water through irrigation).

US EPA has also agreed to conduct a review and its review is anticipated by the June 8 Water Board meeting. Following receipt of US EPA's review, Water Board staff will determine what information is needed from PG&E to revise cleanup alternatives in the draft EIR.

3. Consideration of an Administrative Civil Liability - Water Board staff is working with the Office of Enforcement to evaluate violations and the factors in the Water Code and the statewide Enforcement Policy. An update will be provided at the June Water Board Meeting.

4. Whole Household Replacement Water - Water Board staff has worked with the State Water Board's Office of Enforcement to evaluate this authority and precedent set by other Water Boards for requiring whole house water supply. An update on this matter will be presented at the workshop.

**TIMELINE**

An attached timeline (Enclosure 5) provides an updated schedule of expected Water Board staff activities relating to the site through early 2012.

**RECOMMENDATION:**

The Water Board may provide direction to staff as appropriate.

**ENCLOSURES:**

<b>ENCLOSURE</b>	<b>Item</b>	<b>Bates Number</b>
1	April 13, 2011 Memorandum from Lauri Kemper to Water Board members	<b>01-0005</b>
2	April 1, 2011 Letter from PG&E to Water Board members	<b>01-0009</b>
3	Summary of Water Board Required Actions (with five attachments)	<b>01-00034</b>
	Attachment 1: PG&E Plume Invest comments	<b>01-00036</b>
	Attachment 2: PG&E Clean up & Abatement Order R6V-2008-0002	<b>01-00038</b>
	Attachment 3: PG&E Clean up and Abatement Order R6V-2011-0005	<b>01-00048</b>
	Attachment 4: PG&E Feasibility Study Comments	<b>01-00055</b>
	Attachment 5: Remedial Alternative Summary – Active Remediation Components and Durations	<b>01-00061</b>
4	DTSC Technical Review of Feasibility Study	<b>01-00062</b>
5	Timeline of 2011 Board Staff Activities for PG&E Hinkley	<b>01-00073</b>
6	USEPA Technical Review of Feasibility Study (to be sent under separate cover and anticipated prior to June 8, 2011)	<b>01-00074</b>



**California Regional Water Quality Control Board**  
**Lahontan Region**



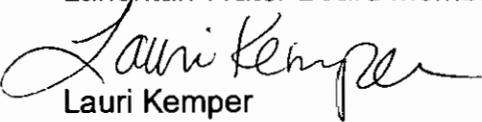
Linda S. Adams  
Acting Secretary for  
Environmental Protection

2501 Lake Tahoe Boulevard, South Lake Tahoe, California 96150  
(530) 542-5400 • Fax (530) 544-2271  
www.waterboards.ca.gov/lahontan

Edmund G. Brown Jr.  
Governor

**MEMORANDUM**

**TO:** Lahontan Water Board Members

**FROM:**   
Lauri Kemper  
Assistant Executive Officer  
California Regional Water Quality Control Board, Lahontan Region

**DATE:** April 13, 2011

**SUBJECT: WATER BOARD STAFF ACTIVITIES RELATED TO PACIFIC GAS AND ELECTRIC COMPANY'S CHROMIUM GROUNDWATER CLEANUP, HINKLEY COMPRESSOR STATION**

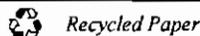
**INTRODUCTION**

This memo provides the status of actions Water Board staff have taken in response to direction provided by the Water Board at its March 9, 2011 meeting held in Barstow. It also provides a proposed schedule for future agenda items on the PG&E Hinkley cleanup project for the Water Board's consideration.

Two informational agenda items describing the status of PG&E's chromium cleanup efforts in Hinkley were presented at the March 9 Water Board meeting. Item 11 addressed the development of the subsequent Environmental Impact Report (EIR) for the final groundwater cleanup strategy, and Item 12 provided a status report on PG&E's plume containment and remediation activities. Water Board members provided direction to staff following public comment on both items. Specifically, staff was directed to:

- 1) Obtain academic peer review of PG&E's 2007 Background Chromium Study Report.
- 2) Obtain technical review of PG&E's 2010 Feasibility Study.
- 3) Consider an Administrative Civil Liability complaint against PG&E for violating the plume containment requirement in Cleanup and Abatement Order (CAO) R6V-2008-0002.
- 4) Evaluate whether to require PG&E to supply whole-house replacement water in addition to bottled drinking water.

*California Environmental Protection Agency*



01-0005

## **STATUS OF ACTIONS**

### **1. Peer Review of PG&E's 2007 Background Study**

Water Board staff has submitted a formal request to the State Water Board in April 2011 to initiate the selection of appropriate reviewers through Cal/EPA's scientific peer review program. The request highlighted the concerns expressed by the public, specifically deviation from the approved workplan and results of recent groundwater sampling. Water Board staff has requested that Mr. Bowcock submit the results of private well testing so that Water Board staff can send this information to the peer reviewers along with any information regarding introduction of water into private wells.

The request, selection, and peer review process can be completed in as little as three months, in the best case. However, according to the scientific peer review program manager, budgetary constraints may extend the process up to six months or longer, depending on the adoption of the 2011/12 fiscal year budget. Water Board staff will provide an update on the status and timeline for peer review of the 2007 Background Study at the June 2011 Water Board meeting.

### **2. Technical Review of PG&E's 2010 Feasibility Study**

The California Department of Toxic Substances Control (DTSC) has agreed, and the United States Environmental Protection Agency (US EPA) is considering a request, to provide technical reviews of the Feasibility Study, including evaluating whether the alternatives proposed represent the best available technology for remediating chromium in groundwater. DTSC staff's review is anticipated by late April 2011. Water Board staff will provide an update on the results of the technical review of the 2010 Feasibility Study at the June 2011 Water Board meeting, including any proposed revisions to the alternatives in the subsequent EIR based on the reviews.

For your information, I have enclosed a compact disc with the Feasibility Study and its addendums with this memo and a text only version can be found on the Water Board's website.

### **3. Administrative Civil Liability (ACL) Complaint against PG&E for its Alleged Lack of Plume Containment**

CAO R6V-2008-0002 requires that PG&E must achieve containment of the chromium plume by December 31, 2008. Plume containment is defined as "no further migration or expansion of the chromium plume to locations where hexavalent chromium is below the background level, or no further migration or expansion of the 50 parts per billion total chromium plume." Plume boundaries from which to evaluate plume migration were specified in Finding 16 of the CAO as those proposed by PG&E in their Boundary Control Monitoring Program, dated July 2, 2008.

In a letter to Water Board members dated April 1, 2011 (now posted on the Lahontan Water Board's website at [http://www.waterboards.ca.gov/lahontan/water\\_issues/projects/pge/index.shtml](http://www.waterboards.ca.gov/lahontan/water_issues/projects/pge/index.shtml)), PG&E requested that the Water Board reconsider its direction to staff to pursue an ACL complaint for violations of CAO R6V-2008-0002. PG&E puts forth several reasons to support their contention that they are not in violation of the plume containment requirement of the CAO. The letter raises issues that are more appropriately addressed as part of a formal adjudicatory hearing. Therefore, staff is continuing to work with the State Water Board's Office of Enforcement to develop an ACL complaint.

#### **4. Require PG&E to Provide Whole-House Water Supply to Certain Hinkley residents**

Currently, CAO R6V-2011-0005 requires PG&E to provide an alternate water supply to Hinkley residents with levels of hexavalent or total chromium in their domestic wells above the maximum background levels. PG&E is providing bottled water to those affected households to comply with this requirement. At the March 9 meeting, Hinkley residents expressed dissatisfaction with bottled water, as it does not provide for other indoor domestic uses, such as washing and bathing. Residents requested that where data indicate increasing chromium concentrations in the domestic wells, even though the chromium levels may be below the maximum background levels, they should receive an alternate water supply that fulfills all indoor domestic water use needs. Whole-house water supply means at a volume sufficient to meet all indoor domestic water needs, including drinking, cooking, bathing, appliances, and laundry.

Water Board staff are working with the State Water Board's Office of Enforcement to evaluate the legal issues surrounding Water Board authority and the establishment of the appropriate chromium concentrations as a trigger to requiring whole-house supply. Water Board staff will provide an update on this matter at the June 2011 Water Board meeting.

#### **PROPOSED SCHEDULE FOR FUTURE PG&E AGENDA ITEMS**

- **June 8, 2011 Water Board Meeting in Barstow:**

Staff plans to bring an update on their progress on the four directives discussed in this memo. Related to the review of the Feasibility Study, staff will review the technical input from DTSC and possibly US EPA, and propose any revisions to the alternatives analyzed in the subsequent EIR for the chromium cleanup strategy in a separate agenda item. PG&E has also requested, either a separate agenda item or as part of the staff agenda item, to present its Feasibility Study, response to the technical review results, and an update on current plume containment and remediation efforts. The Water Board Executive Officer will decide the best approach to scheduling agenda items for the June Board meeting.

- **September 2011 Water Board Meeting in Victorville:**

Water Board staff will hold a workshop on the draft subsequent EIR. I anticipate the release of public review draft subsequent EIR for review and comment just prior to the September Board meeting.

Should you have any questions, please contact me at (530) 542-5436 or the following Water Board staff:

- Lisa Dernbach at (530) 542-5424 for technical, regulatory and enforcement issues.
- Anne Holden at (530) 542-5450 for Environmental Impact Report questions.

Enclosure: Compact Disc of Feasibility Study and two Addendums (Water Board members only)

cc: PG&E Mailing and Lyris List  
State Water Board Office of Enforcement

LSD/clhT: PGE Hinkley Update to Bd Members (4-11-2011).doc



**Pacific Gas and  
Electric  
Company**

**David A. Gilbert**  
Director  
Remediation Program Office  
Shared Services

375 N. Wiget Lane, Suite 170  
Walnut Creek, CA 94598

925.974.4278  
Internal: 583.4278  
Fax: 925.974.4220  
E-Mail: DAG6@pge.com

April 1, 2011

Jack Clark  
Regional Water Quality Control Board  
2501 Lake Tahoe Blvd.  
South Lake Tahoe, CA 96150-7704

Re: March 9, 2011 Hinkley – Lahontan Regional Water Quality Control Board Meeting  
Response Letter

Dear Chairman Clarke,

On March 9, 2011, the Lahontan Regional Water Quality Control Board (“Water Board”) conducted a public workshop and a status report pertaining to PG&E’s remediation activities in Hinkley, California. Water Board staff and consultants presented materials to the Water Board for approximately two hours and the public provided additional comment for over two hours. Because PG&E was asked to keep its remarks to approximately five minutes, PG&E is concerned that the Water Board did not receive the information that it needs as it makes decisions pertaining to PG&E’s Hinkley Remediation Project. The attached letter provides important information on the key issues that arose at the March 9 meeting, including:

Issue #1: PG&E has not violated the 2008 Cleanup and Abatement Order (“CAO”) requiring plume containment and respectfully requests that the Water Board reconsider its direction to staff to pursue an administrative civil liability claim. The 2008 CAO did not consider pre-2008 domestic and agricultural well data demonstrating that the plume was already on the Gorman property and in the Summerset Road area prior to 2008.

Issue #2: PG&E will address its concern regarding the Water Board’s lack of legal authority to require replacement water to residents whose wells meet the state drinking water standard with the Water Board’s counsel. Nevertheless, PG&E is voluntarily providing bottled drinking water to all interested residences within one-half mile of the plume, as well as to the Hinkley School and Senior Center. In addition, PG&E is actively seeking to purchase the ten properties with chromium levels above background.



Issue #3: Agricultural land treatment is an effective, cutting-edge method of plume containment, even though it does not operate at high levels during the winter months. The strong levels of pumping during three quarters of the year more than make up for the reduced pumping during the winter months.

Issue #4: The proper final clean-up level for the Hinkley plume is the maximum natural background value of 3.1 ppb Cr6 and 3.2 ppb CrT. Requiring a clean up to average background levels is infeasible, not supported by California law, and would be unprecedented.

Issue #5: PG&E welcomes a further peer review of the chromium background study. It is well established that natural background levels of Cr6 in groundwater are common in the Mojave Desert and in most areas throughout the world.

Issue #6: PG&E also welcomes a peer review of PG&E's Feasibility Study ("FS") regarding final remedial options in Hinkley. However, PG&E believes the Water Board should be aware that 36 remedial technologies were evaluated as part of the FS in the process of selecting PG&E's preferred remedial option, including technologies raised during the March 9 meeting.

Issue #7: Properly constructed monitoring wells should be used for collection of ground water data and plume map creation rather than data from domestic or agricultural wells.

Issue #8: Prior and ongoing sampling at the Hinkley School demonstrates that the Hinkley School wells have not been affected by the PG&E plume. Nevertheless, to alleviate public concerns, PG&E is now providing bottled water to the school, as a public service.

Issue #9: There is no indication that there is an ongoing source of chromium in the shallow soil near the compressor station. This finding is based on the highest chromium concentrations in monitoring wells being found near the compressor station only in deep wells while lower concentrations found in shallow wells.

Issue #10: There is no basis for Mr. Bowcock's assertion that contaminated water was injected into domestic wells in Hinkley.

Issue #11: No cross-screened wells remain in the area of lower aquifer impacts. The closest remaining cross-screened well will be destroyed by summer 2011.

The attached letter also requests an opportunity to provide the Water Board with a presentation at the June 2011 Board meeting. PG&E would like to discuss the subjects outlined in the attached letter, to fully describe the Feasibility Study, including the 36 technologies that were evaluated, and to provide the Board with other important information regarding the issues raised at the March 9 meeting.



Thank you for taking the time to review the enclosed letter and we look forward to the opportunity to further discuss these issues at the June meeting.

Very truly yours,

A handwritten signature in cursive script that reads "David A. Gilbert". The signature is written in black ink and is positioned above the printed name.

David A. Gilbert  
Director, Remediation

cc: Don Jardine, Vice Chair  
Mike Dispenza  
Keith Dyas  
Amy Horne, Ph.D  
Peter C. Pumphrey  
Eric Sandel  
Harold Singer  
Laurie Kemper  
Lisa Dernbach



**Pacific Gas and  
Electric  
Company**

---

**David A. Gilbert**  
Director  
Remediation Program Office  
Shared Services

375 N. Wiget Lane, Suite 170  
Walnut Creek, CA 94598

925.974.4278  
Internal: 583.4278  
Fax: 925.974.4220  
E-Mail: DAG6@pge.com

April 1, 2011

Jack Clark  
Regional Water Quality Control Board  
2501 Lake Tahoe Blvd.  
South Lake Tahoe, CA 96150-7704

Re: Response to Issues Raised at March 9, 2011 Public Workshop

Dear Mr. Clarke:

The purpose of this letter is two-fold. First, PG&E formally requests the opportunity to provide a presentation to the Water Board during its June meeting in Barstow, California. Our presentation will focus on PG&E's on-going investigation and remediation efforts, including the alternatives considered and the final remedy proposed in PG&E's Feasibility Study. Our presentation will also respond to the key issues raised by the public and Water Board staff at the March 9, 2011 meeting.

Second, this letter responds to the potential for the Regional Board to issue administrative civil liability (ACL) for violations of the 2008 Cleanup and Abatement Order (CAO). We respectfully request that Water Board staff defer the preparation of an ACL complaint until after our presentation at the June 2011 meeting. As discussed below, the plume was larger in 2008 than the boundaries that defined the plume in the 2008 CAO. There is no data to support that the footprint of the plume has been meaningfully expanding and, therefore, there is no basis for administrative civil liability.

The March 9, 2011 meeting was a public workshop and status report and, therefore, no formal action or decision was made by the Water Board. Nevertheless, the Water Board did provide several specific directions to Water Board staff based on claims made during the meeting. Many of these directives were significant steps on which PG&E requests the opportunity to provide input. PG&E believes that the Water Board direction would have been very different if the Water Board had the benefit of more complete information on many of the subjects raised at the meeting.

This letter provides important information pertaining to some of the key issues raised at the meeting. In addition, as stated above, PG&E requests that the Water Board allow PG&E to



make a formal presentation on these issues to the Water Board at the Board's next southern area meeting in June 2011. PG&E further requests that the Water Board direct staff to avoid taking steps that prejudice PG&E until PG&E has an opportunity to make a full presentation to the Water Board.

**Issue #1: PG&E has not violated the 2008 Cleanup and Abatement Order ("CAO") requiring plume containment and respectfully requests that the Water Board reconsider its direction to staff to pursue an administrative civil liability claim.**

The 2008 CAO required PG&E to achieve containment of the plume by December 31, 2008. The key provision in the 2008 CAO defined "containment" as "no further migration or expansion of the chromium plume to locations where hexavalent chromium is below the background level." Unfortunately, the 2008 plume depiction was based only on monitoring well data and, therefore, did not completely depict all locations where hexavalent chromium was already above background levels in 2008.

#### **Data Excluded From the 2008 CAO Plume Boundary**

The 2008 CAO was based on the direction of Board staff that monitoring-well data alone should be used to define the plume in all areas, and that this data would accurately define the area containing hexavalent chromium above natural background levels (i.e., the plume). However, that direction lacked the benefit of previously collected data from agricultural wells on the Gorman property as well as domestic wells in the Summerset Road area that established the presence of chromium at concentrations above natural background levels. Moreover, at Water Board staff direction, the 2008 plume boundary level was drawn at 4 parts per billion (ppb) hexavalent chromium (Cr6). Water Board staff later directed PG&E to draw the plume boundary at 3.1 ppb Cr6 and ultimately at the combined 3.1 ppb Cr6 and 3.2 ppb CrT line. Each change to a lower plume boundary concentration made the data above that concentration outside the plume more significant.

Prior to 2008, there was evidence of chromium-affected groundwater outside the 2008 plume boundary, particularly to the north (Gorman property) and northeast (Summerset Road area). These data were all reported to Water Board staff at the time the data were collected. The attached Figure 1 illustrates these conditions, which are summarized as follows:

**Gorman Irrigation Wells-** The data for the former Gorman irrigation wells G1 (23-10), G2 (23-02), G3 (23-11), G4 (23-09) and G5 (23-15) clearly indicate the presence of chromium at concentrations above background levels on the Gorman property dating as far back as 2002. These data indicate that the plume boundary did not expand to the Gorman property after 2008.

**Summerset Road Area Wells** –Several long screen domestic wells along Summerset Road were sampled in 2006 and showed chromium concentrations exceeding background conditions (wells



25-07, 26-49, and 26-50). These data clearly demonstrate the presence of chromium at concentrations above natural background levels extending east beyond the limits of the 2008 plume boundary.

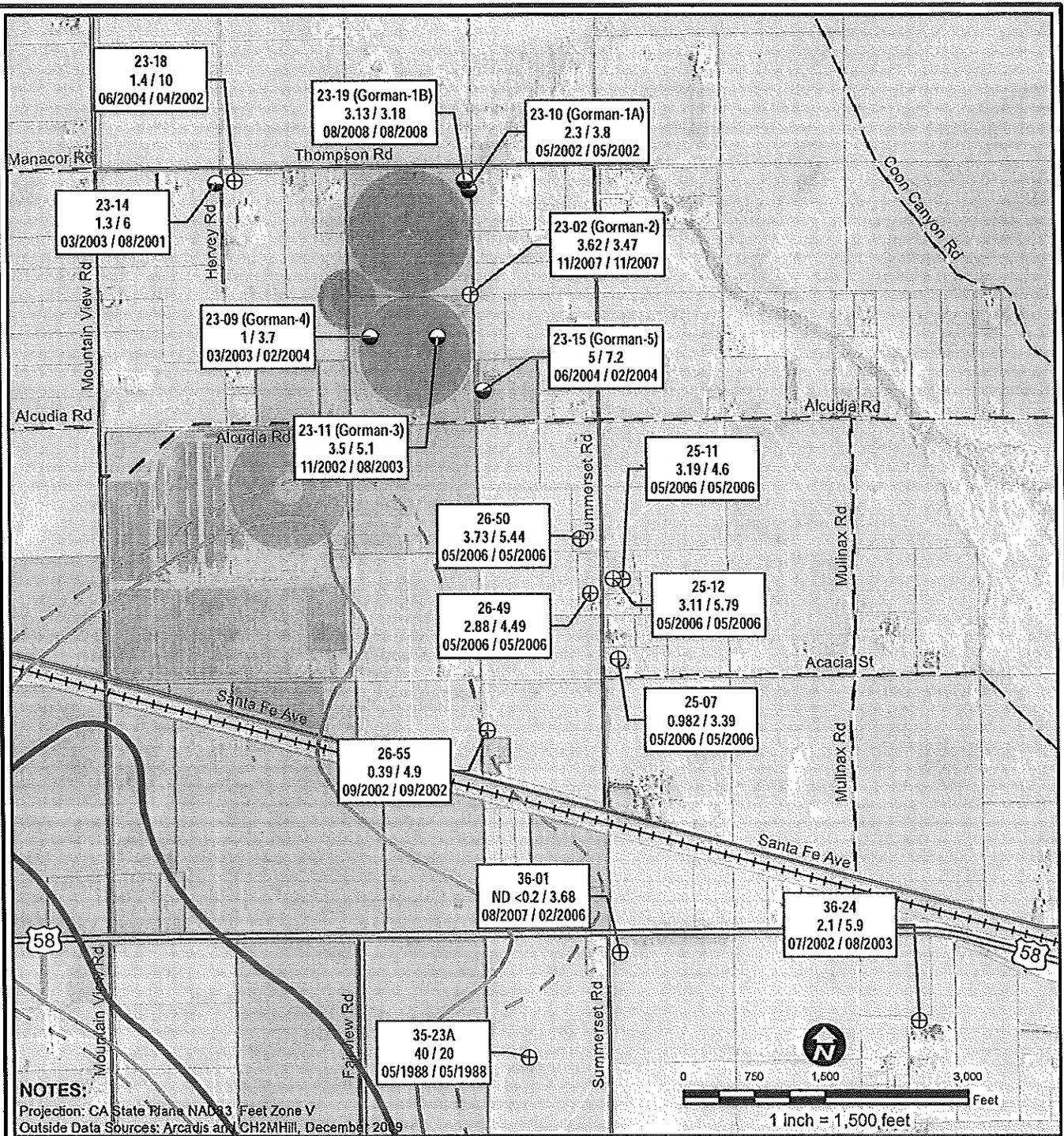
Since March 2010, PG&E has conducted additional investigations on the Gorman property and in the Summerset Road area, including re-sampling the referenced domestic wells that exceeded background limits in 2006 and installing additional monitoring wells. The results suggest similar concentrations in the new monitoring wells compared to the historic data from the Gorman pumping wells and the 2006 data at the three referenced domestic wells along Summerset Road. These data support a conclusion that the plume boundary extended further north and east than depicted in the 2008 plume boundary, and the plume boundary did not expand to these areas after 2008.

Given that chromium was found in groundwater at both the Gorman and Summerset locations prior to the December 31, 2008 compliance deadline found in the 2008 CAO, the current plume depictions and monitoring wells showing chromium levels above background in these locations do not demonstrate a violation of the primary requirement of the 2008 CAO. Using the key terms of the CAO, there has not been “further migration or expansion of the chromium plume to locations where hexavalent chromium [was] below background.”

The 2008 CAO also defines compliance based on a specific list of monitoring wells that are not to increase above “control limits” set based on monitoring results through the third quarter of 2008. Water Board staff point to increased chromium levels in MW-62A as a violation of this technical term. While it is true that chromium levels in MW-62A are higher than they were in early 2008, this observation ignores the data showing that chromium in wells down gradient of MW-62A were above background levels prior to the issuance of the 2008 CAO and well before the CAO compliance date. In addition, MW-62A itself contained chromium concentrations above background levels before the 2008 CAO compliance date. MW-62A exceeded 3.1 ppb Cr6 in August 2008 and exceeded 4 ppb Cr6 in November 2008, both prior to the December 31, 2008 CAO compliance date. As a result, MW-62A chromium levels are not in violation of the CAO.

But, even if the groundwater data collected at monitoring well MW-62A since the 2008 timeframe were construed as a technical violation of the CAO, the historic and new data down gradient of MW-62A demonstrate that the plume has not suddenly and dramatically grown.

Z:\P&E\EMXD\_Files\March 2011\Analytical\Figure 1 (NON WW Analytical) (2011-3-28)8x11.mxd



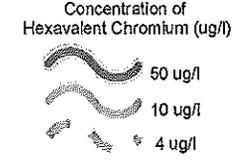
**NOTES:**

Projection: CA State Plane NAD83 Feet Zone V  
 Outside Data Sources: Arcadis and CH2MHill, December 2009

**Wells by Well Type**

- Groundwater Monitoring Well
- ⊕ Domestic Supply Well
- ⊖ Agricultural Supply Well
- Groundwater Extraction Well
- ⊞ Multi-Use, Test Well, Inactive Groundwater Extraction Well
- ⊕ Freshwater Injection Well
- Other Supply Well
- ⊕ Soil Boring
- PGE Property Boundaries

**Chromium Plume (February 2008)**



36-25  
 3.9 / 5.2  
 05/2001 / 10/2001  
 Maximum Result (2008 and Older Data)  
 Cr6 / CrT

**Stantec**  
 57 LAFAYETTE CIRCLE, 2ND FLOOR  
 LAFAYETTE, CALIFORNIA  
 PHONE: (925) 289-9300 FAX: (925) 289-9302

FOR:  
**Pacific Gas & Electric  
 Groundwater Remediation Project  
 Hinkley, California**

JOB NUMBER: 185702221  
 DRAWN BY: TF  
 CHECKED BY: BD  
 APPROVED BY: CM

**2008 And Older Chromium Data  
 Outside the 2008 Plume Boundary**

FIGURE:  
**1**  
 DATE: 03/28/11



With our new understanding of what the plume actually looked like in 2008, it is technically infeasible for PG&E to bring chromium levels at MW-62A below natural background in the immediate future. PG&E will continue to aggressively implement remedial activities in these areas, but it is not realistic to assume the plume will reduce in size to the 2008 illustration for a considerable period of time. PG&E believes it is appropriate for the Regional Board to recognize the inaccuracy of the benchmarks put forth in the 2008 CAO, and to recognize the responsible efforts put forth by PG&E to adapt to the evolving understanding of site conditions.

During 2009 and 2010, Water Board staff correctly exercised their discretion to not issue a notice of violation (NOV) or recommend administrative civil liability (ACL) for the conditions observed at well MW-62A. PG&E believes that the CAO and its related compliance tools should have been updated during this timeframe as the new data clearly indicated the 2008 plume boundary used in the CAO was incorrect. We would like to work with Water Board staff to develop a revised approach to demonstrate control of the plume boundary as we understand it today. We welcome a revised Order that more clearly reflects past and current site conditions. Regardless, the Water Board should now continue to exercise its discretion in not issuing an NOV or ACL.

#### **Chromium Found to the North and Northeast of the DVD is the Result of Pumping by Others**

The increased chromium levels in MW-62A were caused by aggressive nearby agricultural pumping on the Gorman property, which was outside of PG&E's control. During 2009 and 2010, PG&E made numerous requests to the Water Board staff to intervene and address the pumping by Mr. Gorman. When no action was taken, PG&E moved quickly to purchase the Gorman property in mid-2010 to stop the "tug" on the plume from Gorman's agricultural pumping. PG&E has since installed new targeted pumping wells on the property and installed drag drip irrigation that will be used to more effectively control the plume. PG&E is also adding more extraction wells south of the former Gorman property, including wells in close proximity to MW-62A to help control the plume. PG&E's current modeling indicates that these measures should achieve containment of the plume as it is currently depicted, despite the fact that it is substantially larger than depicted three years ago. As an added measure of safety, PG&E is also in the process of adding additional extraction wells to feed new agricultural pivots to the south of this area, which will further enhance plume containment.

PG&E has installed numerous additional groundwater monitoring wells to the north and northeast of the Desert View Dairy (DVD) to further define the extent of the chromium plume in the areas that were not accounted for in the 2008 CAO process. With the exception of MW-62A on the DVD, the data collected from the new wells do not suggest substantial expansion of the plume is occurring in these areas. It is likely that pumping on the Gorman property over the last several years resulted in limited migration of chromium from the DVD to the north. However, as discussed above, chromium was already present in groundwater on the Gorman property for at least a decade and this portion of the plume will shortly be captured by new extraction wells.



In summary, the Water Board directed staff to consider an ACL for 2008 CAO violations. PG&E believes that the fact that chromium was found above background concentrations in the areas in question prior to 2008, that chromium did not migrate to these areas between 2008 and 2011, and that PG&E has aggressively responded with increased pumping, all demonstrate that an ACL complaint is unwarranted. PG&E respectfully requests that the Water Board reconsider its prior direction to staff. PG&E also understands that Water Board staff are now drafting a new CAO concerning plume containment. Given the pre-2008 data showing that the plume was significantly larger in 2008 than understood based on monitoring well data alone, it makes little sense to require PG&E to attempt to pull the plume back to the smaller 2008 plume footprint separately from the final overall remedy. Instead, PG&E should be required to remediate the newly recognized areas of the plume along with the remainder of the plume as part of PG&E's final remedy. PG&E respectfully requests that the Water Board direct staff to take into account all prior chromium data and draft a containment order that acknowledges that the plume was larger in 2008 than recognized. The order should accordingly require containment of that larger plume and should authorize PG&E to perform those actions necessary to accomplish that goal.

**Issue #2: While the Water Board's legal authority to require replacement water to residents whose wells meet the state drinking water standard is questionable, PG&E welcomes the opportunity to discuss all appropriate responses to the concerns raised by residents with domestic water supplies in excess of background levels. In the interim PG&E is voluntarily providing bottled drinking water to all residences within one-half mile of the plume, as well as to the Hinkley School and Senior Center. In addition, PG&E is actively seeking to purchase the ten properties with chromium levels above background, a potential solution to the concerns in and of itself.**

PG&E appreciates the Water Board's and residents' concerns, including the requests for total potable water replacement, and wishes to inform the Board of the steps PG&E has already taken voluntarily to respond. First, while all wells in Hinkley meet the state drinking water standard for chromium, there are ten properties that have wells with chromium levels above natural background. All but one of the ten properties with chromium levels above background now receive bottled drinking water from PG&E, and the one exception receives bottled drinking water from other sources. PG&E is also supplying bottled drinking water to over 53 properties with chromium levels below natural background, but who live within the remediation project boundary (defined as the area of the plume and all properties within one-half mile from the plume edge). PG&E is also supplying bottled water to the Hinkley School and to the Hinkley Senior Center even though their wells do not contain chromium levels above background. Finally, PG&E has offered to supply bottled water to any resident who lives within one-half mile of the plume, regardless of chromium levels in their wells. PG&E will discuss its concerns regarding the Board's regulatory authority to require provision of potable water to residents whose supplies contain less chromium than the limit specified by the California drinking water standard with the Water Board's legal counsel. Hopefully this will lead to a common understanding of the standards to be applied in these circumstances.



Second, PG&E has offered to purchase all 126 properties in the vicinity of the chromium plume, including each of the ten properties with wells that exhibit chromium above background levels. PG&E instructed the appraisers to appraise all residences as if the chromium plume was not present, and to use comparable sales to establish appraised values from communities outside of Hinkley. Contrary to unfounded assertions by certain members of the public at the March 9 meeting that PG&E was buying homes “for pennies on the dollar,” all of PG&E’s purchase offers are significantly higher than appraised values.

Finally, while public concern regarding water safety is completely understandable, the Board should be aware that at public meetings held by Water Board staff in Hinkley on January 26 and 27, Dr. Robert Howd, then a Section Chief for California’s Office of Environmental Health Hazard Assessment (OEHHA), repeatedly stated that the levels of chromium in Hinkley do not pose a risk to human or animal health, including use for drinking, for livestock and pets, for bathing/showering, and even for lawn watering and use in swamp coolers. Perhaps it would be helpful to invite Dr. Howd to address the Water Board directly in the future so that the Board could hear from him directly.

**Issue #3: Agricultural land treatment is an effective, cutting-edge method of plume containment, even though it does not operate at high levels during the winter months**

Agricultural land treatment is an effective and sustainable remedy at Hinkley. It makes good, beneficial use of local groundwater that contains low levels of chromium (*i.e.*, below the drinking water standard). And, it is consistent with surrounding land use. Agricultural land treatment operates at high levels during the warm summer months when most of the water is consumed by the plants and the balance of the water slowly percolates through the root zone soils where organic matter rich in carbon removes the chrome from the water. However, agricultural land treatment does not operate at high levels during the winter months because applied water could pond during the winter rainy season due to lower rates of water uptake by the crops. The reduced water uptake rate is the result of less vigorous rates of plant growth in the cooler winter temperatures. The rate of water percolation through the soil for treatment can be the same year round but the rate of water application in winter is reduced to match percolation with lower plant water consumption.

To provide full containment of the newly defined larger plume, containment pumping must be implemented on a larger scale than merely at the DVD. PG&E is in the process of adding significant additional containment pumping via five additional agricultural pivots. This will increase the total amount of water pumped to agricultural fields from 345 gallons per minute (gpm)<sup>1</sup> in 2008 to over 1200 gpm by later this year, or a factor of nearly four times as much containment pumping. This increase will be more than enough pumping to provide robust

---

<sup>1</sup> All flow rates given are average rates over all four seasons.



capture of the plume as it is currently understood, even though the containment pumping will operate at lower levels during the winter months.

PG&E's technical consultants have prepared numerous computer simulations of groundwater flow in the plume. These computer simulations track the path that a single particle of water (or chromium) would take in the subsurface under various pumping scenarios. These computer simulations are used to estimate the 'area of capture' of a single pumping well, or a system of pumping wells. Particles that flow into a containment well are captured; particles that are not pulled into the well are not captured and flow away. The line that separates these two areas is called the capture zone. We have modeled the capture zone using both annual average flows, and using 'stepped' flows, which conservatively assume that there is high flow in the summer and NO flow in the winter. In reality, the agricultural units are operated with some rate of flow in the winter, so these estimations are conservative.

The "no flow in the winter" modeling shows that, although particles move away from the containment wells when the wells are not pumping in the winter, the spring, summer, and fall pumping more than makes up for the winter reduction in pumping. The plume cannot 'run away' in a few months during the winter - the particles on the edge of the capture zone can only move about 100 feet down gradient during the winter, before they are pulled back on the order of 300 feet or more during the spring, summer, and fall, and are eventually pulled into the well. By pumping at an adequate rate during the growing season, the entire plume can be contained and remediated. In fact, it is possible to capture an area much larger than the currently defined plume using seasonal pumping.

Groundwater typically flows about 300 feet toward extraction wells during spring, summer and fall pumping

Groundwater may flow 100 feet away from extraction wells during winter pumping

The net annual movement of groundwater is about 200 feet toward extraction wells

Contrary to statements made by some members of the public at the March 9 meeting, agricultural application of chromium-containing water is a cutting edge technology that makes good, beneficial use of local groundwater that contains low levels of chromium. The addition of drip irrigation technology in agricultural fields ensures that the applied water does not spray into the air. Many years of robust testing at the Desert View Dairy land treatment unit demonstrate that



this technology removes chromium and nitrates, and creates a robust capture zone in spite of lower flows during the winter months.

**Issue #4: The proper final clean-up level for the Hinkley plume is the maximum natural background value of 3.1 ppb Cr6 and 3.2 ppb CrT. It is infeasible, not supported by California law, and would be unprecedented to require clean up to average background levels.**

Water Board staff and the Water Board's EIR consultant repeatedly asserted at the March 9, 2011 meeting that average background has been set as the cleanup goal for the plume. This is simply incorrect. The current orders only require PG&E to evaluate whether it is even possible to achieve average background levels.

Specifically, CAO No. R6V-2008-0002 required PG&E to submit a feasibility study that assessed final remedial strategies for the plume. CAO R6V-2008-0002A1 established the following background concentrations against which remediation strategies were to be assessed:

Maximum background hexavalent chromium = 3.1 ppb  
Maximum background total chromium = 3.2 ppb  
Average background hexavalent chromium = 1.2 ppb  
Average background total chromium = 1.5 ppb

The CAO further required that the feasibility study must "include an evaluation of achieving average concentrations within the cleanup area that meet the average background concentrations established here, with discrete samples within the cleanup area not exceeding the maximum background concentrations established here."

Importantly, neither CAO set average background as the cleanup level. In fact, in response to concerns over the use of an average background goal expressed by PG&E at the time the average background number was established by the CAO, the Board's Executive Officer assured PG&E that average background was not being set as a cleanup level. The Executive Officer emphasized that PG&E was only being asked to evaluate the potential for using average background as a cleanup level.

As required by the CAOs, PG&E's Feasibility Study (FS) included a thorough evaluation of the possibility of using average background as a cleanup level. The FS concluded that using average background would be unprecedented in California, that there is no regulatory basis for using average background, and that it would be infeasible to cleanup to average background.

A search of available information reveals no sites in California that use average background as the cleanup level, nor any precedent that requires cleanup to an average background



concentration. Instead, all sites in California require cleanup to maximum background levels or higher.

PG&E's background study determined statistical upper tolerance concentrations (UTL's) of Cr6 and Cr(T) that could be present in groundwater throughout the Hinkley valley groundwater basin. The 95 percent UTL concentrations proposed in the background study provide a technically defensible upper limit (or maximum background level) of what could exist from natural sources in any given well sampled throughout the Hinkley valley.

When a UTL is calculated, California law supports using that UTL or maximum background as the cleanup level. Resolution 92-49 requires cleanup to background water quality and refers to 23 CCR section 2550.4 to define background. As outlined by the State Water Resources Control Board Office of Chief Counsel, "Section 2550.4 refers to Section 2550.7(e) which provides the methodology for determining background levels for ground water." (Q&A SWRCB Resolution 92-49, Feb. 16, 1995). Section 2550.7(e) makes it very clear that when a background study is performed that produces a UTL (or maximum background level), just as PG&E did at this site, that monitoring data are to be compared to the UTL (and not to some other value such as average background). "[T]he value for each constituent of concern or monitoring parameter at each monitoring point is compared to the upper tolerance or prediction limit." (23 CCR section 2550.7 (e) (8) (C)). Thus, California law states that maximum background is the appropriate comparison level in this situation and not some other cleanup level such as average background.

In addition, remediation of groundwater to average background concentrations is unreasonable because it would require the treatment and removal of naturally occurring chromium from groundwater. That is, PG&E would have to remove naturally occurring chromium from groundwater to "offset" areas where residual concentrations are above the average but less than the maximum. This is contrary to the specific language of Resolution 92-49: "[U]nder no circumstances shall these provisions be interpreted to require cleanup and abatement which achieves water quality conditions that are better than background conditions." (Resolution 92-49 III.F.1.).

As the plume remediation progresses, different portions of the aquifer may be cleaned up at different rates. Cleanup rates will be a function of several factors, including proximity to locations where remediation activities, such as groundwater pumping and in-situ treatment, are being conducted. If average background were the required cleanup level, PG&E would be required to continue remediation even when all wells were below the UTL or maximum background level.

The average concentrations for Cr6 and Cr(T) presented in PG&E's background study provided nothing more than an overall median concentration of the chromium concentrations naturally present in groundwater over an area comprised of several square miles. After submission of the Feasibility Study, Water Board staff asked PG&E to provide theoretical modeling of the time and expenses required to achieve average background concentrations in the plume. As



requested, PG&E provided the theoretical modeling results. Nevertheless, PG&E repeatedly noted that these modeling results were based on unproven assumptions that such cleanup levels were achievable in reality. To be clear, PG&E does not believe it is feasible to achieve average background chromium levels in the Hinkley plume.

Since there is no regulatory basis or precedent and it would be infeasible to clean up to average chromium background concentrations, the proper background cleanup level for this site is the statistical upper tolerance level or maximum background levels established by PG&E's background study. Because the final cleanup goal has not yet been set, PG&E believes that there would be less confusion if public presentations avoided stating that the cleanup level has been set at average background. PG&E requests that at the appropriate time the Water Board set the cleanup level in Hinkley at the maximum background level established by the background study.

**Issue #5: PG&E welcomes a further peer review of the background study. It is well established that natural background levels of Cr6 in groundwater are common in the Mojave Desert and in most areas throughout the world.**

PG&E supports further peer review of the Background Study approach and results. In November 2003, the Water Board sent PG&E's initial Background Study proposal to three University of California professors for peer review. All three reviewers agreed that the planned study was appropriate and provided several suggestions and recommendations that were incorporated into the revised background study work plan (CH2M HILL, 2004).

The Background Study (CH2M HILL, 2007) sampled wells that were outside of the plume area to identify levels of naturally occurring background Cr6 in the groundwater. Wells were chosen for the background study based on their location far outside of the plume in areas where no effects from the plume could impact the natural chromium levels in the wells. It should be noted that the Background Study was very conservative and likely produced an estimated maximum background that is less than the actual maximum background concentrations in the Hinkley area. Almost all of the wells used in the study were long-screened (often 75 to 150+ feet screen length) domestic or supply wells and were screened across large sections of the upper and lower aquifers. In contrast, monitoring wells target short sections (ten or twenty feet) of the most productive zones of an aquifer that would contain the highest concentrations of chromium. Long screened wells pull water from high and low chromium concentration areas thereby producing a lower net chromium concentration, particularly when compared to the short screened monitoring wells used to map the chromium plume in Hinkley.

The issue of background chromium levels is the subject of much confusion by some members of the public. Our understanding is that certain non-residents, including some speakers at the March 9 Board meeting, have been providing their opinion to members of the Hinkley community that there is no such thing as naturally occurring hexavalent chromium, and that the existence of wells that show no detection of hexavalent chromium is proof of that assertion.



These claims fly in the face of a long-established record of scientific investigations and publicly available data that plainly demonstrate the existence of naturally occurring hexavalent chromium in groundwater. Those who are advancing the “no background” illusion have created unfounded concern among the public by their insistence that any concentration of hexavalent chromium is indicative of contamination (and thus a potential health concern), further adding to the difficulty residents have in putting their well test results in an accurate context. Denying the existence of background levels may be a valuable step in manufacturing fodder for litigation, but it is a perversion of established science and good, solid data.

The natural occurrence of hexavalent chromium in groundwater in arid regions of the southwestern United States has been documented in studies published as early as 1975. The source of this naturally occurring hexavalent chromium is thought to be a combination of oxidation and subsequent dissolution of chromium minerals, such as chromite, resulting in the generation of the hexavalent species, which is highly mobile in groundwater<sup>2</sup>. Trivalent chromium, in its various mineral states, is estimated to constitute around 1 percent of the earth’s crust, and the highest concentrations of those minerals in the United States occur primarily along the western and eastern coastlines.<sup>3</sup>

Numerous studies completed by the United States Geological Survey (USGS), California’s State Water Resources Control Board (SWRCB), the United States Air Force Center for Engineering and the Environment (US AFCEE), and the California Department of Public Health (CDPH), as well as studies by academia, have confirmed that hexavalent chromium occurs naturally in groundwater as a background constituent throughout California, including the Antelope Valley near Hinkley, California.

A detailed study of groundwater conditions in the Mojave Desert near Hinkley conducted by the USGS confirmed the presence of naturally-occurring hexavalent chromium in groundwater at concentrations that ranged from non-detect up to 60 parts per billion (ppb).<sup>4</sup> This local study was supplemented with a more comprehensive regional study of groundwater sampled from drinking water wells in the Antelope Valley (located adjacent to the Mojave Desert) conducted

---

<sup>2</sup> Ball, J.W., Izbicki, J.A., 2005. “Occurrence Occurrence of hexavalent chromium in ground water in the western Mojave Desert, California” *Applied Geochemistry* 19, pg 1123-1125.

<sup>3</sup> Oze, C., Bird, D.K., Fendorf, S., 2007, “Genesis of hexavalent chromium from natural sources in soil and groundwater” *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, April 17, 2007, Vol., 104, no. 16 pg 6544-6549.

<sup>4</sup> United States Geological Survey. 2008. “Naturally High Levels of Chromium Found in Groundwater”. June 9, 2008.



by the USGS and the California SWRCB. In this study, hexavalent chromium was detected in 17 of the 56 wells included in the study, at concentrations ranging from 2 to 14 ppb.<sup>5</sup>

These local studies are consistent with more regional studies of background groundwater quality in California, which also have confirmed the presence of naturally-occurring Cr6 in groundwater. A comprehensive study of background groundwater quality conditions conducted by AFCEE also found that hexavalent chromium is present as a background constituent in groundwater in California. In this study, AFCEE identified 1,307 groundwater monitoring wells at 13 locations in California that were installed in non-contaminated (background) areas and compiled water quality data from those wells to understand background groundwater quality conditions. AFCEE found that hexavalent chromium was present as a constituent in more than one-third of the background monitoring wells, at concentrations up to 60 ppb.<sup>6</sup>

These studies, which rely on data from distinct areas showing both detectable concentrations of hexavalent chromium, as well as no detectable concentration, clearly demonstrate the variability of naturally occurring background concentrations within a given area, and repudiate the unfounded argument that non-detect concentrations somehow “prove” the absence of a background concentration.

Finally, abundant proof of the widespread and common occurrence of hexavalent chromium in groundwater throughout California is provided by the public water supply well database compiled since 1998 by the California Department of Public Health (CDPH). The CDPH database contains data from approximately 7,000 regulated drinking water sources in California. More than 2,200 of those water sources (or 32 percent) have reported some level of hexavalent chromium in the water. More than 20 percent of water sources have levels of hexavalent chromium up to 5 parts per billion (ppb), and approximately 11 percent reported hexavalent chromium levels from above 5 ppb to over 50 ppb.<sup>7</sup>

The City of Davis Public Works Department reported a range of groundwater hexavalent concentrations from non-detect to 38 ppb, with a weighted average concentration of 12.6 ppb in

---

<sup>5</sup> United States Geologic Survey. 2008. Groundwater Quality Data in the Antelope Valley Study Unit, 2008: Results from the California GAMA Program.

<sup>6</sup> Hunter, P.M., et. al. 2005. “Inorganic Chemicals in Ground Water and Soil: Background Concentrations at California Air Force Bases”. Air Force Center for Environmental Excellence (currently Air Force Center for Engineering and the Environment) Brooks City-Base, Texas, Department of Toxic Substances Control, California EPA, Sacramento California. Presented at the 44<sup>th</sup> Annual Meeting of the Society of Toxicology, New Orleans Louisiana. March 10.

<sup>7</sup> California Department of Public Health, Chromium-6 in Drinking Water Sources: Sampling Results, at <http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chromium6sampling.aspx>



2006.<sup>8</sup> That study also reported that 17 of 21 water supply wells had Cr6 concentrations greater than 5.4 ppb. Water delivered from the Soquel Creek Water District naturally contained hexavalent chromium concentrations ranging from non-detect to 38 ppb (average of 15 ppb) from its Aromas aquifer and hexavalent chromium concentrations from non-detect to 15 ppb (average of 5 ppb) from its Central Water District wells.<sup>9</sup>

**Issue #6: Comments regarding the EIR currently under preparation, the scope of alternatives in the EIR, and peer review of the alternatives.**

A number of comments were made at the March 9, 2011 meeting regarding the scope of alternatives in the EIR, and Board members provided direction to staff regarding the scope of alternatives, specific technologies, and peer review of the scope of alternatives. However, PG&E is concerned that Board members may not have been informed that many of those issues, particularly those relating to alternative technologies, were already evaluated in the Feasibility Study, and that Feasibility Study, together with staff direction to the Board's consultant regarding further alternatives to be considered, was the basis for the scope of alternatives currently in the EIR as briefly described to the Board on March 9. We have provided information below that responds to the comments made at the March 9 meeting.

**Evaluation of Alternatives in the Feasibility Study, Selection of Further Alternatives for Evaluation in the EIR**

The process of selecting alternatives to be considered in the EIR began with the Feasibility Study. That study began with an evaluation of 36 remedial technologies and process options, all of which were screened for further evaluation, considering such factors as the specific attributes of Cr6, characteristics of the Hinkley site and the substantial existing data specific to the Hinkley site that has been gathered over the years. The purpose of this initial screening of 36 remedial technologies was to eliminate technologies based on feasibility considerations, and to focus attention and further evaluation on those technologies potentially applicable to Cr6 in groundwater, either individually as a stand-alone remedial technology or as a component of a combined approach. The 36 remedial technologies which were evaluated are listed in Table 6-1 in the Feasibility Study, a copy of the Feasibility Study is contained on the enclosed DVD.

The process of evaluating the 36 technologies included two steps. The first step was to screen technologies to determine which are generally applicable to reduce Cr6 in groundwater. The second step was further to screen those technologies based on considerations specific to the Hinkley site, including the relative effectiveness of the technology at achieving background conditions, restoring beneficial use, containing the Cr6 plume, and achieving productive use of

---

<sup>8</sup> City of Davis 2009 Annual Water Quality Report. City of Davis. Davis, California.

<sup>9</sup> Soquel Creek Water District Consumer Confidence/Water Quality Report 2009. Soquel Creek Water District. Capitola, California. May/June 2010.



the groundwater resource at the site (the four specified remedial objectives). Technologies that could not meet these criteria were eliminated from further consideration.

The Feasibility Study concluded that the most effective, reasonable and sustainable plan to achieve regulatory water quality objectives includes containment pumping, agricultural application of the extracted water, and in situ treatment of the plume core in the area where Cr6 concentrations are higher. As noted in the Feasibility Study, this combined-technologies plan was recommended by PG&E because it has significant benefits, including providing for productive re-use of groundwater already affected by non-chromium constituents (dissolved solids, nitrate) for livestock crop production, removing nitrate from groundwater, minimizing secondary environmental impacts such as well drawdown or increased dissolved solids discharge, increasing local agricultural production, and potentially reducing the import of potable water for agricultural use.

Following submission of the Feasibility Study, Board staff directed PG&E to formulate and model, for evaluation in the EIR, two additional alternatives using the combined technologies recommended in alternative 4 of the Feasibility Study. These two alternatives, 4a and 4b, provide for cleanup of Cr6 over a substantially shorter time frame than that presented under the original alternative 4. Although these two new alternatives were described briefly during the EIR presentation at the March 9 meeting, there was no discussion of the overall process of remedy selection embodied in the Feasibility Study, leaving the audience uninformed as to the extensive analysis of alternative remedial technologies that was included in that study. Based upon the Feasibility Study, and the further delineation of alternatives directed by the Board, PG&E and its technical consultant team believe that the range of alternatives currently being evaluated in the EIR fully meets CEQA's requirements for analysis of a reasonable range of feasible alternatives. The current range of alternatives properly focuses on those alternatives most capable of achieving water quality objectives in a reasonable time.

### **Suggested Alternative Technologies**

Speakers at the March 9 meeting promoted a number of specific alternative technologies, or instances where other technologies have been applied at a particular location. The technologies described by these speakers either have already been evaluated and eliminated from further consideration in the Feasibility Study, or are substantially equivalent to those technologies already reviewed.

One such technology raised at the March 9 meeting was an above-ground treatment plant as a means of treating groundwater. The treatment plant operating at PG&E's Topock remediation project was cited as an example of such an application. PG&E evaluated the use of above-ground treatment plants in the Hinkley Feasibility Study, and created both a plume-wide pump-and-treat option (Alternative 5) in the original Feasibility Study and, at the Water Board staff's request, a "combined" alternative featuring above-ground pump-and-treat technology in Addendum No. 1 to the Feasibility Study. Neither of these options was recommended, due



principally to the extended times necessary to achieve cleanup goals as compared to the recommended alternative (cleanup to 3.1 ppb in 140 years or 90 years for Alternative 5 and the combined alternative, respectively, as compared to 40 years for Alternative 4B). Other drawbacks to above-ground treatment systems include the significantly more complex operation and maintenance programs required by treatment plants as compared to other technologies, the increased environmental impacts resulting from treatment plant operation (such as increased truck traffic), and the significant additional costs associated with treatment plants (for example, an estimated nominal cost of \$882 Million to achieve the 3.1 ppb goal using Alternative 5, as compared to \$109 Million using Alternative 4B).

The relatively small (135 gallons per minute) above-ground treatment plant at the Topock facility was not designed to treat the Topock groundwater plume. Its purpose is to provide a means of disposing of water generated from interim plume-control pumping on the Colorado River floodplain. In fact, the final groundwater treatment remedy for Topock, approved in early 2010 by both federal and state regulators, does not include the operation of the existing pump-and-treat plant or any other above-ground treatment plant. Upon implementation of the approved final remedy at Topock (in-situ technologies), the existing above-ground treatment plant is to be shut down and dismantled.

A second type of above ground treatment raised in public comments on March 9 was resin treatment. The Board asked staff to evaluate a resin treatment technology that is being used for treatment of groundwater at the City of Glendale and at the Lawrence Livermore National Laboratory. The Feasibility Study investigated resin technology (see Table 6-1, p.2, and Appendix C of the Feasibility Study). Based on the specific experience at Glendale and Lawrence Livermore, strong base anion (SBA) resin technology was determined not to be suitable for the Hinkley site. Weak base anion (WBA) resin technology might be feasible, but the performance of WBA resin technology is strongly influenced by factors such as the acidity of the water and the amount of sulfates or other chemicals in the water. These factors are concerns in Hinkley.

As detailed in a memorandum from CH2M Hill included in Appendix C to the Feasibility Study, the Glendale and Lawrence Livermore evaluations set forth several factors that indicate that resins are not likely to be effective at Cr6 removal at Hinkley :

- Treatment using resin requires pH adjustment of the water to 6.0 – 6.5. Because groundwater at Hinkley contains relatively high levels of total dissolved solids (TDS) significant acid addition would be required to achieve the necessary pH. In contrast to the groundwater at Hinkley, groundwater at both the Glendale and Lawrence Livermore sites has relatively low TDS concentrations.
- Hinkley groundwater contains relatively high sulfate concentrations which substantially reduce the effectiveness of resin treatment because the resin also removes sulfate in



addition to chromium. The high levels of sulfate in Hinkley groundwater would “compete” with the chromium for removal, significantly reducing the efficiency of this technology. Groundwater at both the Glendale and Lawrence Livermore sites has relatively low sulfate concentration.

- The Glendale resin treatment is designed to achieve a target cleanup down to 5 parts per billion hexavalent chromium. That level of cleanup is not low enough for use in Hinkley which has a maximum background Cr6 concentration of 3.1 ppb.

PG&E also examined resin treatment technologies first mentioned at the March 9 meeting that are in use in Midland, Texas and Flat Iron Mesa, California. At both locations, the resin treatment is not designed to achieve target cleanup levels as low as the Hinkley maximum background Cr6 concentration of 3.1 ppb.

The Board also raised the possibility that dewatering of the aquifer should be considered. Notably, the purpose of evaluating alternatives in an EIR is to evaluate feasible alternatives that reduce environmental impacts. There is an enormous flux of water in the Hinkley valley, and dewatering the aquifer is not technically feasible. Dewatering would also result in substantial adverse environmental impacts, including the loss of local groundwater supplies, accompanying losses of agricultural uses of land, and substantial subsidence impacts, including the risk of sinkholes and similar problems.

### **Peer Review of Alternatives**

Board staff were directed at the meeting to consider peer review of the scope of alternatives in the EIR. PG&E understands that DTSC has agreed to the Board’s request to review the Feasibility Study alternatives. PG&E welcomes this effort and hopes the work can be completed in a way so as not to delay the CEQA process, and thus delay the remedy.

As background, it is important to note that the legal requirement for an EIR is that the EIR must reflect the lead agency’s independent judgment. Public Resources Code § 21082.1(c). There is no legal requirement for peer review. The Regional Board is ensuring that the EIR reflects its independent judgment by selecting its own consultant to prepare the EIR, and by independently reviewing that work.

If additional peer review regarding the selection of alternatives in the EIR is desired, PG&E respectfully suggests that peer review should be completed by the close of the regular comment period on the Draft EIR, so that any comments can be included in the final EIR, in the normal course of the CEQA process. Given the focus of the suggested peer review on the range of alternatives, PG&E further suggests that the evaluation of alternative technologies in the Feasibility Study, and the subsequent alternatives directed by Board staff, form the basis for any



such peer review. If the number of alternatives exceeds these, it is probable that the Feasibility Study will have to be reopened and the time to reach a final remedy will be significantly expanded, a result that likely would not meet with significant public support.

**Issue #7: Data from properly constructed monitoring wells, rather than from domestic or agricultural wells, should be used to create plume maps. Chemical data from domestic or agricultural wells are often unreliable due to construction materials and screen lengths.**

Monitoring wells must be designed and constructed in a manner that allows representative groundwater samples to be obtained from targeted depth zones without changing the chemistry of the water. This includes the selection of materials for well construction that will not change groundwater quality after it enters the well, and installation of relatively short well screens that allow groundwater only from the target depth zones into the well.

Domestic wells often use casing (*i.e.*, the well “wall”) and well screen made from mild steel. Metallic well materials are not recommended for use in wells that monitor groundwater for metal constituents, as even minor leaching of metals from well materials could result in significant interference with laboratory testing or alteration of test results. In addition, well screens in domestic wells typically extend across relatively long intervals of the most permeable materials in the aquifer and often avoid poor quality groundwater associated with agriculture (such as that containing high concentrations of dissolved solids and nitrate), as opposed to the relatively short screens used in monitoring wells to target specific zones for sampling. Because of these factors, groundwater samples from domestic wells are not directly comparable to groundwater samples from monitoring wells, and may not be representative of groundwater in the aquifer.

The Cal-EPA guidance manual entitled “Monitoring Well Design and Construction for Hydrogeologic Characterization” (Cal-EPA, 1995) provides guidelines for construction of monitoring wells to ensure the collection of representative water quality samples. This guidance addresses specific factors to be considered in constructing a monitoring well, such as: 1) drilling methods that minimize the use of water or drilling fluids; 2) installation methods (proper packaging, staging and handling of well materials) to avoid the introduction of contaminants; 3) well materials (well casings/screen, coupling, centralizers, etc.) that do not alter the chemical qualities of water or the constituents being evaluated; 4) well design (structural integrity, screen depth, screen length, filter pack, annular seal, and protective casing); and 5) well development.

Cal-EPA (1995) has also provided guidelines for evaluating whether existing monitoring wells meet the performance standards required under the California Code of Regulations. When existing wells are physically damaged or when little or no documentation of how wells were designed or installed is available, the guidance recommends that a replacement should be considered.



PG&E's approach is to expand the monitoring well network to assess the lateral and vertical distribution of Cr6 and Cr(T) in groundwater as necessary, rather than to rely on results from private wells for this purpose. In addition, at Water Board staff's request, PG&E already places domestic/agricultural well data on plume maps, but draws plume contours only using monitoring well data. PG&E suggests that the current approach of installing new monitoring wells in locations where domestic/agricultural wells are above background levels, mapping the plume using monitoring well data, and listing the domestic/agricultural well test results on the plume maps, provides an accurate and scientifically defensible accounting of plume conditions.

**Issue #8: The Hinkley School wells have not been affected by the PG&E plume.**

The Hinkley School wells have always tested within natural background levels for chromium. The wells show natural variability in hexavalent and total chromium concentrations in each sampling, but all test results have been solidly within the range of natural background levels. These data provide clear evidence that the school wells have not been affected by chromium from the plume.

A reported concentration of 2.9 ppb in Hinkley School well 27-28 in the October 28, 2010 sampling event was also cited as evidence that the plume may have affected the school wells. However, it is important to note that the sample results in question, along with other samples taken on the same day, were "flagged" with a notation during the quality control/quality assurance review, indicating that the results may not be reliable (in this case, due to the high degree of variability between hexavalent and total chromium results for the same well). As is the established procedure in such cases, additional samples were taken from that well to provide confirmation of chromium levels. Those additional tests, as well as all subsequent tests, show chromium concentrations within the background range of non-detect to 2.2 ppb that has characterized all previous results for the school wells.

Groundwater data from monitoring and domestic wells on the western side of the Hinkley plume in the general area between the plume and the Hinkley School supply wells show generally stable chromium conditions and do not suggest any plume impact on the Hinkley School wells. PG&E provided bottled water to the school due to increased public concern caused mainly by unsupported and misleading claims made by a number of outside interests.

**Issue #9: The highest chromium concentrations in monitoring wells near the compressor station are found only in deep wells while lower concentrations are found in shallow wells, indicating that there is no ongoing source in the shallow soil near the compressor station.**

Concerns were raised at the March 9 meeting that there may be a continuing source of Cr6 to groundwater in shallow soils near the compressor station. The concerns were based upon high levels and an increasing concentration trend at monitoring well SA-MW-05D. PG&E recognizes that the hexavalent chromium concentrations at SA-MW-05D have varied over time. The baseline Cr6 concentration was 5,070 ppb in 2007, the maximum concentration was 9,030 ppb in



November 2010 and the most recent concentration was 7,280 ppb in February 2011. However, the SA-MW-05D Cr6 concentration trends, together with the data trends from the other monitoring wells in the vicinity, indicate that the high Cr6 concentrations in the deep unit detected at SA-MW-05D exist only in the deep unit. Shallow monitoring wells in the same location show much lower chromium levels of 20 to 30 ppb, indicating that there is no on-going shallow source at the compressor station.

Upon installation of monitoring well SA-MW-05D in 2007, the Cr6 concentration at the well was 5,070 ppb, higher than the maximum Cr6 concentration at nearby PMW-03, 3,890 ppb, indicating that small pockets of high concentration groundwater that had not previously been detected existed in this area in the deep unit. The variation in concentration from 5,070 to 9,030 ppb at SA-MW-05D is likely due to natural variability in plume concentrations and may be due to the hydraulic influence of pumping at nearby remediation extraction well SA-RW-04, rather than from an ongoing source at the compressor station.

It should be noted that PG&E is currently in the process of expanding the Source Area in-situ remediation zone under the existing permit. The expansion specifically targets the Cr6 mass in the vicinity of SA-MW-05D in the deep unit. SA-MW-05D is on PG&E owned land and is more than one half mile from the nearest domestic well. PG&E's expanded in-situ effort in the source area will aggressively treat the chromium in this area of SA-MW-05D.

**Issue #10: There is no basis for Mr. Bowcock's assertion that contaminated water was injected into domestic wells in Hinkley.**

Litigation consultant Bob Bowcock asserted at the March 9 meeting that water tanker trucks reportedly put contaminated water into certain domestic wells when they were dry. PG&E has thoroughly explored similar claims as they were raised in litigation and there is no basis for these assertions. No witness has claimed, nor have any documents been produced that support the claim that contaminated water was injected into domestic wells in Hinkley. In addition, such an activity seems extremely unlikely, given the effort required to remove the pumps and piping from the wellhead to inject water down a domestic well, and the subsequent effort required (likely to no avail) to attempt to pump such water back out of a well after the water had spread into the geologic formation.

It is true that PG&E allowed the Hinkley Fire Department to fill its tanker trucks at the PG&E Compressor Station fire hydrant for firefighting in the Hinkley area. The water obtained did not contain chromium. The supply wells were upgradient from the plume and various tests confirmed they weren't impacted by the plume. Moreover, no testimony or documents exist stating that water from the fire hydrant at the PG&E Hinkley Compressor Station was put into local wells. Nevertheless, even if that did happen, the water from the PG&E fire hydrant has always been clean.



During the lawsuits, some firefighters reported that they made infrequent deliveries to local storage tanks when residents were out of water in summer months, or filled local pools at the beginning of the summer. But, no firefighter or document has suggested that anyone injected water into domestic wells.

If the Water Board believes that there is any merit to Mr. Bowcock's assertion, the Water Board should ask Mr. Bowcock to back up his claim with documents or credible witnesses. PG&E has asked Mr. Bowcock to support this claim and has asked him for his sampling data from Hinkley. However, Mr. Bowcock has not responded to PG&E's requests.

**Issue #11: No cross-screened wells remain in the area of lower aquifer impacts. The closest remaining cross-screened well will be destroyed by Summer 2011.**

PG&E's lower aquifer delineation report confirms that chromium impacts to the lower aquifer are limited to the general area of monitoring well MW-23C. PG&E began a comprehensive evaluation of historic agricultural and domestic wells in this area in 2009. PG&E prioritized the destruction of any wells that could be cross-screened between the upper and lower aquifer. The only remaining well that could be cross-screened in the area of lower aquifer impacts is well 26-04. Based on the location of this well, and the lateral distribution of chromium in the lower aquifer, it does not appear well 26-04 has provided a conduit for chromium to affect the lower aquifer (chromium affected wells MW-23C and MW-92C are located up-gradient of well 26-04). Well 26-04 will be destroyed in accordance with local agency requirements no later than Summer 2011.

Conclusion

PG&E requests the opportunity to make a full formal presentation to the Water Board at the June meeting in Barstow so that it can more thoroughly discuss these concerns and answer any questions that the Board or staff may have. PG&E believes It is important that this opportunity not be delayed beyond the June meeting because the Board's staff will be proceeding with the March 9 directives without the benefit of a great deal of very important information and delay will also result in a continuation of the potential for public misunderstanding of the current state of PG&E's remediation efforts. We ask that PG&E be provided with sufficient time to address these issues with the Water Board at the next southern-area meeting in June, 2011. Thank you for your consideration of this request.

Very truly yours,

David A. Gilbert



cc: Don Jardine, Vice Chair  
Mike Dispenza  
Keith Dyas  
Amy Horne, Ph.D  
Peter C. Pumphrey  
Eric Sandel  
Harold Singer  
Laurie Kemper  
Lisa Dembach

**May 27, 2011**  
**Summary of Water Board Required Actions**  
**PG&E Chromium Contamination Cleanup**

**1. Plume Boundary Identification**

At Water Board staff's directives found in Investigative Orders, PG&E continues efforts to delineate the plume in groundwater out to the maximum background values for hexavalent and total chromium. The most recent directive, Investigative Order No. R6V-2011-0016, issued April 11, 2011 (Attachment 1), requires further investigation in the northern, eastern, and western portions of the plume. PG&E complied by submitting a work plan proposing to step out monitoring wells to locations up to one mile distance of the currently drawn plume boundaries. PG&E proposes submitting a technical report of investigation results by late summer 2011.

**2. Plume Containment**

CAO R6V-2008-0002 (Attachment 2) requires PG&E to contain the chromium plume in groundwater from further migration. Starting in March 2011, PG&E began annual increased extraction of groundwater at the Desert View Dairy. New this year is the startup of groundwater extraction at three other field crops near the Dairy. The results of these efforts for achieving plume containment may not be known to the Water Board for some months.

**3. Groundwater Remediation**

In addition to plume containment, CAO R6V-2008-0002 requires PG&E to continue implementation of in-situ corrective actions in the source and central areas of the chromium plume. CAO R6V-2008-0002A2 incorporated the South-Central Remediation In-situ Area as another in-situ remedial area. Quarterly reporting for all in-situ actions are combined under General Permit R6V-2008-0014. The latest report from first quarter 2011 actions show that chromium is slowly being cleaned up to non-detect levels (less than 0.2 ppb Cr(VI)) in each of the three in-situ areas. The Water Board will consider a new CAO to set cleanup goals and a timeline for comprehensive groundwater cleanup based on PGE's Feasibility Study and the Subsequent Environmental Impact Report.

**4. Water Supply for Affected Domestic Wells**

CAO R6V-2011-0005 (Attachment 3) requires PG&E to provide an alternate water supply to Hinkley residents with levels of hexavalent or total chromium in their domestic wells above the maximum background concentrations. PG&E complied by providing bottled water to residents with affected wells.

CAO R6V-2011-0005 also requires PG&E to expand the domestic well sampling program and submit results to the Water Board. During winter 2011, PG&E expanded the sampling program to now include 157 domestic wells. The well sampling results were received in a technical report on April 29, 2011. The latest plume map is posted under the PG&E Hinkley page on the Water Board's website at: [www.waterboards.ca.gov/lahontan](http://www.waterboards.ca.gov/lahontan).

#### **5. Feasibility Study**

CAO R6V-2008-0002 required PG&E to, among other things, submit a feasibility study that assesses remediation strategies for final site cleanup. On August 31, 2010, the Water Board received a Feasibility Study report that evaluated five alternatives for final cleanup of the chromium plume. Board staff issued preliminary comments on the feasibility study in January 2011 (Attachment 4) and requested an addendum to address a cleanup time sooner than the 200+ years that was proposed to achieve the average background chromium concentrations. PG&E responded with two addendums that eventually proposed a final cleanup time of 95 years and 40 years to achieve the average and maximum background chromium concentrations, respectively, using in-situ remediation and land treatment units to grow alfalfa. A table summarizing the proposed clean-up alternatives and estimated clean-up times is shown in Attachment 5.

At the March 9, 2011 Board hearing, members of the public stated their dissatisfaction with PG&E's proposed Feasibility Study. The main objection was against using cleanup methods, such as land treatment units, which allowed plume migration during portions of each year. These comments prompted the Board to direct staff to obtain an outside technical review of the Feasibility Study to determine whether best available technology for hexavalent chromium was appropriately evaluated in the Feasibility Study.

#### **Attachments:**

1. April 11, 2011 Investigative Order R6V-2011-0016
2. CAO R6V-2008-0002
3. CAO R6V-2011-0005
4. January 10, 2011 Water Board Staff comments to PG&E on the Feasibility Study
5. Feasibility Study Table of Alternatives



# California Regional Water Quality Control Board Lahontan Region



Linda S. Adams  
Acting Secretary for  
Environmental Protection

2501 Lake Tahoe Boulevard, South Lake Tahoe, California 96150  
(530) 542-5400 • Fax (530) 544-2271  
www.waterboards.ca.gov/lahontan

Edmund G. Brown Jr.  
Governor

**APR 11 2011**

Eric P. Johnson  
Pacific Gas and Electric Company  
350 Salem Street  
Chico, CA 95926

## **INVESTIGATIVE ORDER NO. R6V-2011-0016, REQUIREMENT TO SUBMIT REVISED WORK PLAN FOR CHROMIUM PLUME INVESTIGATION, PG&E COMPRESSOR STATION, HINKLEY, SAN BERNADINO COUNTY**

Water Board staff has reviewed PG&E's March 24, 2011, *Work Plan for Installation of Additional Upper Aquifer Monitoring Wells (Work Plan)*. The Work Plan was submitted based upon recommendations in the February 15, 2011 document, *Additional Groundwater Investigation to the East and North of the Desert View Dairy*, to install additional monitoring wells for plume delineation. PG&E was directed in Investigative Order R6V-2010-0038 to evaluate the lateral and vertical limits of chromium contamination in groundwater in the upper aquifer.

The Work Plan proposes to install nested monitoring wells in the upper aquifer on private properties to the east and north of Summerset Road. A map in the Work Plan shows nine of these properties where PG&E is attempting to obtain access. The properties were selected based upon detection of chromium above maximum background levels in groundwater.

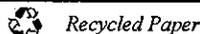
### **Comments**

Water Board staff concurs that additional investigation is necessary to define the boundaries of chromium contamination in groundwater. Specifically, monitoring wells are need in the following locations:

- Going in the direction from south to north along Summerset Road: east of MW-95, -41, -88, -86, -55, -79, and -94.
- South of MW-95.
- Going in the direction from east to west along Thompson Road: north of MW-79, -94, -84, and -89.
- Adjacent to and north of domestic well 23-30 on Thompson Road.

In addition, based upon the detection of total chromium above the 3.2 micrograms per liter ( $\mu\text{g/L}$ ) maximum background level in monitoring well MW-58 on Serra Road during

*California Environmental Protection Agency*



01-00036

the November 2010 sampling event, we believe further plume definition is needed to the west. Specifically, monitoring wells are needed to evaluate whether chromium is potentially migrating through gaps between the fresh water injection wells, also on Serra Road. We are concerned whether the force from agriculture well 27-03 is acting to pull the plume westward.

Furthermore, recent disclosure by PG&E to the Water Board of historical information indicates additional areas of chromium impacts to groundwater that require investigation. Chromium data submitted in PG&E's April 1, 2011 correspondence shows that up to 10 µg/L as total chromium was detected along Thompson Road back in the early 2000s. Such information indicates that impacted groundwater was not being captured by agriculture wells operating on the Desert View Dairy or the Gorman properties. It also indicates that chromium from PG&E's release impacted groundwater farther west along Thompson Road and farther north along Mountain View Road than previously thought. The extent of chromium in groundwater requires that monitoring be stepped out to the north and west of the Thompson and Mountain View Roads intersection. Considering the extensive time that has occurred since the historical sampling results, Board staff believes that stepped out monitoring should extend north to Salinas Road and Sonoma Street. Board staff believes it is imperative to get out in front of the chromium plume rather than to continually chase it.

### Requirement

Pursuant to section 13267 of the California Water Code, PG&E is directed to submit a revised work plan for delineating the lateral and vertical extent of chromium contamination in the upper aquifer. **By May 11, 2011**, submit a revised work plan proposing sampling at the locations described in the above Comment section. The revised work plan must contain a map showing proposed sampling locations rather than just properties. Proposed sampling locations shall be no greater than 1,300 feet or one-quarter mile apart from each other. The revised work plan shall state if tasks proposed in the original Work Plan have changed. Include a proposed schedule for conducting the groundwater investigation and submitting a technical report of results.

Please contact me at 542-5436 or Lisa Dernbach at (530) 542-5424, if you should have any questions.



LAURI KEMPER  
ASSISTANT EXECUTIVE OFFICER

Enclosure: Section 13267 Fact Sheet

cc: Mailing List

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION**

**CLEANUP AND ABATEMENT ORDER NO. R6V-2008-0002**

**WDID NO. 6B369107001**

**REQUIRING PACIFIC GAS AND ELECTRIC COMPANY  
TO CLEANUP AND ABATE WASTE DISCHARGES OF  
TOTAL AND HEXAVALENT CHROMIUM TO THE  
GROUNDWATERS OF THE MOJAVE HYDROLOGIC UNIT**

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board), finds:

1. The Pacific Gas and Electric Company owns and operates the Hinkley Compressor Station (hereafter the "Facility") located southeast of the community of Hinkley in San Bernardino County. For the purposes of this Order, the Pacific Gas and Electric Company is referred to as the "Discharger."
2. On December 29, 1987, the Lahontan Water Board issued Cleanup and Abatement Order (CAO) No. 6-87-160 to the Discharger because wastewater containing hexavalent chromium (also known as chrome six, chromium (VI), and Cr (VI)) was discharged at the Facility in a manner that polluted groundwater. The CAO required the Discharger to complete a site investigation, to characterize the hydrogeology of the site, and to initiate cleanup and abatement of hexavalent chromium in the soil and groundwater. The site investigation delineated a zone of groundwater polluted with elevated hexavalent chromium (the "plume") extending downgradient from the initial discharge area at the Facility to approximately 1 1/2 miles north of, and off, the PG&E compressor Facility. The requirements of CAO No. 6-87-160 have been completed.
3. Amendments to CAO No. 6-87-160 were issued on June 3, 1994 (CAO 6-87-160A1) and August 3, 1998 (CAO 6-87-160A2). The amendments required the Discharger to conduct further site characterization, determine the extent of soil and groundwater pollution, begin full-scale cleanup actions, estimate the time necessary to reach cleanup levels in groundwater, and submit annual reports evaluating the progress of cleanup. The Discharger chose to clean up the pollution by pumping polluted groundwater and using this water to irrigate forage crops at two land treatment units near the Facility. The land treatment units resulted in the conversion of hexavalent chromium in the pumped groundwater to trivalent chromium in the upper soils. This remedial method appeared to contain the chromium plume from further migration.

4. In response to the detection of hexavalent chromium in air samples taken surrounding the land treatment units, the Lahontan Water Board issued CAO No. 6-01-50 on June 29, 2001. This CAO required the Discharger to immediately abate the creation of a threatened nuisance formed by any airborne discharges of hexavalent chromium originating from the land treatment units. The CAO required submittal of a report evaluating hexavalent chromium treatment methods that would not have the potential for releasing airborne hexavalent chromium. The CAO also required groundwater sampling and the submittal of reports to evaluate stability of the chromium contaminant plume.
5. On June 29, 2001, the Discharger stopped groundwater extraction and irrigation at the two land treatment units because it had not identified a mechanism for preventing airborne discharges containing hexavalent chromium. The Discharger initiated well sampling to monitor stability of the chromium plume in groundwater. Sampling data obtained since July 2001 indicate that the chromium plume has expanded in a northerly direction.
6. On March 13, 2002, the Discharger submitted a report titled, *Draft Proposed Approach for Remediation of Hexavalent Chromium in Groundwater at the Hinkley Compressor Station, San Bernardino County*. The main elements of the proposal include: (a) in the short-term, implementing an action for controlling plume migration; (b) conducting a study of naturally-occurring chromium in groundwater; (c) conducting a feasibility study and pilot study of certain groundwater remedial technologies; and (d) implementing remediation of groundwater contamination.
7. In August 2004, the Discharger implemented a corrective action at the northern end of the plume by pumping groundwater from extraction wells to regain hydraulic control of chromium plume migration. Extracted water is distributed at the Desert View Dairy by a subsurface drip irrigation system, where soil and water interact to reduce hexavalent chromium to trivalent chromium. Crops are grown on the land that is irrigated. The discharge of pumped groundwater at the Desert View Dairy is regulated by Waste Discharge Requirements under Board Order No. R6V-2004-0034. This corrective action at the Desert View Dairy has halted the northern migration of the chromium plume but has not stopped migration to the west in the northern portion of the plume. Additional actions are necessary to completely contain the plume's migration.
8. On October 13, 2004, the Lahontan Water Board adopted Waste Discharge Requirements under Board Order No. R6V-2004-041 allowing the Discharger to conduct two in-situ pilot tests to evaluate remediation of hexavalent chromium in groundwater. The results of the field-scale tests, submitted in the July 2005 document titled, *Final Report, In-situ Remediation Pilot Study*, showed that lactate and emulsified vegetable oil successfully converted hexavalent chromium in groundwater to trivalent chromium and also showed an overall decrease in total chromium concentrations in groundwater in a limited area. This reduction in total chromium concentration occurred because the trivalent chromium tends to bind with the aquifer materials, resulting in less total chromium in the

- groundwater. Besides chromium, reducing conditions also affect other metals in the aquifer, such as manganese and iron. While these by-products exist at levels exceeding drinking water standards, they do not migrate beyond cell boundaries. Because the water quality has not yet been restored in the pilot test cells, the Discharger is required to continue the monitoring program.
9. On June 14, 2006, the Lahontan Water Board adopted Waste Discharge Requirements under Board Order No. R6V-2006-023 allowing the Discharger to conduct a large-scale in-situ pilot study for remediation of hexavalent chromium in the central area of the groundwater plume. The field-scale study consists of injecting lactate, whey, and emulsified vegetable oil into the subsurface to evaluate in-situ remediation for long-term plume cleanup. The first phase of project implementation occurred October 2006 until February 2007. While monitoring reports are being submitted every three months, remediation effectiveness reports are not required but should be to evaluate progress towards aquifer restoration.
  10. On November 9, 2006, the Lahontan Water Board adopted Waste Discharge Requirements under Board Order No. R6V-2006-0054 allowing the Discharger to conduct a full-scale in-situ project for remediation of hexavalent chromium in the source area of the groundwater plume at the compressor station. The project consists of injecting lactate, whey, emulsified vegetable oil, and/or ethanol, into the subsurface using a recirculation system for long-term plume cleanup. Hydrologic testing using clean water and baseline sampling of a recirculation well were conducted in fall 2006. Project startup began in May 2008. While monitoring reports are being submitted every three months, remediation effectiveness reports are not required but should be to evaluate progress towards aquifer restoration.
  11. The Groundwater Monitoring Report for October 2007 contains data indicating plume migration continues along the northwest boundary. Groundwater data shows that total and hexavalent chromium concentrations increased above the drinking water standard of 50 µg/L (micrograms per liter) in monitoring wells MW-38A and MW-45A. The information suggests that the plume core boundary, consisting of total chromium concentrations of 50 µg/L or greater, migrated approximately 300 feet to the west along at least a one-half mile length in the northwestern area of this 50 µg/L plume boundary. Data in the report did not indicate that the plume boundary of the interim background chromium concentration of 4 µg/L had migrated during the same sampling event. However, historical data trends suggest that the latter boundary migration is a delayed effect that will likely be detected in future groundwater sampling events.
  12. On November 28, 2007, the Lahontan Water Board adopted Amended Waste Discharge Requirements under Board Order No. R6V-2004-0034A1 that allows the Discharger to discharge to land at the Desert View Dairy groundwater containing chromium from off-site parcels. The project is intended to contain plume migration along the northwest boundary. The Waste Discharge Requirements allow disposal of groundwater extracted from six wells located

between Santa Fe Avenue and Highway 58, near the intersection of Mountain View Road. However, the revised Order did not increase the volume of groundwater that the Discharger may dispose; therefore, groundwater extraction will be reduced at the Desert View Dairy property to accommodate the additional extraction at off-site parcels. While modeling has indicated that plume containment can still be achieved at this reduced extraction level, continued monitoring of the plume in this area is needed. The project has been operating continuously since June 2008.

13. Also on November 28, 2007, the Lahontan Water Board adopted Revised Waste Discharge Requirements under Board Order No. R6V-2007-0032 for the Revised Central Area In-situ Remediation project. The Waste Discharge Requirements revises the project referenced in Finding No. 9 by allowing the use of ethanol for in-situ remediation. Full-scale implementation of the project began on November 29, 2007.
14. CAO No. 6-87-160A2 established the cleanup level for chromium in groundwater at background concentrations. Sampling at the Facility and in the vicinity indicates that hexavalent and total chromium occur naturally in groundwater at variable concentrations. On February 27, 2007, the Discharger submitted the document, *Background Chromium Study*. The Study presents the results of one year of water sampling from wells located outside the boundaries of the chromium plume. The Study concludes that statistical analysis shows maximum likely background chromium concentrations of near 4 µg/L for total and hexavalent chromium in groundwater in the Hinkley Valley. The mean concentrations detected in background are 1.19 µg/L for hexavalent chromium and 1.52 µg/L for total chromium. The Water Board has not accepted this report or its conclusions. However, it intends to use the information in the report to: (1) determine plume delineation levels; and, (2) establish background water quality as part of a process to establish final numerical cleanup levels.
15. On August 27, 2007, the Discharger submitted a report of waste discharge describing various remediation projects to provide plume containment and to clean up chromium contamination in groundwater at different locations within and outside the plume boundaries. The Lahontan Water Board adopted, at its April 9, 2008 meeting, general waste discharge requirements (Board Order No. R6V-2008-0014) allowing the Discharger to implement these types of projects as needed to contain and cleanup the chromium pollution in soils and groundwater.
16. On July 2, 2008, the Discharger submitted to the Lahontan Water Board a document titled, *Boundary Control Monitoring Program and Updated Site-wide Groundwater Monitoring Program*. The Discharger proposes in the Boundary Control Monitoring Program groundwater monitoring and data evaluation methods to evaluate if its remedial measures are complying with the requirement to achieve chromium plume stability. The method includes calculation of control limits, using the 95% upper confidence limits, for selected wells based on the chromium concentrations in those wells from February 2005 through the 3<sup>rd</sup> quarter 2008. Concentrations above the

control limits may indicate plume movement, which would be assessed through an evaluation monitoring program. If warranted, a corrective action program would be implemented to address the plume movement.

The document also proposes revisions to the site-wide monitoring program, which includes certain monitoring wells from remediation and plume control projects and from other wells that are used to evaluate plume stability. The proposed revisions include adding certain wells, eliminating monitoring at certain wells, and reducing the frequency at certain wells.

17. The 1995 *Water Quality Control Plan for the Lahontan Region* (Basin Plan) establishes Water Quality Objectives (WQOs) for the protection of beneficial uses. WQOs include the following Maximum Contaminant Level (MCL) established by the California Department of Health Services as a safe level to protect public drinking water supplies:

Total chromium	50 micrograms per liter ( $\mu\text{g/L}$ )
----------------	---

18. The Groundwater Monitoring Report for February 2008 contains the results of groundwater sampling of 137 monitoring, domestic, agricultural and inactive wells. The wells define the lateral and vertical extent of chromium in groundwater. Well PMW-05, located north of the Compressor Station property, contains the highest concentrations of chromium:

Total chromium	2,120 $\mu\text{g/L}$
Hexavalent chromium	2,270 $\mu\text{g/L}$

(Note that hexavalent chromium concentrations may exceed total chromium concentrations in a given well due to the different analytical methods used for hexavalent and total chromium and the analytical error of up to  $\pm 15$  and  $\pm 25\%$  for the respective methods.)

19. The concentrations of total chromium and hexavalent chromium detected in groundwater samples at the Facility exceed WQOs for groundwater specified in the Basin Plan. The concentrations adversely affect the groundwater in the Mojave Hydrologic Unit for its municipal and domestic supply beneficial uses. The levels of waste chromium in groundwater, therefore, constitute pollution as defined in Water Code section 13050, subdivision (l).
20. The discharge of waste, such as chromium, to the groundwaters of the Mojave Hydrologic Unit, as described in Finding Nos. 2, 19 and 20 above, violates a prohibition contained in the Basin Plan. Specifically, the discharge violates the following discharge prohibition:

"The discharge of waste... as defined in Section 13050(d) of the California Water Code which would violate the water quality

objectives of this plan, or otherwise adversely affect the beneficial uses of water designated by this plan, is prohibited.”

21. Chromium in groundwater continues to migrate in the northwest direction. Furthermore, chromium in the source area at the compressor station continues to adversely affect groundwater quality. Additional work is needed to clean up and abate the effects of the discharge. This Cleanup and Abatement Order requires implementing corrective actions for plume containment and long-term groundwater remediation. Technical reports are necessary to verify corrective action implementation, cleanup of water quality to background concentrations, and progress towards restoring the beneficial uses of the aquifer.
22. This enforcement action is being taken by this regulatory agency to enforce the provisions of the California Water Code, and as such is exempt from the provisions of the California Environmental Quality Act (Public Resources Code section 21000 et seq.) in accordance with California Code of Regulations, title 14, section 15321.

**IT IS HEREBY ORDERED** that, pursuant to the Water Code sections 13267 and 13304, the Discharger must clean up and abate the effects of the discharge and threatened discharge of chromium to waters of the State, and must comply with the provisions of this Order:

1. The Discharger must conduct the investigation and cleanup tasks by or under the direction of a California registered geologist or civil engineer experienced in the area of groundwater pollution cleanup. All technical documents submitted to the Lahontan Water Board must contain the signature and stamp of the registered individual overseeing corrective actions.
2. The Discharger shall not cause or permit any additional waste chromium to be discharged or deposited where it is, or probably will be, discharged into waters of the State.
3. Plume Containment

The Discharger must achieve containment of the chromium plume in groundwater. For the purposes of this Order, containment is defined as:

- (a) no further migration or expansion of the chromium plume to locations where hexavalent chromium is below the background level, or
- (b) no further migration or expansion of the 50 µg/L total chromium plume.

The current background level (interim level) in groundwater for hexavalent chromium is 4 µg/L. This level will be used to determine background until the Water Board either confirms this level or establishes another level based on the previously cited background chromium study.

The Discharger may propose that the Water Board allow a quantified (for specific area and for a defined period of time) migration of the 4 µg/L hexavalent chromium

plume or the 50 µg/L total chromium plume as part of a proposed remedial action project. The proposal must clearly justify that the quantified migration is necessary to achieve compliance with this Order and is the only feasible method readily available to the Discharger. Additionally, the Discharger must clearly describe the actions that will be implemented to return the 4 µg/L hexavalent chromium plume or the 50 µg/L total chromium plume to their prior boundaries. If allowed, the Water Board will amend this order to establish the boundaries of this migration and the date that the Discharger must eliminate all levels of hexavalent chromium above 4 µg/L or total chromium above 50 µg/L in groundwater in the area of the allowed migration.

- 3.1. **By December 31, 2008**, achieve containment of the chromium plume in groundwater as defined in (a) above. Compliance will be determined by comparing groundwater samples collected after this date to the control limits established using data through the third quarter 2008 using the methodology contained in the *Boundary Control Monitoring Program* (see Finding No. 16, above, and Order 6.2, below), except that only the last eight samples for each well through the 3<sup>rd</sup> quarter 2008 must be used to determine the control limits.
- 3.2. **By December 31, 2008**, achieve containment of the 50 µg/L total chromium plume, as defined in (b) above. Compliance will be determined by comparing groundwater samples collected after this date will be compared to the control limits established using data through the third quarter 2008 using the methodology contained in the *Boundary Control Monitoring Program* (see Finding No. 16, above, and Order 6.2, below), except that only the last eight samples for each well through the 3<sup>rd</sup> quarter 2008 must be used to determine the control limits.

#### 4. Interim Groundwater Chromium Remediation

The Discharger must implement corrective actions to remediate the elevated chromium concentrations in groundwater in the source area at and near the Compressor Station.

- 4.1. The Discharger must continue implementation of full-scale in-situ corrective actions in the central area of the plume as described in Finding Nos. 9 and 13, or an alternate but equally effective method, to remediate the elevated chromium concentrations in groundwater in the central area of the plume.
- 4.2. The Discharger must continue implementation of the full-scale in-situ corrective actions in the source area described in Finding No. 10, or an alternate but equally effective method, to remediate the elevated chromium concentrations in groundwater in the source area.

5. Final Cleanup Actions

The Discharger must take all actions necessary to clean up and abate the effects of the discharge and threatened discharge of chromium to waters of the State.

- 5.1. **By September 1, 2010**, the discharger must submit a feasibility study report that assesses remediation strategies implemented at the site or proposed for the site for achieving compliance with State Water Resources Control Board Resolution 92-49, as amended. If the Discharger proposes a final cleanup strategy that will result in cleanup to concentrations higher than background water quality, the report must include a detailed analysis of different cleanup strategies, one of which must achieve background water quality, if feasible. For those strategies that have been implemented at the site, the report must describe the effectiveness of each remediation strategy compared to expected or modeled effectiveness. Any adverse environmental or public health impacts created from the implemented strategies must be reported along with remedies taken to correct such problems. The report must also include estimated cleanup times and costs for each remediation strategy to achieve the background level established by the Water Board or a level above background if it is not reasonable to achieve background levels considering the factors in section III.G. of Resolution 92-49. If background levels of water quality cannot be restored, the report must describe an alternate level of water quality above background that the remediation strategy can achieve and must describe why such a level is (1) consistent with the maximum benefit to the people of the state, (2) will not unreasonably affect present and anticipated beneficial use of the water, and (3) will not result in water quality less than that prescribed in the Water Quality Control Plans and Policies of the State and Lahontan Water Boards (See section III.G. of Resolution 92-49). Finally, the report must recommend a final remediation strategy for the entire site to achieve background levels of water quality or certain levels above background if achieving background is not reasonable and provide justifications for the recommendation.
- 5.2. **By April 1, 2011**, implement the final cleanup strategy as approved by Water Board.

6. Reporting

- 6.1. Groundwater monitoring associated with the site-wide groundwater monitoring program, the Desert View Dairy Land Treatment Unit, the Central Area In-Situ Remediation Zone project, and the Source Area In-Situ Remediation Zone project shall be reported on a coordinated schedule. Required quarterly sampling shall be reported by the 30<sup>th</sup> day following the end of the quarter, i.e., by April 30<sup>th</sup>, July 30<sup>th</sup>, October 30<sup>th</sup>, and January 30<sup>th</sup> of each year. Required semiannual sampling shall be

reported by April 30<sup>th</sup> and October 30<sup>th</sup> of each year. Sampling is to be conducted in the quarter prior to the appropriate reporting dates, i.e., from January 1 through March 31, April 1 through June 30, July 1 through September 30, and October 1 through December 31 of each year. The site-wide monitoring program shall conform to the wells and schedule presented in PG&E's July 2, 2008 *Updated Site-Wide Groundwater Monitoring Program* described in Finding No. 16, except that monitoring well MW-34 shall continue to be monitored semiannually and monitoring wells MW-64B and MW-67B shall be monitored semiannually.

This Order modifies the Monitoring and Reporting Program for Waste Discharge Requirements No. R6V-2006-0054 for the Source Area In-Situ Remediation Zone project and modifies the required monitoring and reporting periods of the August 17, 2007 order pursuant to Water Code section 13267 for the In-Situ Remediation Pilot Test Project.

- 6.2. The 3<sup>rd</sup> quarter 2008 groundwater monitoring report must contain a tabulation of the hexavalent and total chromium control limits for boundary control monitoring wells identified in the July 2, 2008 *Boundary Control Monitoring Program* described in Finding No. 16. The last eight samples for each well through 3<sup>rd</sup> quarter 2008 shall be used to calculate the 95 percent upper control limits, which become the control limits for those wells.
- 6.3. **Beginning September 30, 2008**, submit semiannual status reports describing actions taken to remediate chromium levels in groundwater and contain plume migration. The initial report must evaluate actions taken between January 1, 2008 and June 30, 2008 and subsequent reports must evaluate actions taken during each subsequent six-month period. Status reports must discuss remedial actions being implemented according to the cleanup plan approved by the Water Board. The report must tabulate the volume, concentration, and location of wastes discharged under orders from the Lahontan Water Board. Any and all violations of orders must be discussed and cite corrective measures taken. The report must provide groundwater monitoring data and discuss the actual effectiveness of the implemented remedy compared to its predicted effectiveness. Any adverse environmental or public health impacts created from the project must be reported along with remedies taken to correct such problems. The report must provide recommendations and an implementation schedule for increasing effectiveness if current actions are not achieving plume containment and expected reductions in chromium concentrations in groundwater. Subsequent semi-annual status reports must be submitted by March 31 and September 30 of each year.
- 6.4. **Beginning March 31, 2012**, submit semi-annual final cleanup effectiveness reports to the Water Board. The first report should evaluate actions taken between April 1, 2011 and December 31, 2011. Subsequent

reports must evaluate actions taken during six-month periods, the initial period being January 1, 2012 to June 30, 2012. Each report must discuss the actual effectiveness of the final cleanup remedy compared to expected effectiveness. If current actions are not achieving expected reductions in chromium concentrations throughout the entire site, the report must propose recommendations and an implementation schedule to increase effectiveness. Subsequent semi-annual status reports must be submitted by September 30 and March 31 of each calendar year.

7. Rescissions

This order rescinds Order No. 4 in CAO No. 6-01-50 requiring monthly groundwater monitoring and the May 1, 2003 Water Code section 13267 order that allowed bimonthly sampling to replace monthly sampling.

Failure to comply with the terms or conditions of this Order will result in additional enforcement action that may include the imposition of administrative civil liability pursuant to Water Code sections 13268 and 13350 or referral to the Attorney General of the State of California for such legal action as he may deem appropriate.

Ordered by: Harold J. Singer  
HAROLD J. SINGER  
EXECUTIVE OFFICER

Dated: August 6, 2008

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION**

**AMENDED CLEANUP AND ABATEMENT ORDER NO. R6V-2011-0005  
WDID NO. 6B369107001**

**REQUIRING PACIFIC GAS AND ELECTRIC COMPANY  
TO CLEAN UP AND ABATE WASTE DISCHARGES OF  
TOTAL AND HEXAVALENT CHROMIUM TO THE  
GROUNDWATERS OF THE MOJAVE HYDROLOGIC UNIT**

San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region (Water Board), finds:

1. The Pacific Gas and Electric Company (PG&E) owns and operates the Hinkley Compressor Station (hereafter the "Facility") located southeast of the community of Hinkley in San Bernardino County. For the purposes of this Order, PG&E is referred to as the "Discharger."
2. On August 6, 2008, the Water Board issued Cleanup and Abatement Order (CAO) No. R6V-2008-0002 to the Discharger to clean up and abate the effects of waste discharges and threatened discharges containing hexavalent chromium and total chromium to waters of the State. The CAO, in part, required the Discharger to prevent the chromium plume from migrating to locations where hexavalent chromium is below the background levels.
3. Sampling in the Hinkley Valley indicates that hexavalent and total chromium occur naturally in groundwater at variable concentrations, according to the February 27, 2007, document, *Groundwater Background Chromium Study Report, Hinkley Compressor Station*. The mean concentrations detected in background are 1.19 micrograms per liter ( $\mu\text{g/L}$ ) for hexavalent chromium and 1.52  $\mu\text{g/L}$  for total chromium. The work plan for the Study recommended that maximum background concentrations should be expressed as the 95% upper tolerance limits. The 95% upper tolerance limit is the value that is estimated to include 95 percent of the population with a 95 percent confidence level. The 95% upper tolerance limits are 3.09  $\mu\text{g/L}$  for hexavalent chromium and 3.23  $\mu\text{g/L}$  for total chromium.
4. At the November 12-13, 2008 meeting, the Water Board considered the 2007 *Background Chromium Study*, along with comments and recommendations by

interested persons and staff. Following the meeting, the Water Board Executive Officer issued Amended CAO No. R6V-2008-0002A1 to establish background concentrations for chromium in Hinkley Valley groundwater as follows:

Maximum background hexavalent chromium = 3.1 µg/L

Maximum background total chromium = 3.2 µg/L

Average background hexavalent chromium = 1.2 µg/L

Average background total chromium = 1.5 µg/L

5. The levels described in Finding 4, above, are used to determine compliance with background concentrations against which remediation strategies are to be assessed, and to determine if the chromium plume has migrated into areas previously unaffected by PG&E's discharge. The levels also provide for the basis for determining wells which are considered affected by PG&E's discharge. Wells with concentrations that exceed these background levels are deemed affected by the discharge of waste chromium from the Facility.
6. On July 28, 2010, Water Board staff received information from PG&E that hexavalent and total chromium concentrations exceeded background concentrations at three residential wells and four shallow monitoring wells along Summerset Roads, and to the east of Summerset Road, north of Santa Fe Avenue. Three of these wells contained hexavalent chromium ranging from greater than 4 µg/L to 5.5 µg/L. These data indicate that the chromium plume had migrated to locations where the hexavalent chromium levels had previously been below background levels, according to previously submitted data. This violates the requirements of CAO No. R6V-2008-0002 regarding plume migration described in Finding 2, above.
7. The migration of the waste chromium plume constitutes a discharge of waste creating a condition of pollution to previously unaffected groundwaters of the State.

#### **AUTHORITY – LEGAL REQUIREMENTS**

8. California Water Code section 13304, subdivision (a) states in part:

*Any person . . . who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged to waters of the state and creates, or threatens to create, a condition of pollution or nuisance, shall upon order of the regional board clean up or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including but not limited to, overseeing cleanup and abatement efforts. A cleanup and abatement order issued by the state board or a regional board may require the provision of, or payment for,*

*uninterrupted replacement water service, which may include wellhead treatment, to each affected public water supplier or private well owner.*

9. The conditions described in these Findings identify discharges of wastes in violation of a previously issued CAO, where chromium wastes have been discharged or deposited into waters of the State (groundwater) or probably will be discharged into the waters of the State. The Discharger is therefore subject to Water Code section 13304.
10. The Water Code does not define what constitutes an "affected" well. As described in Finding 5, above, Water Board staff has determined that any well with concentrations of total or hexavalent chromium above the maximum background levels described in Finding 4 are affected by PG&E's discharge.
11. Pursuant to Water Code section 13304, subdivision (f):

*Replacement water provided pursuant to subdivision (a) shall meet all applicable federal, state, and local drinking water standards, and shall have comparable quality to that pumped by the public water system or private well owner prior to the discharge of waste.*
12. Pursuant to Water Code section 13267, subdivision (b):

*In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the reports, and shall identify the evidence that supports requiring that person to provide the reports.*
13. This Order requires monitoring and reports pursuant to Water Code section 13267, subdivision (b). The monitoring required by this Order is necessary to evaluate the extent of pollution in groundwater, determine affected well owners, and to protect human health. Workplan and technical reports required in this

Order are essential to design a water replacement plan and implementation schedule and to determine compliance with this Order.

14. Pursuant to Water Code section 13304, the Water Board is entitled to, and may seek, reimbursement for all reasonable costs actually incurred by the Water Board to investigate unauthorized discharges of wastes or to oversee cleanup of such waste, abatement of the effect thereof, or other remedial action pursuant to this Order.
15. The issuance of this Order is an enforcement action taken by a regulatory agency and is exempt from the provision of the California Environmental Quality Act (Public Resources Code section 21000 et seq.), pursuant to California Code of Regulations (CCR), title 14, section 15321, subdivision (a)(2). The implementation of this Order is also an action to assure the restoration of the environment and is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, section 21000 et seq.), in accordance with CCR, title 14, sections 15308 and 15330.

**IT IS HEREBY ORDERED**, pursuant to Water Code sections 13267 and 13304, the Discharger must:

1. **By January 25, 2011**, submit and implement a proposed water replacement plan to the Water Board's Assistant Executive Officer for approval. The water replacement plan shall describe a method to supply uninterrupted replacement water service (i.e., bottled water or equivalent), to residences or businesses served by private or community domestic wells in which hexavalent chromium has been detected at concentrations exceeding 3.1 µg/L, or total chromium has been detected at concentrations exceeding 3.2 µg/L, based on data generated in the most recent sampling event for any domestic well in the Project Area. The Project Area is defined as the area up to 3,000 feet from the 3.1 µg/L hexavalent chromium plume boundary identified in the most recent groundwater monitoring report submitted by the Discharger. The Project Area may be modified if chromium concentrations increase above 3.1 µg/L (hexavalent) or 3.2 µg/L (total) in additional supply wells. "Uninterrupted water service" means that water shall be supplied continuously to meet human water consumption needs (including drinking and cooking) with no break in water availability longer than two hours.
  - 1.1. The water replacement plan shall describe how the water needs of each replacement water recipient shall be determined to ensure adequate uninterrupted water supply. The water replacement plan shall describe plans to monitor domestic supply wells within the Project Area described in Order No. 1, above, for the purpose of determining the likelihood of future exceedance of the maximum background level of hexavalent or total chromium to assess the need for any domestic supply well's inclusion into the replacement water plan. The plan must also describe how new

residences or businesses will be added to the program should hexavalent chromium or total chromium be detected in domestic or community wells exceeding the above listed concentrations.

- 1.2. Implement the approved water replacement plan as revised after comments from Water Board staff. Replacement water service for a particular well can only be ceased upon the Assistant Executive Officer's concurrence that at least three sampling events occurring no less than 30 days apart verify that chromium concentrations are less than 3.1 µg/L hexavalent chromium and 3.2 µg/L total chromium.
2. **By January 28, 2011**, provide a letter report to the Water Board listing all residences and business that have been provided uninterrupted replacement water service. The letter report must include addresses, well numbers, and detected hexavalent chromium and total chromium concentrations.
3. **By February 1, 2011**, provide written notification to all parcel owners and occupants in the Project Area that hexavalent chromium concentrations in groundwater may exceed the maximum background of 3.1 µg/L, or total chromium concentrations may exceed the maximum background of 3.2 µg/L. The Discharger shall also include notification that all potentially affected wells will need to be sampled on a quarterly basis, beginning February 15, 2011. The notification should include letters to each business, residence or individual in the Project Area. Copies of the notifications must be received by the Water Board.
4. **Beginning April 30, 2011**, in all further quarterly reports submitted to the Water Board, provide a listing of all residences and businesses addresses and well numbers that have been provided uninterrupted replacement water service. Include the method(s) that the Discharger has implemented to provide uninterrupted replacement water service including how this service will be maintained. If access to properties for well sampling or water delivery is denied, list the address, well number, and date of denied access. CAO No. R6V-2008-0002 requires the Discharger to submit quarterly groundwater monitoring reports by January 30<sup>th</sup>, April 30<sup>th</sup>, July 30<sup>th</sup>, and October 30<sup>th</sup> of each year.

**Liability for Oversight Costs Incurred by Water Board:** The Discharger shall be liable, pursuant to Water Code section 13304, to the Water Board for all reasonable costs incurred by the Water Board to investigate unauthorized discharges of waste, or to oversee clean up of such waste, abatement of the effects thereof, or other remedial action, pursuant to this Order. The Discharger shall reimburse the Water Board for all reasonable costs associated with site investigation, oversight, and cleanup. Failure to pay any invoice for the Water Board's investigation and oversight costs within the time stated in the invoice (or within thirty days after the date of invoice, if the invoice does not set forth a due date) shall be considered a violation of this Order. If the Discharger is enrolled in a State Board-managed reimbursement program, reimbursement shall be

made pursuant to this Order and according to the procedures established in that program.

**Certifications for All Plans and Reports:** All technical and monitoring plans and reports required in conjunction with this Order are required pursuant to Water Code section 13267 and shall include a statement by the Discharger, or an authorized representative of the Discharger, certifying (under penalty of perjury in conformance with the laws of the State of California) that the workplan and/or report is true, complete, and accurate. Hydrogeologic reports and plans shall be prepared or directly supervised by, and signed and stamped by a Professional Geologist or Professional Civil Engineer registered in California.

**No Limitation of Water Board Authority:** This Order in no way limits the authority of this Water Board to institute additional enforcement actions or to require additional investigation and cleanup of the site consistent with the Water Code. This Order may be revised by the Executive Officer as additional information becomes available.

**Enforcement Options for Noncompliance with the Order:** Failure to comply with the terms or conditions of this Cleanup and Abatement Order will result in additional enforcement action, which may include the imposition of administrative civil liability pursuant to Water Code sections 13350 and 13268 or referral to the Attorney General of the State of California for such legal action as he or she may deem appropriate.

**Evidentiary Hearing before the Water Board -** Any person affected by this action of the Water Board may request an evidentiary hearing before the Water Board. The Water Board's Executive Officer may elect to hold an informal hearing or a "paper hearing" in lieu of scheduling a hearing before the Water Board itself. If the Discharger decides to request an evidentiary hearing, send the request to the Water Board Assistant Executive Officer, Attn: Lauri Kemper. Please consider the following carefully:

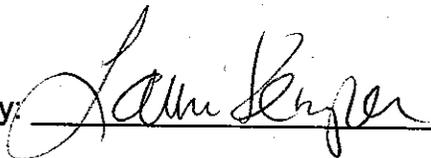
- a. The Water Board must receive your request within **30 calendar days** of the date of this Order.
- b. The request must include all comments, technical analysis, documents, reports, and other evidence that you wish to submit for the evidentiary hearing. However, please note that the administrative record will include all materials the Water Board has previously received regarding this Site. You are not required to submit documents that are already in the record.
- c. The Executive Officer or Water Board may deny a request for a hearing after reviewing the evidence.
- d. If the Discharger does not request an evidentiary hearing, the State Water Resources Control Board (State Water Board) may prevent the

Discharger from submitting new evidence in support of a State Board petition.

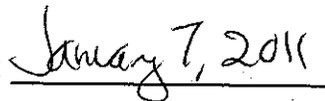
- e. The Discharger's request for an evidentiary hearing, if one is submitted, does not stay the effective date of the Order, whether or not a hearing is scheduled.
- f. A request for an evidentiary hearing does not extend the 30-day period to file a petition with the State Water Board (see below). However, in that case, the Discharger is advised to ask the State Board to hold the petition in abeyance while the Discharger's request for an evidentiary hearing is pending. (Refer to CCR Title 23 Section 2050.5(d)) Additional information regarding the SWRCB petition process is provided below.

**Right to Petition:** Any person aggrieved by this action of the Water Board may petition the State Water Board to review the action in accordance with Water Code section 13320 and California Code of Regulations, title 23, sections 2050 and following. The State Water Board must *receive* the petition by 5:00 p.m., 30 calendar days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at: [http://www.waterboards.ca.gov/public\\_notices/petitions/water\\_quality](http://www.waterboards.ca.gov/public_notices/petitions/water_quality) or will be provided upon request.

Ordered by:



Dated:



LAURI KEMPER  
ASSISTANT EXECUTIVE OFFICER



# California Regional Water Quality Control Board Lahontan Region



Linda S. Adams  
Acting Secretary for  
Environmental Protection

2501 Lake Tahoe Boulevard, South Lake Tahoe, California 96150  
(530) 542-5400 • Fax (530) 544-2271  
www.waterboards.ca.gov/lahontan

Edmund G. Brown Jr.  
Governor

January 10, 2011

Robert C. Doss  
Pacific Gas and Electric Company  
MAIL CODE B24A  
77 Beale Street  
San Francisco CA 94120

## PRELIMINARY COMMENTS ON FEASIBILITY STUDY FOR CHROMIUM POLLUTION, PG&E COMPRESSOR STATION, HINKLEY, SAN BERNARDINO COUNTY

On August 31, 2010, the Water Board received the document, "Feasibility Study (Study)" for final site cleanup at the Pacific Gas and Electric Company's (PG&E) Compressor Station in Hinkley. The Study, prepared by Haley & Aldrich, was submitted in compliance with Order No. 5.1 of Cleanup and Abatement Order (CAO) No. R6V-2008-0002. The Study develops a final remedy for chromium pollution to groundwater and includes an evaluation to comply with Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304".

Upon notification by Water Board staff that the Study lacked discussion and an evaluation of estimated cleanup time and cost to achieve the average background concentration of 1.2  $\mu\text{g/L}$  hexavalent chromium [Cr(VI)] as required in the CAO, PG&E submitted a letter of Supplemental Data, dated October 14, 2010, containing the missing information.

Using more than 20 years of assessment, pilot testing, and interim remedial actions, PG&E identifies five possible remedial approaches capable of cleaning up chromium in groundwater to background levels. Of those five approaches, PG&E recommends implementing Alternative 4 involving in-situ remediation to clean up the plume core to 50  $\mu\text{g/L}$  total chromium [Cr(T)] and groundwater pumping at the toe or downgradient-most end of the plume for plume containment using extraction wells and agricultural land treatment. While the Supplemental Data shows a potential cleanup time of 220 years to achieve cleanup to the average background concentration of 1.2  $\mu\text{g/L}$  hexavalent chromium [Cr(VI)], PG&E only recommends clean up to the maximum background concentration of 3.1  $\mu\text{g/L}$  Cr(VI) due to the lack of regulatory basis or precedent for cleaning up to the average background level.

*California Environmental Protection Agency*



01-00055

## **Preliminary Comments and Recommendations**

The following are the Water Board staff's preliminary comments for the Study and Supplemental Data. These comments are subject to change or may be augmented following additional technical evaluation by the Department of Toxic Substances Control and input received during the initial public comment period on the Study that ends January 10, 2011.

1. The Study or its addendum must describe the existing levels of hexavalent and total chromium concentrations in groundwater throughout the Project Area. The Study only states in Section 3.3.2 that the chromium data from the February 2010 sampling set was used for the purposes of defining the Remedial Area in the Study. Of the numerical values listed for chromium in the Study, the highest value mentioned is 50 µg/L Cr(T). The February 2010 monitoring data shows that up to 8,450 µg/L Cr(VI) and 8,170 µg/L Cr(T) were detected in the Source Area at well SA-MW-05D, exceeding the hazardous waste limit of 5,000 µg/L. In contrast, Section 3.3.3 goes into great detail in describing the various total dissolved solids (TDS) and nitrate concentrations in groundwater along the entire length of the chromium plume.
2. The Study states in numerous sections that in-situ remediation at the site is currently operating at full scale. Section 4.3 states that, "To date, three pilot and three full-scale IRZs (in-situ remediation zones) have been implemented." Water Board staff disagree with this statement, since in-situ remediation is only operating at pilot study areas. Full-scale in-situ remediation operations that extend out to the 50 µg/L Cr(VI) chromium plume boundaries have not yet been implemented at the site. We request the addendum clarify this information from the Study.
3. In Study Section 3.3, a description of high concentrations of total dissolved solids (TDS) in groundwater in the area of the chromium plume is attributed to historical agricultural use unrelated to PG&E's activities. The Study, however, fails to mention that PG&E's past land treatment units also likely contributed to higher than normal TDS concentrations in groundwater. PG&E operated the East land treatment unit on the north side of Community Boulevard for about ten years. PG&E also operated the Ranch land treatment unit between Highway 58 and Santa Fe Avenue for about four years. These past PG&E operations contributed to increased TDS levels in groundwater that now extend over a 1.5 mile distance in the chromium plume. Furthermore, TDS data in Study Figure 2-4 indicate that operations at the Compressor Station have also added to TDS impacts to groundwater above background concentrations.
4. In discussing plume boundary control in Section 4.1.1, the Study states that, "...data show that groundwater extraction from this well network is largely effective in achieving hydraulic capture of the northern portion of the Remedial Area plume, thus containing it." This statement is inaccurate based on data submitted throughout

2010 showing that the northern portion of the chromium plume is not being captured by PG&E's groundwater extraction. PG&E has been notified of its failure to contain the plume in accordance with directives in CAO R6V-2008-0002. Third Quarter 2010 monitoring data for the Desert View Dairy indicates further violation of plume containment beyond the Dairy property. We request that PG&E provide in an addendum a more accurate description of the limits of the plume containment efforts to date and offer additional measures to effectively contain plume migration.

5. The description of the five alternatives for final site clean up contains incomplete discussions. For instance, the descriptions for Alternatives 2 through 5 state that emphasis is placed on rapid reduction of Cr(VI) concentrations in the plume core ( $>50 \mu\text{g/L}$ ) to expedite re-establishing beneficial use of the Upper Aquifer. However, this premise is short-sighted given the current proposed public health goals. Beneficial uses may not be considered restored by achieving  $50 \mu\text{g/L}$  Cr(VI). Additionally, the Study descriptions of each alternative imply that the primary cleanup method will be shut off following achievement of cleanup to the  $50 \mu\text{g/L}$  Cr(T) concentration boundary. The exception being Alternative 4 which states that, "(fate and transport modeling and cost estimates assume IRZ is discontinued after 5 years of operation)". Moreover, the descriptions and model simulations in Appendix E imply that natural attenuation will be the principal method for achieving cleanup to background concentrations after remediation to the  $50 \mu\text{g/L}$  Cr(T) boundary occurs. PG&E needs to explicitly describe in an addendum the timing and area of implementation for each proposed active remedial actions. PG&E must also include at least one alternative where remedial actions continue until background concentrations of Cr(VI) are achieved in the groundwater within the Project Area.
6. The Study contains conflicting information concerning the degree of chromium clean up using in-situ remediation. Section 4.3.1 states that in-situ treatment in the Central and Source Areas was able to achieve clean up of chromium to background levels in approximately 50 to 60 percent of the treated wells. Yet, the section concludes that it would be extremely difficult to fully treat Cr(VI) to background in all areas of the plume due to variations in groundwater flux and heterogeneities in the formation. In comparison, data in in-situ monitoring reports imply that more aggressive treatment implementation would enable clean up chromium in groundwater to background levels in all or almost all treatment wells. Water Board staff requests PG&E evaluate the benefits of more aggressive treatment actions which include in-situ treatment for a longer period of time (10 and 20 years), closer-spaced extraction and injection wells, and the application of additional in-situ zones.
7. Water Board staff requests PG&E provide an estimate for chromium mass (hexavalent, trivalent, and total chromium) to be left in the environment following completion of each of the remediation alternatives. Alternative 1 indicates that all chromium mass will be left in the groundwater over a wide area in the form of hexavalent chromium. Alternatives 2 through 4 imply that chromium mass will be left



in the soil within 5 feet of ground surface and/or at the water table, approximately 80 feet below ground surface, in the trivalent solid state. Lastly, Alternative 5 indicates that most of the chromium mass will be removed from the environment by ex-situ treatment while some will be left in the soil within 5 feet of ground surface in the trivalent solid state. An estimate of chromium mass to be left in the environment for each remedial approach is needed to compare the different alternatives. In addition, provide a comparison of the amount of chromium mass to be left in the environment to the amount of chromium naturally in soil at the site.

8. The estimated cleanup times given for each of the five alternatives are unacceptably long with respect to restoring beneficial uses of groundwater within the Project Area. The Supplemental Data lists an estimated cleanup time for the recommended alternative, Alternative 4, as being 6 years for the 50 µg/L Cr(T) concentration boundary, 150 years for the 3.1 µg/L Cr(VI) concentration boundary, and 220 years for the 1.2 µg/L Cr(VI) concentration boundary. The latter two estimated cleanup times represent 144 years and 214 years in which no active remediation will be occurring at the site other than possible groundwater extraction for plume containment in the north. Since the Study indicates that active remediation is technically reasonable and feasible to achieve cleanup from 8,170 µg/L to 50 µg/L Cr(T) concentration in six years, continuing such efforts for up to 20, or even 40 years would likely significantly reduce hexavalent chromium concentrations and, thus, the overall cleanup time to achieve background concentrations. Water Board staff recommends evaluating at least one alternative with ongoing active remediation actions until maximum background concentrations are reached. These alternatives should describe rates of cleanup and estimated chromium concentrations at 10, 20, and 40 years.
9. Water Board staff requests PG&E clarify its recommendation in an addendum to include at least one revised alternative that hastens cleanup times and provides better measures to ensure that the existing plume size will not expand in size, pursuant to Water Board's 2008 and 2009 Cleanup and Abatement Orders. In addition, evaluate benefits and impacts of various remedies and scales of implementation for a revised alternative.

### **General Considerations**

As part of developing and evaluating alternatives with active remediation occurring over larger areas and continuing over longer time periods, Water Board staff requests PG&E evaluate in an addendum a new alternative that combines Alternatives 2, 3, and 5 for simultaneous implementation in an aggressive manner (e.g. greater pumping rates, additional and extended in-situ treatment zones, longer active remediation time, etc.). An evaluation of these combined alternatives should include description of benefits (increased reduction of chromium concentrations in groundwater) and adverse effects.

Alternative 2 provides for plume containment at the toe or downgradient-most end of the plume using extraction wells and agricultural land treatment. This method appropriately implemented could prevent further chromium migration in groundwater to unaffected areas. Since PG&E already owns the Desert View Dairy and the Gorman fields in the north, implementation of this alternative would be almost immediate. Additional extraction wells are likely needed to ensure containment of potential plume migration along the northwestern and southeastern plume boundaries.

Alternative 3, which primarily proposes plume-wide in-situ remediation, may be appropriate for implementation over the entire off-site plume length (approximately 1.8 miles), to the containment zone in the north. This alternative is easily implemented considering that in-situ remediation facilities are already in place and would only require additional wells and piping to expand treatment out to the 3.1 µg/L Cr(VI) plume boundary. Some property acquisition might also be required. Potential by-products of reduced metals, such as iron, manganese, and arsenic, would only occur for a limited distance and over a limited time during overall remediation activities.

Alternative 5, which primarily proposes groundwater extraction and ex-situ treatment using an aboveground treatment facility, may be appropriate for implementation in the Source Area in lieu of in-situ remediation for two reasons: chromium exists at hazardous waste concentrations and the method offers complete removal of chromium from the environment, preventing potential conversion back to hexavalent chromium in the future. Implementing this alternative would require constructing a new treatment facility on the Compressor Station property, already in PG&E's control, similar to the facility built to remediate hexavalent contamination in Topock.

As proposed in the Study for each alternative, it is appropriate to continue operating the freshwater injection wells in the northwestern plume area to prevent plume migration in that direction.

Following achievement of remediation by the three alternatives to 3.1 µg/L Cr(VI), monitored natural attenuation could be used to verify final site cleanup to the average background value of 1.2 µg/L Cr(VI).

#### **Report Requested**

Water Board staff requests that by **January 31, 2011**, PG&E provide an addendum that addresses the comments and requests for information in this letter. The addendum must include an evaluation and estimates of cleanup using a combined approach, implementing simultaneous active remediation (combining Feasibility Study Alternatives 2, 3, and 5) for the 10-year, 20-year, and 40-year timeline, for achieving cleanup to 50 µg/L Cr(T), 3.1 µg/L Cr(VI), and 1.2 µg/L Cr(VI). Also, disclose potential environmental impacts (e.g., chromium mass, drawdown, subsidence, TDS increase, etc.) from implementing this combined remedial approach.

Robert C. Doss  
Pacific Gas and Electric Company

- 6 -

If you have any concerns about these comments, please contact Lisa Dernbach at (530) 542-5424 or me at (530) 542-5436.



LAURI KEMPER  
ASSISTANT EXECUTIVE OFFICER

cc: PG&E Mail and Lyris Lists

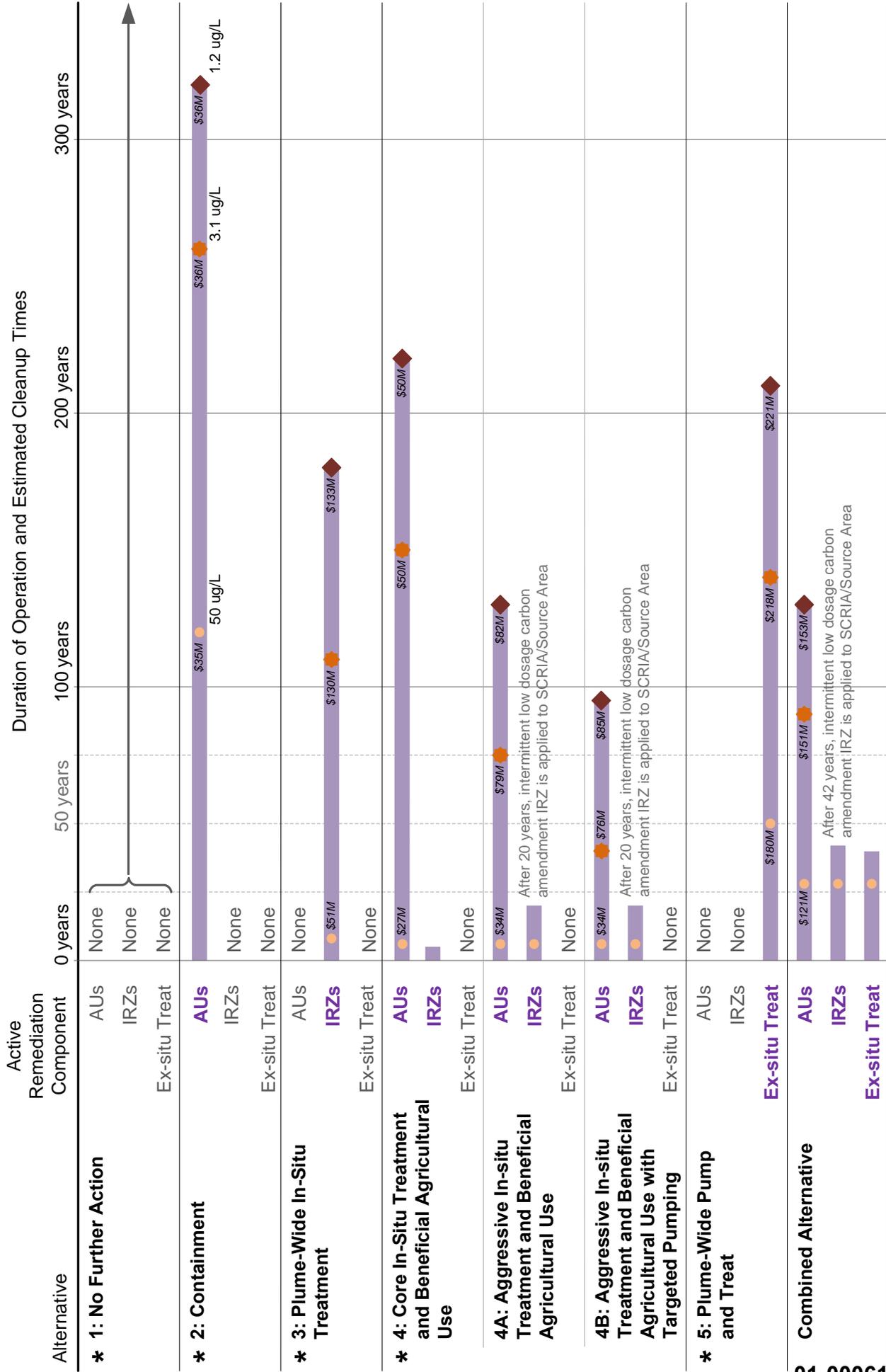
LSD/ad LSD/adwU:Cleanup and Enforcement/ Specialists PG&E Hinkley,PG&E Feas Study comments 1-10-11 lsd  
File Under: WDID 6B369107001 (VVL)

*California Environmental Protection Agency*



01-00060

# Remedial Alternative Summary – Active Remediation Components and Durations



\* Alternative per FS (8/30/2010)  
 AUS = Agricultural Units  
 IRZs = In-situ Reactive Zones  
 Ex-situ Treat = Includes pump and ex-situ treatment system

○ 50 ug/L  
 ● 3.1 ug/L  
 ◆ 1.2 ug/L\*\*

Durations required to achieve the noted criteria. Durations were based on the time when the starting plume area (within the respective Cr(VI) contour interval) is reduced by 99 percent in model Layers 1 and 3 (based on the modeling of alternatives).  
 \*\* to the extent achieving this criteria is feasible

Net present value (NPV) cost est. in millions (M) to reach criteria (rounded)

Figure 1





*Linda S. Adams*  
Acting Secretary for  
Environmental Protection



## Department of Toxic Substances Control

Leonard E. Robinson  
Acting Director  
5796 Corporate Avenue  
Cypress, California 90630



*Edmund G. Brown Jr.*  
Governor

### INTRAGENCY MEMORANDUM

**TO:** Harold J. Singer  
Executive Officer  
Regional Water Quality Control Board, Lahontan Region

**FROM:** *Karen Baker for*  
Stewart W. Black  
Acting Deputy Director  
Brownfields and Environmental Restoration Program  
Department of Toxic Substances Control

**VIA:** *Karen Baker*  
Karen T. Baker, CHG, CG  
Performance Manager  
Office of Geology

**DATE:** May 17, 2011

**SUBJECT:** REVIEW OF FEASIBILITY STUDY, PACIFIC GAS AND  
ELECTRIC COMPANY (PG&E) COMPRESSOR STATION,  
HINKLEY, SAN BERNARDINO COUNTY

### Background

In response to the request by the Lahontan Water Board Staff to review and provide recommendations on the Feasibility Study for a groundwater remedy at the subject site, Department of Toxic Substances Control (DTSC) Senior Hazardous Substances Engineers, Ms. Yolanda Garza and Mr. Aaron Yue, provided an administrative review of the August 31, 2010 Feasibility Study prepared by Haley and Alrich, Incorporated for PG&E, and its two addenda dated January 31, 2011 and March 3, 2011. These reports together form the complete Feasibility Study (FS) at the site.

Based on the summary of the FS, DTSC staff note that PG&E has limited the proposed groundwater remedy evaluations to technologies that are capable of remediating hexavalent chromium (Cr(VI)) in groundwater to achieve two regulatory water quality

01-00062

Mr. Harold J. Singer  
May 3, 2011

objectives (WQOs) pursuant to the Cleanup and Abatement Order (CAO) issued by the Lahontan Regional Water Quality Control Board:

1. Site-specific background conditions as required under State Water Resources Control Board (SWRCB) Resolution 92-49 (Resolution 92-49); and
2. The State of California Maximum Contaminant Level (MCL) of 50 micrograms per liter ( $\mu\text{g/L}$ ), which provides the basis for the most restrictive beneficial use for groundwater (total chromium (Cr(T) and Cr(VI)).

In addition to the WQOs, Chapter 5 of the FS identified four Remedial Action Objectives (RAOs) that must be met by all remedial alternatives under the "effectiveness" selection criterion. The RAOs are:

- Achieve background conditions;
- Restore groundwater beneficial use;
- Achieve plume containment; and
- Restore productive use of the groundwater resource.

**History of Remedial Activities:** PG&E had instituted several actions at and around the vicinity of the site after the investigation of groundwater and soil between 1987 – 1991. These actions consisted of at least three land treatment units; three in-situ remedial operations using treated and untreated groundwater, as well as, fresh water injection for hydraulic barrier containment. Land treatment operations were conducted by extracting contaminated groundwater and applying it to agricultural fields where the agricultural crop naturally converted the hexavalent chromium to a trivalent form of chromium. In addition to reduction of hexavalent chromium, these Land Treatment units also provided plume containment by operation in specific areas such as the former East Landfarm and the Desert View Dairy property. Additional in-situ reduction pilot tests were also implemented at the compressor station and the East Landfarm location in 2004 by injection of food grade substrates into groundwater.

Two years later, another in-situ pilot test was instituted to control plume migration in the central plume area. This interim remediation zone was designated as a treatment barrier, using water extraction and substrate injection methods. The Source area interim remediation zone around the compressor station was designed to treat source area groundwater contamination with down gradient extraction to induce reductant flow and up gradient injection. The South central reinjection area interim remediation zone was redesigned to treat groundwater extracted from the northern diffuse end of the plume and treat hexavalent chromium in the aquifer as well.

### **Comments and Summary of Review**

Plume containment and capture is a significant issue at this site. DTSC understands that PG&E may have the information, data and analysis necessary to adjust, modify and/or redesign the pilot studies, including the potential to scale up the pilot operations

Mr. Harold J. Singer  
May 3, 2011

to ensure plume containment and capture. However this evidence was not transparent nor explained in their final Alternative recommendations. Furthermore, the FS lacks discussion on remedial action which may have been implemented to address source investigation and control. This work is important because it may affect plume containment if there is ongoing migration of hexavalent chromium from soil to groundwater. Vigilance through monitoring and data analysis should continually be assessed throughout the remediation process as understanding of plume, groundwater and data evolve.

The discussion of the alternatives proposed in the FS as potential remedy is not adequate to address the complexity of the site. The four basic treatment alternatives of containment, plume-wide in-situ treatment; plume-wide pump and treat; and core in-situ treatment with beneficial agricultural use do not appear to be tailored to the nuances of the plume or the wide range in the contaminant concentrations through out the project area. Supplemental submissions from PG&E in response to comments from the Water Board contained a more thoughtful combination and tailored approach to the various areas of the site instead of plume wide remedies. As a result, PG&E identified additional variants of the alternatives discussed in the Addenda #1 and #2 as Alternatives 4a and 4b.

The Addenda were developed with more interactive parameters and combined potential remedial alternatives to address the complexity of the site and groundwater plume. The level of evaluation and approach taken in the addenda to meet the RAOs should be expanded to include more criteria than cost, implementability and effectiveness. This suggested concept is expanded in the technical comments provided below.

Although DTSC has been requested to evaluate the FS strategy, this review is limited by the site information provided in the document. Our review can not replicate or displace the significant site information PG&E has developed. DTSC staff are not familiar with the site-specific intricacies of the geo-chemistry and hydrogeology, or PG&E's claims of regional nitrate and TDS degradation of the groundwater not associated with historical PG&E operations. We are also not familiar with details of the provisions and limitations of the 1987 and subsequent CAOs and Resolution 92-49. Therefore, DTSC can only review the FS based on information provided without prejudices on the accuracy of the background information as presented in the FS document. It is significant, therefore, for DTSC to underscore the importance for additional documentation that reveal the scientific and strategic analysis that must have taken place in order to arrive at the final recommendations in the FS by PG&E.

Rather than going back to refine the FS with additional addenda, DTSC suggests to proceed cautiously and only after reviewing the scientific evidence, assumptions and investigation derived documentation developed by PG&E for the remedial alternatives that meet the RAOs developed by the Water Board. Given the magnitude of the existing pilot tests and remedial measures already in place, PG&E should include additional details for the proposed remedial alternatives that are scientifically backed by *evidence from a calibrated flow model, with clearly defined assumptions used in the fate*

Mr. Harold J. Singer  
May 3, 2011

and transport evaluation associated with the site conceptual model for the contamination. Furthermore, it is recommended in the technical responses below, for PG&E to utilize more of the established EPA guidance developed for remedial actions.

DTSC also recommends consideration of focus areas for remediation goals and strategy. At some complex sites, individual areas or operable units are defined and can be treated as separate sites throughout the remedial process. DTSC recommends consideration of this separation given the distinct but interactive zones and regions in the groundwater and soil. It will allow completion and monitoring of focus areas for attainment of RAOs.

Finally, DTSC concurs with the FS proposal for a 5-year review cycle and recommends the CERCLA guidance to implement this strategy. DTSC recommends that in addition to the development of comprehensive remedial goals, short term RAOs can be identified and strategically targeted for completion by the five-year review for the selected remedial action. In so doing, PG&E can focus their efforts in the first five years to obtain maximum contaminant reduction to MCLs and plume containment through a combination of specific remedial actions. Elements of the remedy can then be modified and adjusted, such as extraction and injection well placement can be assessed based on evidence at the five year review. Under this approach, PG&E can switch or modify the remedy after attainment of the short term RAOs as necessary to respond to the changes in the subsurface conditions for the long term RAOs.

Further guidance on a comprehensive Remedy in complex sites can be found in EPA's Superfund Comprehensive Five-Year Review Guidance, EPA 540-R-01-007, OSWER no. 9355.7-03B-P and can also be found at:  
**<http://www.epa.gov/superfund/accomp/5year/guidance.pdf>**

In summary, DTSC finds the current FS lacking in details that would be vital for the evaluation of plume containment effectiveness. Moreover, limitation of beneficial use only to agriculture, open ended timeframe for cleanup, and lack of design details on customized combined technologies and alternative approaches are areas that may require additional supporting evidence or evaluation. At present, the FS lacks focus on contaminant mass removal as a performance measure and efficiencies of remedial technology for future modeling. Adequate source elimination or removal discussion could provide a better understanding of the plume behavior and its control. Finally, we recommend that the Water Board consider phasing and segmenting the plume into operable units. This will allow associated remedies based on contaminant concentrations, groundwater influences and may increase productive assessment of the selected remedies.

DTSC appreciates the opportunity to provide input on this important FS and hopes that the expedited review provides valuable suggestions to the Lahontan Regional Regional Water Quality Control Board on its effort to protect public health and the environment.

Mr. Harold J. Singer  
May 3, 2011

## Technical Responses to the Lahontan Regional Water Quality Control Board

Based on the cursory review of the FS with limited site specific knowledge, DTSC notes the remarkable absence of engineering details for all remedial alternatives to properly evaluate the effectiveness of plume containment at the site. However, as part of the Lahontan Regional Water Quality Control Board request for DTSC's review of the FS, specific questions were presented to guide our review. Those questions are reproduced below along with our responses as a result of the FS review.

1. Does the Feasibility Study provide a well rounded evaluation of best available technologies for the remediation of Cr6 in groundwater and a solid basis for the elimination of alternatives to arrive at their preferred remedy?

**Response:** The technologies identified by PG&E are well known methods for remediation of the contaminant of concern. However, the evaluation itself appeared to lack the scope required to address the large scale groundwater plume which is currently underlying the site. Given the complex hydrogeology and concentration fluctuations across the plume (vertical and horizontal), it may be more efficient to evaluate remediation alternatives in sectional or operable unit sectors. This will help PG&E and the community to better assess the selected alternative in each area and monitor the remediation system efficiency. Use of the operable unit approach will also allow PG&E and the Water Board to evaluate plume capture, mass balance, mass removal, and other parameters that are customarily evaluated in the corrective action cleanup processes.

DTSC agrees that Table 6-1 and 6-2 of the FS provided a reasonable list of processes and technologies available for the remediation of groundwater contaminated with hexavalent chromium. We believe that the "best available technology" for remediation of the site would likely be a combination of the processes and treatment parameters presented in the two FS addenda.

DTSC agrees with the Water Board's comments to PG&E requesting further refinement of the proposed remedial alternatives. Even with the addenda, there is still a lack of specificity associated with the conceptual design of all alternatives presented. Although the FS identified various extraction rates and proposed general injection areas to promote clean-up and sustain hydraulic containment, the models presented by PG&E lacks particle tracking information over time to properly evaluate the effectiveness of the current systems or any given concept that will be proposed for the future.

It is understood that there are infinite possibilities on number of wells, well locations, extraction rates and injection parameters. However, it is PG&E's responsibility to ensure that all proposed alternatives would, at a minimum, truly achieve the stated outcome. It is only after such documentation, that the basis of the comparison and refinement of each alternative can begin.

Mr. Harold J. Singer  
May 3, 2011

As for the rejection of Alternatives 1 and 2, these alternatives clearly do not meet the established Remedial Objectives specified in Chapter 5 of the FS; therefore, they are appropriately rejected. The bases for rejecting Alternative 3, 4, 4a and 5 as the preferred remedy are less obvious. Without refinement of the design concept, PG&E can argue for or against any of the alternatives as described.

2. Are the remedy selection criteria used (such as estimated cleanup times and cost) in the Feasibility Study appropriate and should other criteria be considered as part of a balanced remedy evaluation?

Response: DTSC notes that under the Lahontan Regional Water Quality Control Board order, PG&E is only required to evaluate effectiveness, implementability, and cost as remedial selection criteria. DTSC agrees that these three criteria are important and should be weighed heavily in a remedy decision. However, DTSC staff traditionally work on sites under the jurisdiction of either the Resources Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Prescriptive guidance and regulations under these Acts are well established. Although the terminologies are slightly different between the two programs, the required remedial selection criteria are fundamentally equivalent and include:

- Performance Standards/Threshold Criteria:
  - Protection of human health and the environment
  - Attain media cleanup goals
  - control sources of release
- Compliance with Applicable or Relevant and Appropriate Requirements (ARAR)
- Balancing/Evaluation Criteria
  - Long term effectiveness, permanence, and reliability
  - Short term effectiveness
  - Reduction of toxicity, mobility, or volume of contaminants through treatment
  - Implementability
  - Cost
  - State or support agency acceptance
  - Community acceptance.

DTSC understands that the Hinkley site is not required to follow these regulatory evaluation criteria since it is neither a RCRA nor a CERCLA site. However, for large complex sites like this, DTSC believes the rationale associated with each criterion provides a systematic basis of evaluation and decision making which include the benefits and drawbacks of the alternatives being evaluated. More importantly, using this approach would align the Hinkley site with similar projects

Mr. Harold J. Singer  
May 3, 2011

in the state of California and will provide assurances of similar quality, transparency and effective communication with the community and stakeholders.

Finally, the criteria used for remedy selection evaluates a remedy based principally on agricultural use. The beneficial use for the Middle Mohave River Valley Basin, as defined in the Basin Plan, includes agricultural, municipal and domestic supply, industrial, freshwater replenishment and aquaculture. The FS limited the focus to a remedy tailored only to agricultural uses in the future. It does not comprehensively discuss the short or long term beneficial uses, impacts, timeframe for other uses to be revitalized or as a parameter of the remedy selection.

3. Are the estimated costs for remedial technologies discussed in the Feasibility Study realistic?

Response: Because the FS only discusses the alternatives as high level concepts without specifics on design, it is impossible to verify the cost basis of their estimates. Although PG&E did provide some assumptions in Appendix D for each remedial alternative, it does not provide adequate detail for meaningful cost estimates. The FS states that the cost was based in part on experience and knowledge of the consultants. In general practice, however, all cost data must be verifiable and provided as evidence of cost bases. For example, how did PG&E calculated capital cost for in-situ reactive zones (IRZ) without conceptually identifying the number of wells needed? Furthermore, without this information, how were the linear feet of piping and associated costs estimated?

For the cost estimate, DTSC also did not notice inclusion of cost for oversight or details under O&M. DTSC's experience is that the annual cost for the long-term monitoring program alone is significant; however, the FS did not provide any assumptions on number of wells anticipated for monitoring and the sampling frequency. Although the FS claims that the cost estimate followed EPA's guidance on cost estimate development and that the estimate is within -30 to +50 percent. DTSC is unable to determine if the numbers presented are truly accurate without further documentation and justification.

4. Can you comment on the adequacy of PG&E's recommended remedy: in-situ remediation and agriculture re-use and plume capture of the chromium plume in groundwater?

Response: The proactive remedies/pilot studies have significant evidence and real time hydrogeologic performance data that is not conceptual and should provide a solid basis for a more detailed FS with pronounced and customized set of remedial alternatives analogous to the 4a/b proposal.

As stated earlier, without additional groundwater modeling information specifically pulling in data and scientific evidence using interim measures

information regarding, the recommended remedy, Alternative 4b, lacks a basis for its claim to hydraulically control the plume or to be the most cost effective remedy. PG&E's claim that it is implementable as a result of past pilot studies requires a more thorough discussion using existing site evidence in the FS to demonstrate the effectiveness of the studies given the available wealth of site specific data that should be available. It is advisable for PG&E to revise the FS with more specificity on the conceptual design along with groundwater flow modeling with particle tracking over time to demonstrate proper hydraulic capture and containment.

5. To the extent described in the FS, are capture zones shown for the recommended alternative realistic on a year-round basis?

Response: It appears that fluctuations in hydraulic flow based on seasonal use(s) and other factors may have a significant effect on the capture zones. A more in depth discussion would appear to be warranted to demonstrate through site studies how the capture zones would be maintained year round. Additional flow modeling efforts with particle tracking may assist in determining the effectiveness of the concept as proposed. Although given enough adjustments on the amount of water extracted for Agricultural Use, and flexibility in the installation of extraction and injection wells, it is reasonable that hydraulic containment can be achieved; however, information is insufficient in the current FS for this determination.

6. Could supplemental plume capture methods or treatment improve upon the recommended alternative for achieving consistent containment of the chromium plume?

Response: Similar to the response above, it is nearly impossible to provide additional recommendation without further information from PG&E on their proposed design for the recommended remedy of Alternative 4b. In general, DTSC would likely concur with a recommendation to continue extraction of contaminated water to hydraulically control plume migration. We also feel that the proposed use of contaminated water for agricultural purposes as treatment within the northern diffuse plume area should be evaluated very carefully. The reason is that extraction will, in general, pull the contaminated plume into the extraction well in a predictable manner as compared with placement of contaminated water into the subsurface which can create a hydraulic mound and spread the contamination. Proper engineering with an accurate understanding of the site-specific hydrogeology can overcome this generality; nevertheless, a solid contingency plan is advisable. Seasonal fluctuations, localized impacts due to land or water uses occurring in the area could be built into the remedy selection discussion for a more thorough evaluation and a more predictable capture zone.

Mr. Harold J. Singer  
May 3, 2011

7. Does chromium mass being left in shallow and deep soils as trivalent chromium (Cr3) pose a potential threat to the environment and/or public health?

Response: DTSC did not find a discussion on sources or source removal at the project site in the FS. The lack of documentation that sources are no longer a continuing threat to groundwater is an area needing additional discussion in the FS. Pursuit of a final remedy relies heavily on understanding and control of potential sources due to implications on contaminant mass removal over time and its influence on the selected remedy efficiency.

DTSC assumes that the site has been fully characterized. This includes evaluation of Cr6 on both soil and groundwater. We are also assuming that all residual source(s) of contamination found in soil were removed. Unless the project area is absent of a continuous source, or sources have been controlled through engineering efforts, the estimated time to clean-up groundwater to MCL or background will be very difficult (If not impossible) to calculate. Furthermore, unless the sources have been identified and remediated, contact with the contaminated soil may pose a potential threat to the receptor. It is advisable for PG&E to confirm by documentation, all known sources of contamination, how each of these sources was remediated and its disposition with confirmation analytical data.

8. Is there any likelihood that Cr3 left in the environment could realistically or potentially be converted back to Cr6?

Response: The issue of potential conversion of trivalent chromium (Cr3) back to hexavalent chromium (Cr6) has been raised by the experts at the US Geological Survey (USGS). Although DTSC's understanding is that significant conversion from Cr3 back to Cr6 will only take place if there are dramatic changes in surface geo-chemistry, such as a significant change in the pH of the soil or groundwater.

There can, however, be a limited reconversion as a result of natural process, but typically at or around the natural background concentration for Cr6. Since Mr. John Izbicki of the USGS has conducted limited study of this issue, it is advisable to consult with him on this matter. Mr. John Izbicki, Research Hydrologist, can be reached at (619) 225-6127 or at 4165 Spruance Road, Suite 200, San Diego, California 92101. The USGS website may provide additional information at [http://toxics.usgs.gov/highlights/detecting\\_crv.html](http://toxics.usgs.gov/highlights/detecting_crv.html)

Generally speaking, when hexavalent chromium has been converted via microbial reduction treatment insitu, trivalent chromium is immobile in the subsurface where conversion occurs and precipitates as an insoluble hydroxide and sorbs strongly to iron and manganese materials in the soil. Trivalent chromium, particularly as a hydroxide solid is stable in groundwater with typical aquifer conditions of pH greater than 5 and a redox potential of less than 600 mV

Mr. Harold J. Singer  
May 3, 2011

(Deutsch 1997). The reducing conditions created by the driving force for the reduction of hexavalent to trivalent forms of chromium, particularly with injection treatment provides suitable electron donors that directly reduce the hexavalent chromium to the trivalent state. Monitoring of hexavalent chromium concentration will be necessary during and for a period after remediation in groundwater because an increase in concentration may be attributed to a continuing source areas or influx of additional impacted groundwater and not necessarily reconversion. Site specific environmental conditions are most likely in PG&E's dataset and should be assessed from the pilot studies to further define the variables relative to this issue and based on the treatment itself.

9. Based on your experience and review of the Feasibility Study, are there any additional recommendations to improve the readability/ understanding of the document or to establish a well founded determination for remediation of the hexavalent chromium plume?

Response: DTSC recommends that PG&E consult the US EPA guidance titled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988" for the preparation and presentation of the final revised FS. This guidance provides a standardized approach to the discussion and scope of the evaluation within an FS. Although the Hinkley facility is not under CERCLA authority, and it is not the intent to initiate a CERCLA or RCRA driven project, the scientific basis, engineering evaluations and remedial considerations may be beneficial, more transparent and receive better understanding in arriving at a remedy. Following a commonly accepted approach on the preparation of the FS will reduce the perception of pre-selecting a final remedy, or a biased evaluation of a specific alternative.

Following the CERCLA Guidance will also provide a systematic assessment and evaluation of parameters, a transparent and thorough discussion of remediation options. The CERCLA process also promotes a clear understanding of the nuances between each alternative and allows for a customized approach to remediating the site without eliminating parameters of importance. Further, using these criteria promotes a thorough and consistent remedy implementation if there are future changes to the remedy.

To properly complete the FS, PG&E should provide additional background discussion on the following:

- Site investigation activities conducted to date
- The current status and disposition of all source areas
- Additional presentation of calculations and assumptions made during the remedy alternative evaluation and conceptual design.

Soils investigation and source identification should be reassessed if contamination increases or ceases to be reduced in areas deemed to have

Mr. Harold J. Singer  
May 3, 2011

sources eliminated. PG&E must ensure that all maps, figures, and diagrams are properly labeled with legends and definitions for maximum understandability.

Regarding the remedy selection, defining a realistic period to achieve the RAOs is essential for comparison of remedies. Evaluation of the plume, contaminant concentrations, sources and hydraulic gradients in distinct operable units for groundwater may provide a multipronged remedy that maximizes contaminant removal/treatment in each operable unit. In addition, focused investigation or analysis on potential continuing source(s) or soils may be warranted given the plume expansion in spite of several active interim measures at the site.

Providing a regulatory review in reassessing the remedial action in the five year review period seems prudent. Furthermore, a focused and well planned short term effort may provide better information on plume wide behavior, cost effectiveness, contaminant capture and remedy modification for the long term or next phase of remediation.

# Timeline for 2011 Water Board Staff Activities for PG&E Hinkley

