LATE REVISION

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF NOVEMBER 12-13, 2008
Barstow

ITEM: 4

SUBJECT: **AMENDED CLEANUP AND ABATEMENT ORDER FOR THE PACIFIC GAS AND ELECTRIC COMPANY'S COMPRESSOR STATION, HINKLEY, SAN BERNARDINO COUNTY**

Changes to item, insertions are underlined below:

1. Replace pages 04-0005 through 04-0008, the Proposed Amended Cleanup and Abatement Order. Additional language has been added to finding 12, and a new paragraph has been added on the last page of the order. Additions are shown underlined.

2. Insert a new Enclosure 6, Proposed Amended Cleanup and Abatement Order comments from Ken Berry, dated October 30, 2008.

3. Insert a new Enclosure 7, Proposed Amended Cleanup and Abatement Order comments from PG&E, dated November 3, 2008.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
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CHRONOLOGY: The site has a long history of regulation by the Water Board, including Cleanup and Abatement Orders (CAOs) and permitted discharges associated with cleanup of chromium in soil and groundwater. Key orders are identified below.

December 29, 1987, Cleanup and Abatement Order (CAO) No. 6-87-160 required PG&E to investigate and remediate chromium contamination in groundwater.

August 3, 1998, CAO No. 6-87-160A2 set the hexavalent chromium cleanup level at the detection limit available at the time of 10 micrograms per liter (µg/L).

August 6, 2008, CAO No. R6V-2008-0002 directed the discharger to contain chromium migrating with groundwater, to continue implementing groundwater remediation, and to develop and implement a final cleanup strategy.

ISSUES: Have the background levels proposed by staff been established in a technically sound manner?

DISCUSSION: Discharges of hexavalent chromium resulted from operations at the PG&E Compressor Station between 1952 and 1965 where waste water was stored in unlined ponds. Groundwater below the PG&E Compressor Station contains total chromium in concentrations up to 7,490 µg/L, well above the drinking water standard of 50 µg/L. Hexavalent chromium is present in the groundwater at concentrations up to 7,260 µg/L. There is no drinking water standard for hexavalent chromium, but hexavalent chromium is regulated under the total chromium standard. The chromium plume is two miles long and over a mile wide in the groundwaters of the Middle Mojave River Valley Ground Water Basin.

PG&E has been implementing plume containment and groundwater cleanup activities at the site for many years. Land treatment of contaminated groundwater has occurred since 1991, and in-situ treatment of chromium has been tested and implemented since 2004. In-situ treatment consists of injecting a source of carbon, such as lactate or alcohol, into the groundwater to stimulate microbial growth. This microbial growth consumes oxygen from the water and creates electrochemically reducing conditions, which convert hexavalent chromium to trivalent chromium. The trivalent chromium precipitates out on the aquifer materials and is effectively removed from the groundwater solution. In-situ treatment appears to be the most efficient, environmentally sound and cost effective method to remove chromium from the groundwater.

An essential piece of information that is needed prior to establishing cleanup levels for a groundwater contaminant plume is determining the existing background level of the constituent. Therefore, in response to a 2002 Water Board order, PG&E designed and implemented a background chromium study in the Hinkley Valley. In February 2007, PG&E submitted the document, *Groundwater Background Study Report, Hinkley Compressor Station*. The background chromium study in the Hinkley area involved sampling 48 domestic and agricultural wells outside the boundaries of the chromium plume. Naturally-occurring total chromium concentrations in groundwater ranged from less than the detection limit (1 µg/L) to 3.15 µg/L. Naturally-occurring hexavalent chromium concentration in groundwater ranged from less than the detection limit (0.2 µg/L) to 2.69 µg/L. Because the samples represent a subset of the entire population of chromium concentrations in area groundwater, a statistical method was used to estimate the highest likely chromium concentrations. These highest likely chromium concentrations were estimated using the 95% upper tolerance limits (UTLs). The 95% UTLs represent the upper bound (with 95% confidence) of the 95th percentile of the background total and hexavalent chromium concentrations. The resultant maximum likely background concentrations are 3.23 µg/L for total chromium and 3.09 µg/L for hexavalent chromium. This statistical methodology along with the background study workplan was subject to peer review. The enclosed staff report provides more details on the workplan, final report and recommendation.

On September 25, 2008, Water Board staff distributed a draft amended CAO to PG&E, interested agencies and the public. The draft CAO set forth maximum background concentrations for hexavalent chromium and total chromium of 3.09 µg/L and 3.23 µg/L, respectively, to be used to evaluate final cleanup alternatives and plume containment. The draft CAO also established average background concentrations for hexavalent chromium and total chromium of 1.19 µg/L and 1.52 µg/L, respectively, to be used in evaluating final cleanup alternatives that PG&E is required to report on by September 1, 2010.

The only comments received on the draft amended CAO were from PG&E. PG&E recommended that the values that it recommended in the *Background Study Report* (4 µg/L for both hexavalent and total chromium) be used as background. PG&E also commented that using background values measured to the hundredths of a microgram per liter was inappropriate. A copy of PG&E's letter and Water Board staff's response are enclosed with this agenda item as Enclosures 4 and 5.

The proposed amended CAO differs from the public comment draft in that the concentration level to be used to define plume containment will remain at the interim value of 4 micrograms per liter for hexavalent chromium. This change reflects the potentially significant short-term costs associated with complying with the proposed background concentrations rather than the interim value, considering that both values are low and close to each other, and considering that a final cleanup plan will be produced by September 1, 2010 and that plan will assess cleanup to background levels. Background values have also been rounded from hundredths of micrograms per liter to tenths of micrograms per liter to reflect the units that laboratories report detectable chromium concentrations.

RECOMMEN-DATION: Adopt the amended CAO as proposed.

Enclosure:

1. Proposed amended Cleanup and Abatement Order
2. Cleanup and Abatement Order R6V-2008-0002
3. August 2008 Staff Report
4. Comments from PG&E, dated October 10, 2008
5. Regional Board staff's response to PG&E's comments

ENCLOSURE 1

LATE REVISION

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

AMENDED CLEANUP AND ABATEMENT ORDER NO. R6V-2008-0002A1 (PROP)

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 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 August 6, 2008, the Water Board issued Cleanup and Abatement Order (CAO) No. R6V-2008-0002 (attached) to the Discharger to cleanup and abate the effects of waste discharges and threatened discharges containing hexavalent chromium and total chromium to waters of the State. The CAO required the Discharger to take additional corrective actions to contain chromium migrating with groundwater, to continue to implement groundwater remediation in the source area and central plume area, and to develop and implement a final cleanup strategy. The Order also modified the monitoring and reporting program for permitted projects.

3. Amended CAO No. 6-87-160A2, issued in 1998, established the cleanup level for hexavalent chromium in groundwater at the laboratory method reporting limit that was in effect at the time of 10 micrograms per liter (µg/L). The method reporting limits for hexavalent chromium and total chromium are now 0.2 µg/L and 1 µg/L, respectively.

4. 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* (Study). The Study, submitted by the Discharger, presents the results of one year of water sampling from wells located outside the boundaries of the chromium plume. The mean concentrations detected in background are 1.19 µg/L for hexavalent chromium and 1.52 µg/L for total chromium. The work plan for the Study recommended that maximum likely 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 µg/L for hexavalent chromium and 3.23 µg/L for total chromium.

The Study added the laboratory analysis methods' accuracy limits to the 95% upper tolerance limits to recommend background threshold values of 3.55 µg/L for hexavalent chromium and 4.04 µg/L for total chromium in groundwater. In an August 2008 staff report, Water Board staff recommended the 95% upper threshold limits, rather than the Study's recommended background threshold values, as the maximum background concentrations that should be considered when evaluating the chromium plume. Staff's recommendation is based on the independent, expert peer reviewers' comments on the draft Study work plan, which were incorporated into the final Study work plan. The peer reviewers recommended using the 95% upper tolerance limit of the background study sample results as the maximum likely background chromium concentrations. Staff's review of literature on setting background concentrations has not identified a single case where laboratory method accuracy limits were added to the maximum likely concentrations derived through statistical analysis, such as the 95% upper tolerance limit method.

5. On September 11, 2008, Water Board staff hosted a meeting in Hinkley to inform the public of the status of chromium cleanup in groundwater and of the contents of the 2007 *Background Chromium Study*. Public comments and concerns about the Study were considered by Water Board staff.

6. At the November 12-13, 2008 meeting, the Water Board considered the 2007 *Background Chromium Study* and comments and recommendations by interested persons and staff.

7. 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 µg/L

8. On August 15, 2008, the Discharger submitted to the Water Board a document titled, *Second Quarter 2008 Monitoring Report, Source Area In-situ Remediation Project* (Report). Groundwater monitoring data in the Report shows that concentrations of total chromium were reported up to 7,400 µg/L and hexavalent chromium were reported up 7,050 µg/L in the source area at well SA-MW-05D.

9. The concentrations of total chromium and hexavalent chromium detected in groundwater at and downgradient of 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 a pollution of hazardous waste as defined in Water Code section 13050, subdivision (l).

10. The discharge of chromium to the groundwaters of the Mojave Hydrologic Unit, as described in Finding No. 8 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."

11. Chromium in groundwater in and downgradient of the source area at the compressor station continues to adversely affect groundwater quality. This Amended Cleanup and Abatement Order establishes background chromium concentrations to be considered when evaluating final cleanup actions. Technical reports are necessary to verify corrective action implementation, cleanup of water quality, and progress towards restoring the beneficial uses of the aquifer.

12. 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. In addition, there is no possibility that the proposed activity will have a significant effect on the environment. In pertinent part, California Code of Regulations, title 14, section 15061, subdivision (b)(3), known as the "common sense exemption", states that where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA. In this case, the proposed activity maintains the interim background concentration for hexavalent chromium of 4 ug/L for the purpose of plume containment and establishes background concentrations for hexavalent chromium and total chromium against which remediation strategies are to be assessed. Consequently, because there is no possibility that the proposed activity will have a significant effect on the environment, the proposed activity is also exempt from CEQA pursuant to California Code of Regulations, title 14, section 15061, subdivision (b)(3).

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. For the purposes of evaluating plume containment and complying with Requirement No. 3 of Cleanup and Abatement Order No. R6V-2008-0002, the interim background concentration for hexavalent chromium of 4 µg/L remains in effect.

2. For the purposes of complying with Requirement No. 5, Final Cleanup Actions, of Cleanup and Abatement Order No. R6V-2008-0002, background concentrations against which remediation strategies are to be assessed are established as follow:

   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

   Remediation strategy assessment 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.

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.

Any person aggrieved by this action of the Lahontan 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 days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, of 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 or will be provided upon request.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on November 12, 2008.

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachment: Cleanup and Abatement Order No. R6V-2008-0002

ENCLOSURE 2

04-0009

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 3rd 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 (µg/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 µg/L
Hexavalent chromium	2,270 µg/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 ±15 and ±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. <u>Plume Containment</u>

   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 3rd 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 3rd 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 30th day following the end of the quarter, i.e., by April 30th, July 30th, October 30th, and January 30th of each year. Required semiannual sampling shall be

reported by April 30th and October 30th 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 3rd 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 3rd 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

ENCLOSURE 3

04-0020

California Regional Water Quality Control Board
Lahontan Region

STAFF REPORT

BACKGROUND CHROMIUM STUDY
PACIFIC GAS AND ELECTRIC COMPANY
COMPRESSOR STATION
35863 FAIRVIEW ROAD
HINKLEY

AUGUST 2008

Lisa Dernbach, P.G., C.Hg., C.E.G.
Senior Engineering Geologist (Specialist)

Reviewed by: Chuck Curtis, P.E.
Cleanup and Enforcement Division Manager

04-0021

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FOREWARD

In February 2007, the Pacific Gas and Electric Company (PG&E) submitted to the California Regional Water Quality Control Board, Lahontan Region (Water Board), the document, "Groundwater Background Study Report" (Report) (CH2M Hill, 2007a). The purpose for the background study was to estimate the concentration of naturally-occurring total chromium [Cr(T)] and hexavalent chromium [Cr(VI)] in groundwater near the PG&E natural gas compressor station in Hinkley, California (Figure 1).

The background study was completed based on the September 2004 "Revised Background Chromium Study Work Plan (Work Plan)." The Work Plan incorporated comments from three University of California professors who peer-reviewed the original 2002 work plan. As a result of the peer review, the criteria for selecting wells for the study was refined, depth-discrete sampling was added, and the statistical analysis method used to evaluate the data was selected. The Work Plan was accepted by the Water Board in November 2004.

EXECUTIVE SUMMARY

Forty-eight wells in the Hinkley Valley were sampled during 2006 for the background study. About 90 percent of the wells sampled were domestic wells and the remainder were agricultural wells. The number of sampling events for each well ranged from one to four during the year. Besides chromium, the water samples results were analyzed for hydrogeochemical similarities, temporal trends, mathematical outliers, and data set balance to check that each sample was representative of the background study area. The background study also included analysis of stable chromium isotopes by the United States Geological Survey.

The maximum detected Cr(T) value during the background study was 3.15 micrograms per liter (µg/L). The maximum detected Cr(VI) value was 2.69 µg/L. The individual Cr(T) and Cr(VI) results at each well were averaged to determine a representative concentration for each well. These averages were used in the statistical evaluation of the background study data set.

The maximum likelihood estimate approach was used to determine the mean and standard deviation for the Cr(T) and Cr(VI) data sets. Using this approach, the means were 1.52 µg/L for Cr(T) and 1.19 µg/L for Cr(VI). The maximum likely background concentrations in the Hinkley area were calculated based on the 95th percent upper tolerance limits (UTLs). The UTLs are 3.23 µg/L for Cr(T) and 3.09 µg/L for Cr(VI). These values are shown in the table below, along with the means and maximum values detected.

Table 1.
Summary of Chromium Values from Background Study

	Cr(T) (µg/L)	Cr(VI) (µg/L)
Mean	1.52	1.19
Maximum detected	3.15	2.69
UTL	3.23	3.09

Water Board staff finds the background study was conducted in a reasonable manner, and the study results are generally acceptable.

SITE HISTORY

The PG&E compressor station (Facility) is located at 35863 Fairview Road, east of the community of Hinkley in San Bernardino County. PG&E owns the land on which the compressor station is located. While not discussed in the Report, it is essential to understand how the discharge of chromium came to be in the Hinkley Valley, prompting the need for the background study.

The Facility began operating in 1952 and added hexavalent chromium to cooling tower water to prevent corrosion. The untreated cooling tower water was discharged to unlined ponds until 1964. In 1965, phosphate replaced hexavalent chromium as the corrosion inhibitor. The ponds were taken out of service in 1966 and replaced with lined ponds. Chromium contaminated soil has since been excavated from shallow depths in the area of the former unlined ponds, pipelines, and beneath tanks.

In 1987, PG&E reported to the Water Board that off-site monitoring wells, located to the north of the Facility, showed chromium concentrations in groundwater exceeding the California drinking water standard of 50 µg/L. As of February 2008, the chromium plume in groundwater extends 2 miles long and 1.3 miles wide. The highest levels, up to 5,000 µg/L Cr(T), are detected at and just north of the compressor station. Remediation is underway to contain plume migration and clean up chromium in groundwater.

HYDROGEOLOGY

The Facility is located in the Harper Valley Subarea of the Mojave Hydrologic Unit. The Mojave River contributes more than 80 percent of the natural groundwater recharge to the Hinkley Valley. The groundwater flows to the north into the Harper Lake Playa. Groundwater at the Facility generally flows to the north and then to the northwest starting at about Frontier Road. Sediments in the Hinkley Valley originate from floodplain deposits from the Mojave River that overlay regional deposits from erosion of the surrounding mountains.

The evaluation of water budget was based on a numerical groundwater flow model that was developed for the Hinkley site. On average, about 7,000 acre-feet of groundwater enters the modeled area from the south each year. About 20 percent of this subsurface flow continues eastward towards Barstow, and about 2 percent flows out of the modeled boundary to the north toward Harper Lake Playa. The bulk of the groundwater inflow is pumped for irrigation, industrial, or domestic/municipal supply. Concentrations of total dissolved solids (TDS) generally increase to the north with distance from the Mojave River (Figure 2). This is typical of a freshwater recharge system in which low-TDS river water migrates away from the recharge source, accumulating salts and dissolved solids as it passes through the aquifer. The source of salts and dissolved solids can originate naturally from alluvial sediments and anthropogenically from activities on the ground surface, such as agriculture.

The majority of the Hinkley Valley is underlain by two distinct aquifer units separated by a clay unit, referred to as the Blue Clay (Figure 3). The Upper Aquifer consists of interbedded gravels, sands, silts, and minor amounts of clay. The thickness of this unconfined aquifer is about 180 feet beneath the compressor station with groundwater typically at 80 feet below the surface. The Upper Aquifer gets thinner towards the north and the west.

The Blue Clay is a low-permeability aquitard, likely of lacustrine (lake) origin. The thickness of the Blue Clay ranges from 40 feet beneath the compressor station to being absent north of Highway 58 and within a few hundred feet of the Mojave River to the south.

Below the Blue Clay is the deeper, semi-confined water-bearing zone referred to as the Lower Aquifer. The sediments that comprise the Lower Aquifer include calcareous sedimentary rock and highly weathered, decomposed, and fractured bedrock. The Lower Aquifer is thickest beneath the compressor station at about 40 feet. As with the Blue Clay, the Lower Aquifer pinches out to the north of Highway 58 and west of Mountain View Road. Below the Lower Aquifer is a granitic bedrock unit that is encountered at depths of 100 feet in the northwest portion of the chromium plume and as deep as 300 feet below the compressor station.

The chromium plume is detected only in the Upper Aquifer. Multi-depth sampling has shown that the chromium plume exists in the saturated zone from about 80 to 135 feet below ground surface in the vicinity of the Facility. As the Upper Aquifer becomes shallower towards the north, the plume becomes less thick. Sampling at the Desert View Dairy indicates the plume's thickness to only be half that at the Facility or about 25 feet. Past investigations of the Lower Aquifer detected Cr(T) up to 8 µg/L.

Sources of Natural Chromium in Groundwater

Even though not a topic in the background study, it is important to note the sources of natural chromium in groundwater when reviewing water quality data presented in

the following sections. The following explanations for natural chromium sources were taken from references cited in the background study.

In general, chromium is a relatively common element, naturally occurring in rocks, soil, plants, animals, and in volcanic dust and gases. Chromium typically occurs in the trivalent oxidation state when a solid and in the hexavalent oxidation state when dissolved. Chromium occurs naturally in many aquifers throughout the world, including in the western Mojave Desert. Aquifers consisting of alluvium weathered from granitic, metamorphic, and volcanic rock may contain hexavalent chromium from chromate or dichromate. Groundwater near the Mojave River in the Hinkley area generally contains little or no detectable chromium.

BACKGROUND CONCENTRATION CALCULATIONS

This section provides the methodology used to estimate background values for Cr(T) and Cr(VI) in groundwater in the study area.

Water samples were collected from background wells during four quarters in 2006. Fourteen wells were sampled during all four consecutive events, two wells were sampled during three events, 23 wells were sampled during two events, and nine wells were sampled during one event. The wells range in distance from 750 to 16,000 feet from the chromium plume boundaries. The data set comprises geographically distinct samples collected from geologically variable materials, representative of the Hinkley Valley.

The maximum detected Cr(T) value in background wells was 3.15 µg/L (Figure 4). The maximum detected Cr(VI) value was 2.69 µg/L. Five of the wells sampled did not contain Cr(T) or Cr(VI) above the 1.0 µg/L and 0.2 µg/L reporting limits, respectively, during any of the sampling events.

The individual Cr(T) and Cr(VI) results at each well were averaged to determine a representative concentration. These averages were used in the statistical evaluation of the background study set and to restrict bias from wells that were sampled fewer than all four quarterly events. The maximum likelihood estimate approach was used to determine the mean and standard deviation for the data sets (USEPA, 2006).

The mean Cr(T) of background wells was 1.52 µg/L, and the mean Cr(VI) of background wells was 1.19 µg/L. This represents the average total and hexavalent chromium concentrations in the area groundwater not affected by chromium contamination.

One goal of this effort was to determine the maximum likely background concentrations in the Hinkley area, called the background threshold values. These values can be larger than the maximum detected concentrations during the sampling because the sampling represents a subset of all potential background chromium concentrations in the area. The study Report calculated these thresholds as the sum

of the upper tolerance limits (UTLs) and the laboratory method accuracy limits. The background UTLs were calculated as the upper bound (with 95 percent confidence) of the 95th percentile of the background total and hexavalent chromium concentrations. The UTLs are 3.23 µg/L for Cr(T) and 3.09 µg/L for Cr(VI). The analytical methods used for Cr(T) have an accuracy of +/-25 percent, and the analytical method used for Cr(VI) has a accuracy of +/-15 percent. The background threshold values presented in the Report are 4.04 µg/L for Cr(T) and 3.55 µg/L for Cr(VI). Water Board staff does not agree that adding the laboratory accuracy limits to the UTLs is appropriate. Water Board staff have not found any documentation that supports inclusion of laboratory method accuracy limits in determining background concentrations.

The values described in this section are summarized in Table 2.

Table 2.
Summary Statistics for Cr(T) and Cr(VI) Using Well Averages

Parameter	No. of Samples	No. of Detects	Percent Detects	Min. Detect*	Max. Detect*	Mean*	Std. Dev.*	95% UTL*	Threshold Value*
Cr(T)	48	36	75	0.683	2.8	1.52	0.824	3.23	4.04
Cr(VI)	48	41	85	0.181	2.57	1.19	0.915	3.09	3.55

* Concentrations in micrograms per liter.

COMPARISON TO OTHER CHROMIUM STUDIES

The chromium background results from Hinkley are compared to the results of previous studies of naturally occurring chromium concentrations that have been performed in the Mojave Desert and adjacent areas. The studies that were considered include:

- Topock compressor station background study recommendations (CH2M Hill, 2007b).
- California Department of Health Services sampling results, as of April 2004, for Cr(VI) in public supply wells in California (CDHS, 2004).
- Evaluation of Cr(VI) in the southwestern portion of the Mojave Desert, which includes the Hinkley area (USGS, 2004).

The Cr(VI) results of these studies are shown in Table 3.

Table 3.
Summary Statistics for Cr(T) and Cr(VI) Using Well Averages of Other Studies (micrograms per liter)

Parameter	Hinkley Background Mean	Hinkley Background UTL	Topock Background Mean	Topock Background UTL	CDHS Mean	USGS Mojave UTL
Cr(T)	1.52	3.23	9.37	34.1	NA	Not calculated
Cr(VI)	1.19	3.09	7.8	31.8	5.8*	27

*San Bernardino County public water systems

Overall, mean chromium concentrations and calculated UTLs in the Hinkley groundwater background study are lower than chromium concentrations found in other site-specific studies.

OTHER FINDINGS

The following additional findings are noted in the Report.

1. An evaluation was completed to determine each well's suitability for inclusion in the final data set. The evaluation concluded that all 48 wells were properly located within the target study area based on hydrochemistry and lithologic analyses.

2. Total chromium and hexavalent chromium concentrations in groundwater are typically at low or non-detectable levels in the area of the Mojave River. Detectable chromium concentrations increase with distance away from the river up to a maximum detection of 3.15 µg/L for Cr(T).

3. Seasonal variation of Cr(T) and Cr(VI) concentrations among the 14 wells that were sampled during all four sampling event was minimal. Only one of the 14 wells indicated a potential trend, that being a decreasing one. The lack of significant evidence for a temporal trend was supported by the major ions plot showing similar locations in the Trilinear diagrams during each quarter.

4. Discrete-depth water samples were collected at only two well locations, and all showed non-detectable levels for Cr(T) and Cr(VI), or less than 0.2 µg/L and 1.0 µg/L, respectively. Therefore, the results of depth-discrete sampling within the Upper Aquifer are inconclusive for evaluating potential variations of chromium background concentrations with depth in the upper aquifer.

5. No conclusions were drawn about background chromium concentrations in the Upper Aquifer versus Lower Aquifer, as only 17 of the 48 wells had boring logs and the logs indicated wells were often screened across both the upper and lower aquifers.

6. The Lockhart Fault, a northwest trending, right-lateral, strike-slip fault that crosses the southwest corner of the Facility, is considered to impede groundwater flow somewhat but has no affect upon background chromium concentrations.

7. Besides the Facility, no other anthropogenic sources of chromium were identified in the Hinkley Valley.

8. In addition to the well sampling and analyses described above, the U.S. Geological Survey evaluated the chromium isotope ratios in samples collected from 15 wells inside and outside of the chromium plume over three sampling events. The goal of this testing was to investigate whether isotope results: (1) might indicate a site-specific reduction pattern of Cr(VI) along flow paths within the mapped groundwater plume and (2) might be used to differentiate anthropogenic Cr(VI) from non-anthropogenic Cr(VI). The results indicate that chromium isotope ratios were not useful to delineate the specific chromium degradation pattern within the plume, or to differentiate anthropogenic versus non-anthropogenic concentrations of Cr(VI).

COMMENTS

The background study followed the September 2004 Work Plan accepted by Water Board staff, with the exceptions discussed below. The Report included the following expected Work Plan topics:

- Evaluation of existing wells in the background target area and review of boring logs and well construction details.
- Evaluation of past pumping in the Hinkley area.
- A numerical groundwater flow model to evaluate the water budget of the Hinkley Valley.
- Creation of wind rose diagrams to assess potential wind deposition of airborne chromium.
- Evaluation of groundwater geochemistry to determine each background well's suitability for inclusion in the final data set.
- Chromium stable isotope analysis.
- Evaluation of seasonal trends of sample data.
- Statistical analysis of Cr(T) and Cr(VI) analytical data.

Work Plan topics that were either changed or were incomplete in the Report include the addition of wells, depth-discrete well sampling, and calculation of the background threshold concentrations. Each of these topics is discussed in more detail in the following sections.

Wells Added During Study

The Work Plan states that water samples would be collected quarterly (every three months) at approximately 20 locations. Background wells would be selected with emphasis on being located along the flow path of the Mojave River, or cross gradient from the chromium plume at the Hinkley site. A groundwater flow model created for the Hinkley site was used to estimate the groundwater flow paths and verify well locations in the upgradient and cross gradient location direction. The Work Plan also states that wells would also be located in a hydrogeologic setting representative of plume conditions.

The first and second sampling event consisted of 17 well locations. Of the 48 wells included in the background study, 31 wells were added after the Work Plan was accepted by the Water Board and after two sampling events had already occurred. The background study explains that wells were added to compensate for the three wells not available for depth discrete sampling. The new wells were also added to create a larger data set, thereby providing more information on the natural variation in Cr(T) and Cr(VI) concentrations in the study area.

Of some concern are added wells located in areas not fitting the criteria cited in the Work Plan. The added wells are located: (1) in the apparent down and cross gradient flow direction of the chromium plume (BGS-46, 47, 48, 51); (2) up to 3.2 miles cross gradient from the plume boundary (04E-01); and (3) outside the regional and floodplain aquifers (BGS-18 & 19). It can be argued that these specific wells are not truly background locations because they do not represent background conditions in the area of the chromium plume. The Cr(T) and Cr(VI) concentrations in these wells vary from less than 1.0 µg/L to 2.94 µg/L in 15 samples. The average values for this limited data set is 1.38 µg/L Cr(T) and 1.33 µg/L Cr(VI). When the limited data set is subtracted from the total data set for the background study, the results show a 5 percent change or less of the original means calculated for Cr(T) and Cr(VI) discussed earlier in this document; 1.58 µg/L instead of 1.52 µg/L for Cr(T) and 1.13 µg/L instead of 1.19 µg/L for Cr(VI). Because the change is so small, it is considered insignificant. Deleting the data from these seven wells will not significantly alter the UTLs or threshold values from the background study.

Depth-Discrete Samples

The Work Plan states that five wells would be selected for collection of depth-discrete samples to determine if variations in background chromium concentrations existed within the Upper Aquifer. The Report states that discrete depth samples from the Upper Aquifer were collected at only two well locations and the sample results were all at non-detectable concentrations. It is explained that additional discrete-depth samples could not be collected due to well access limitations. The Work Plan assumed large-diameter agricultural wells would be available for discrete-depth sampling, but the vast majority of these wells contained submerged debris or had been filled in and abandoned entirely.

The concern is whether naturally-occurring chromium concentrations vary with depth. Boring logs were only available for 17 of the 48 background study wells, or 35 percent. The depth of background study wells ranged from 55 to 115 feet. All 17 wells with boring logs are screened in either the Upper Aquifer or both the Upper and Lower Aquifers, including a few wells with notations of bedrock. This information indicates that water samples from these wells likely represent a variety of depths within the aquifers.

Analysis of Maximum Likely Background Concentrations

The Report calculated background threshold values as the sum of the UTLs and the laboratory analytical method accuracy limits. UTLs are an accepted method of determining the maximum likely background values, and this was the method identified in the Work Plan for determining the Hinkley chromium background threshold values. Adding the laboratory method accuracy limits of 15 percent for hexavalent chromium and 25 percent for total chromium increases the estimate of the maximum likely background concentrations from the UTL of 3.23 µg/L to 4.04 µg/L for Cr(T) and from the UTL of 3.09 µg/L to 3.55 µg/L for Cr(VI). Water Board staff have found no documentation that supports inclusion of laboratory method accuracy limits in determining background concentrations.

CONCLUSION

In general, the background study followed the September 2004 Work Plan accepted by Water Board staff. The final calculated mean background values are 1.52 µg/L for Cr(T) and 1.19 µg/L for Cr(VI), and the background threshold values based on the UTLs are 3.23 µg/L for Cr(T) and 3.09 µg/L for Cr(VI). These threshold values are considered the maximum likely concentrations of naturally occurring chromium in groundwater. Water Board staff does not accept the addition of laboratory method accuracy limits to the UTLs to calculate background threshold values. And while the background study added well locations that were outside the criteria established in the Work Plan, the change in calculated UTLs from deleting data from those locations is insignificant. Water Board staff finds the background study was conducted in a reasonable manner, and the study results are acceptable, except as noted above regarding using laboratory method accuracy limits in the background threshold concentrations calculations.

Water Board staff recommend that the Water Board establish background threshold levels at a maximum of 3.23 µg/L with a mean of 1.52 µg/L for total chromium and a maximum of 3.09 µg/L with a mean of 1.19 µg/L for hexavalent chromium. If cleanup is required to background levels, the resultant average chromium concentrations in the cleanup area should be equal or less than these mean background values. The calculated background threshold values may be used to assess whether a given sample represents background conditions or the effect of the release; values above

the background thresholds may indicate the groundwater has been affected by the release.

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ENCLOSURE 4

Pacific Gas and Electric Company

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October 10, 2008

Chuck Curtis, P.E.
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Subject: Comments to Draft Amended Cleanup and Abatement Order
PG&E Groundwater Remediation Project
Hinkley, San Bernardino County

Dear Mr. Curtis:

This letter transmits comments from Pacific Gas and Electric Company (PG&E) on the Draft Amended Cleanup and Abatement Order (CAO) for the Groundwater Remediation Project in Hinkley, California (the Site). The proposed Order would amend existing CAO No. R6V-2008-0002, dated August 6, 2008. The Executive Officer and Water Board staff proposes that the CAO be amended to formally establish the background concentrations for hexavalent chromium [Cr(VI)] and total chromium [Cr(T)] in Site groundwater.

The amendment proposes Cr(VI) and Cr(T) background concentrations that are lower than the concentrations recommended in PG&E's Background Study Report (CH2MHILL, 2007). In addition, the amended CAO would require plume delineation and containment to concentrations stated at a precision of one hundredth of a part per billion. As discussed further below, laboratories can not consistently report data to this degree of precision, even ignoring the multiple layers of uncertainty in "validated" data reported under of the existing federal and state laboratory test methods.

As we stated in the cover letter to the Background Study, PG&E believes that the existing interim background concentration of 4 micrograms per liter (µg/L) for Cr(VI) should continue to be used for the purposes of plume delineation and boundary control. PG&E concurs with Water Board's staff that the 95 percent upper tolerance limit (UTL) for Cr(VI) as determined during the background study is calculated to be 3.09 µg/L. However, if one considers and quantifies the multiple layers of laboratory uncertainty (e.g., calibrations and various quality control sample tolerances), these calculations are likely to support a much higher control number for Cr(VI) than 4 µg/L. Instead of

proposing a higher control number, it is preferable to acknowledge that uncertainty from a *single*-laboratory background study exists and the plume delineation and boundary control concentration for Cr(VI) should remain at 4 µg/L.

As you are aware, PG&E has consistently taken this position. When the Water Board staff-recommended lower concentrations were to be presented to the public by Water Board staff during the September 2008 public workshop in Hinkley, PG&E opposed verbally and in writing. Water Board staff proceeded to present their recommended lower concentrations at the meeting despite PG&E's opposition, and were unwilling to include PG&E's recommendations as part of the meeting.

Establishing a single background concentration without consideration of laboratory uncertainty and with precision to hundredths of a part per billion is misleading to the public, implying that the laboratory can analyze and report samples at such low concentrations and to this level of accuracy. Members of the public would be unnecessarily alarmed if a sample from their well exceeded 3.09 µg/L for Cr(VI), suggesting they are located within the plume. In fact, the true value may be considerably lower than 3.09 µg/L considering all of the factors of uncertainty such as laboratory and sampling methods. Having a background value of 4 µg/L is commensurate with the results of the background study. This value takes into account a reasonable level of accuracy in the sampling methods, and would not result in unnecessary public concern.

As currently drafted, this proposed amendment to the CAO would require a plume delineation concentration of 3.09 µg/L Cr(VI); the boundary control requirements would also apply at that concentration. As described in detail below, laboratories simply cannot reliably measure the concentration of Cr(VI) to the hundredth of a part per billion on a consistent basis. In fact, as outlined below, two laboratories could use the same federal and state test methods for the same exact homogeneous sample and report "valid" concentration results--acceptable for all regulatory purposes--that differ by more than 1 µg/L. Based on the laboratory uncertainty acknowledged in the regulatory agency test methods themselves, it is scientifically indefensible to amend the CAO to require plume delineation and boundary control at 3.09 µg/L for Cr(VI). The most appropriate number for plume delineation and boundary control remains 4 µg/L for Cr(VI).

The proposed amendments to the CAO also contain additional improper or unworkable provisions. Specifically, the proposed amended CAO requires the use of Cr(T) for definition of the Cr(VI) plume and establishes a "baseline" for future Cr(T) and Cr(VI) cleanup goals that lack technical basis. Most importantly, the amended CAO would require plume boundary control at 3.09 µg/L Cr(VI) and 3.23 µg/L for Cr(T) by December 31, 2008. All of the existing infrastructure and approved boundary control monitoring plans are based on control of the plume at 4 µg/L for Cr(VI). Adopting a lower level and including Cr(T) in the analysis will require PG&E to revisit the existing Site remediation systems and the recently approved boundary control monitoring

program, and the December 31, 2008 deadline simply does not allow time for such an evaluation much less design, permitting, and modifications to the Site remediation systems if such actions were deemed necessary to attain compliance.

Absent coming to consensus with Water Board staff on this issue, PG&E will exercise its right to make a presentation at the November Water Board meeting to voice our opposition to the proposed amendments to the CAO and to request that the Water Board make the necessary changes in adopting the CAO amendments.

Each of PG&E's specific objections to the proposed amendments to the CAO is described in the following sections.

1) <u>State-of-the-Art Laboratory Test Methods and Practices Can Not Accurately Measure Cr(VI) at the Concentrations That Would Be Required Under the Proposed Amended CAO</u>

The Background Study Report (CH2MHILL, 2007) included allowances for laboratory uncertainty of 15 percent for Cr(VI) and 25 percent for Cr(T) in determining an appropriate background level. The proposed amended CAO rejects the inclusion of any allowance for laboratory uncertainty. However, the background concentrations proposed in the amended CAO would be misleading, unnecessarily alarming to the public, and impractical to implement in terms of defining the plume boundary if laboratory uncertainty and precision are not considered in their derivation.

In fact, PG&E proposed that only one type of laboratory uncertainty be incorporated into the background analysis (accuracy tolerances associated with the instrument calibration, as discussed below). However, there are many *additional* layers of laboratory and sampling uncertainty that can significantly affect reported chromium concentrations, particularly at the extremely low levels detected during the background study and at the precision of hundredths of a part per billion required by the proposed amended CAO. Failure to include an allowance for laboratory uncertainty makes the proposed amended CAO unworkable.

There are six types of uncertainty in laboratory analyses for chromium, any one of which calls into question the concentrations proposed in the amended CAO; taken together, they clearly demonstrate the fallacy of the proposed amended CAO's reliance on assumed, but impossible to obtain, certainty in the laboratory data. Each of these six sources of uncertainty is described below.

- **Laboratory Accuracy** – the accuracy of laboratory data is a reflection of how close the reported value is to the true value. The laboratory uses both method blanks (samples with no contaminant present), calibrations of instruments using known concentration standards, and matrix spiked samples (samples of the same matrix—i.e., soil or water--with a specified level of contaminant added to the sample) to provide an expression of the accuracy of the associated analytical data. In order for

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the laboratory data to be considered valid, the accuracy does not need to be 100 percent. In fact, for Cr(VI) and Cr(T) analysis, the matrix spike accuracy is considered acceptable if it is within plus or minus 20 percent of the true value. That is, a sample result for Cr(VI) that is 2.5 micrograms per liter (µg/L) could in fact be 2.0 or 3.0 µg/L and either value would be considered valid within the published regulatory analytical method.

Similar to matrix spike accuracy, calibration standards results within 15% of the true value are considered acceptable for Cr(VI) and 25% for Cr(T). These percentages were the basis for the inclusion of laboratory uncertainty in the Background Study Report (CH2MHILL, 2007). For example, if a field sample result is reported as 2.5 µg/L for Cr(VI), and the analysis of a calibration standard is within 15 percent of the known standard concentration, then the actual concentration of the field sample could be anywhere from 2.13 µg/L to 2.88 µg/L.

- **Laboratory Precision** – the precision of laboratory data is a reflection of how repeatable the results are. The laboratory uses laboratory duplicate samples (two sample portions, of the same sample, prepared and analyzed separately) and continuing calibration checks (analysis of a standard with a known concentration) run throughout the analysis process.

  There are no criteria for laboratory duplicate results that would cause a sample result to be considered invalid. That is, the laboratory could split a sample and the result for the primary sample could be 3.0 µg/L and the result for the secondary sample could be 1.0 µg/L. The data for the primary sample would be considered valid and reported, albeit qualified as estimated.

- **Field Duplicate Samples** – As part of the normal sampling program, PG&E collects one field duplicate sample for every 10 field samples collected. Field duplicates assist in the evaluation of both the sampling methods and the potential for natural variability in individual well sample data.

  The field duplicates are two samples collected from the same well, using the same methods, typically within a few minutes or less of each other. Both results are included in monitoring reports provided by PG&E. Field data are considered valid provided that the relative percent difference (RPD) of the two results is equal to or less than 20 percent. That is, if one sample result for Cr(VI) was 2.0 µg/L the field duplicate must be greater than or equal to 1.6 µg/L or less than or equal to 2.4 µg/L for the dataset represented by the duplicate to be considered valid.

  Note that most individual property owners would not collect field duplicate samples when sampling their wells.

- **Field Sampling Methods** – PG&E and its consultants exercise a high degree of expertise in sampling monitoring wells for Cr(VI) and Cr(T) analysis. Wells are sampled in accordance with United States Environmental Protection Agency published methods, and the methods are repeated in the exact same manner across literally hundreds of wells at the Site. This includes well purging, recording and stabilization of field parameters, and detailed chain of custody records for sample storage, holding, transport, and receipt by the laboratory.

  In contrast, the average property owner near the Site would be unlikely to have the same degree of experience or familiarity with this process. As a result, it is possible, if not likely, that the property owner might omit well purging, recording of field parameters, allowing the stabilization of field parameters, completion of chain of custody documentation, or the use of appropriate laboratory containers or sample preservation in obtaining a groundwater sample.

  A single background concentration that does not take into account the variations likely with different sample methods could result in an inaccurate determination of whether or not a well is located within or outside the plume.

- **Variability Among Laboratories** – There is most assuredly significant variability in results among laboratories. An examination of the very wide acceptance ranges of multi-laboratory performance testing studies clearly shows just how variable analytical results can be between two or more accredited laboratories using the exact same published regulatory method.

  In the groundwater monitoring data reported to the Water Board, PG&E uses a single laboratory for Cr(T) and Cr(VI) analysis. This was also the case for the data collected during the background study. However, it would be almost impossible for all individual property owners to use the same laboratory as PG&E. Considering the background concentrations proposed by the Water Board staff are specified at a precision of one hundredth of a part per billion, very minor differences among laboratories could have significant implications when determining whether a well is within or outside of the plume.

- **Matrix Spikes for Small Data Sets** – Matrix spikes are discussed above under the topic of accuracy. PG&E typically collects samples from many wells during routine sampling events, and these samples are submitted to the laboratory in batches. One of the samples from the batch is selected at random, and a portion from the sample is spiked with a known concentration of the constituent to be analyzed (i.e., spiked in duplicate). PG&E specifies the number of matrix spike duplicates based on the number of samples in each batch, and only PG&E-collected samples are used in this analysis.

04-0038

In contrast, unless directed otherwise by the client, individual samples or very small sample sets are typically combined by the laboratory with other small data sets to make a batch. A sample is again selected at random, and the same procedure described above is used to create a matrix spike and matrix spike duplicate. The results are used to provide quality assurance and control data for the entire batch.

An individual property owner is unlikely to request a matrix spike and matrix spike duplicate just for their individual sample. Thus, a sample totally unrelated to the Hinkley site would likely be used to document the quality assurance and control of the property owner's sample. Considering the very low Cr(VI) and Cr(T) concentrations being considered for the background concentrations at the Site, introducing quality assurance and quality control data from such an unrelated data set into the data evaluation process for the Hinkley site would be inappropriate, and the possibility of that outcome needs to be considered in setting the background concentrations for the site and in determining the manner in which such concentrations will be utilized.

Example of Potential Laboratory Uncertainty in Sample Results

Consider the following very likely scenario, and how this scenario demonstrates the fallacy of rejecting laboratory uncertainty in setting background concentrations.

Assume an individual property owner collects a single sample, and the result is 3.9 µg/L for Cr(VI). The sample was analyzed by a laboratory other than the one used by PG&E, whose results statistically are 0.15 µg/L higher for Cr(VI) results on a consistent basis as compared to the PG&E laboratory. The property owner did not request a matrix spike and matrix spike duplicate for the individual sample, so the sample is pooled with other small sample sets and a sample from another site is used for the matrix spike duplicate analysis.

In this scenario, assume the results of the multiple calibration runs using known standard samples indicate, on average, results that are 11 percent higher than the standard concentration. This is within the allowable 15 percent variation, so the data is considered valid in terms of precision.

Also assume that the matrix spikes results are 19 percent higher than the "true" result. This is within the 80-120 percent acceptance criterion, so the data is considered valid in terms of accuracy.

Lastly, in this scenario the laboratory used the property owner's sample for laboratory duplicate analysis. The reported result was 3.9 µg/L. However, the duplicate result was 3.4 µg/L. The laboratory may report the duplicate in the QC section analytical report but would not report the duplicate result as if it were the investigative sample. Again, because the result is within the allowed 20 percent RPD precision criterion, the data is considered valid from the laboratory perspective.

Assuming the reported result may have been 3.4 µg/L, and taking into account the affects of using a different laboratory (0.15 µg/L), the 11 percent bias from calibration, and the 19 percent bias for spike recoveries, the actual sample result could be as low as 2.42 µg/L. Thus, without consideration of these layers of laboratory uncertainty, the individual property owner's well would have been considered inside the plume boundary when in fact the actual concentration was considerably below the background concentration threshold. Note that all of this laboratory uncertainty doesn't take into account the uncertainty posed by the property owner's sampling methods, chain of custody, or other factors that could adversely influence sample quality and results.

PG&E is not recommending that each of the laboratory uncertainty factors described above be taken into direct account for every sample collected at the Site. However, the above example provides a clear picture of what could happen if these factors are not acknowledged and carefully considered when prescribing background concentration thresholds.

Considering that the background concentrations at the Site are very low and considering the overall precision and accuracy of laboratory data when evaluating such low concentrations, establishing such concentrations to the hundredths of a part per billion is not in the best interest of the public, the Water Board, or PG&E. PG&E is recommending that the interim concentration of 4 µg/L for Cr(VI) be used to define the plume boundary as a realistic approach that can be readily implemented in an effective manner and that is fully protective of public health and the environment.

2) <u>Adopting a Background Value with Precision to the Hundredth to a Part per Billion and without Consideration of Laboratory Uncertainty Would be Unnecessarily Alarming to the Public</u>

If the Water Board were to adopt a single background value with precision to the hundredths of a part per billion without consideration of laboratory uncertainty it would unnecessarily alarm the public, implying a laboratory can repeatedly accomplish an objective of accuracy that is technically infeasible. Members of the public would be unnecessarily alarmed if a sample from their well equals or exceeds 3.09 µg/L for Cr(VI), suggesting they are located within the plume. In fact, the true value may be considerably lower than 3.09 µg/L considering all of the factors of uncertainty such as laboratory and sampling methods. Having a background value of 4 µg/L is commensurate with the results of the background study and a reasonable accuracy of the laboratory and sampling methods. This value is consistent with the current approach for plume delineation and control, and would not result in unnecessary public concern.

04-0040

3) Existing Data Demonstrates that Plume Containment Can Not be Accurately or Precisely Measured at Concentrations Expressed to the Hundredths of a Part per Billion

Recent data for sentry wells (just outside the 4 µg/L Cr(VI) plume boundary) provide an excellent example of the difficulties of implementing the proposed amended CAO. These wells tend to exhibit very small short-term increases and decreases in concentration with no long-term trend in either direction. For example, the most recent data for well MW-54 shows a Cr(VI) concentration above and below 3.09 µg/L. Since August 2007, this well has been sampled eight times including the most recent event (August 2008). Concentrations of Cr(VI) have ranged from 2.72 µg/L (February 2008) to 3.49 µg/L (June 2008). For the 8 sampling events, the well would have been inside the plume as defined by the proposed amended Order (Cr(VI) above 3.09 µg/L) during four of the events and outside of the plume during the other four events. There is no discernible increasing or decreasing trend at this well since August 2007, simply small ups and downs of within 1 µg/L. It is unclear how the proposed amended CAO as currently written would interpret these data in terms of compliance. Would PG&E be in compliance one sampling event and then out the next based on a concentration change of a few hundredths of a part per billion?

As discussed in detail above, although some laboratories report results to the hundredths of a part per billion, what is deemed acceptable in terms of accuracy and precision under the U.S. EPA method allows for a fairly wide range in potential concentrations above and below the reported result. This range of potential *acceptable* concentrations (also known as the "uncertainty") must be considered when deriving regulatory trigger concentrations. Given the method allowable error for precision (20 percent) and accuracy (15 percent), the range in concentrations at well MW-54 as noted in the example above could easily be completely attributable to method *acceptable* analytical uncertainty. Similar trends are noted at other sentry wells such as MW-49A, which has Cr(VI) concentrations slightly above 4 µg/L, and at MW-50A, which exhibits Cr(VI) concentrations similar to MW-54.

For all of these reasons, it is most practical to round the statistically derived upper limit for Cr(VI) to a whole number for the purposes of evaluating the plume boundary. Consistent with the background study, PG&E is recommending that the interim background concentration of 4 µg/L for Cr(V) continue to be used for the purposes of defining the plume boundary, implementing the Boundary Control Monitoring Plan, and complying with the requirements of the existing CAO.

4) Cr(T) Should Not Be Used To Define a Plume of Cr(VI)

Cr(T) represents the total of all chromium in a given water sample, including all Cr(VI). The drinking water standard for Cr(T) is 50 µg/L, well above the interim Cr(VI) plume delineation concentration of 4 µg/L.

04-0041

Requirement 3(a) of the existing CAO requires containment of the existing plume boundary based on evaluation of Cr(VI) data only. PG&E's approved plan for data evaluation and reporting to demonstrate plume boundary control (Boundary Control Monitoring Program, SECOR 2008) is consistent with this CAO requirement and does not use Cr(T) as part of the plume boundary evaluation.

However, the proposed amended CAO would require the use of background Cr(T) concentrations to define the limits of the existing plume for the purposes of containment. But, the primary "plume" that PG&E is remediating is Cr(VI). PG&E is required to collect Cr(T) data at the site, and we will continue to do so. But, provided that PG&E is containing the plume at the established Cr(VI) background limit, it is reasonable to assume that the Cr(T) is also being addressed. Note that Cr(T) levels at the fringes of the plume may be slightly higher than Cr(VI) levels because Cr(VI) naturally attenuates to Cr(III) at the plume edges. Cr(T) concentrations at the plume edges are significantly lower than the drinking water standard of 50 µg/L, and natural attenuation of Cr(VI) should be viewed as a very positive and valuable outcome of natural processes that are assisting in containment and cleanup. Containment based on the background Cr(VI) concentration will ensure that the plume is stable (and shrinking as the remediation progresses) and that public health is protected.

5) <u>Establishing a Background Level in the CAO for The Purpose of Developing Cleanup Standards Is Premature</u>

The SWRCB Resolution 92-49 analysis, scheduled to be completed in September 2010, will be used to develop final cleanup goals for the Site. This analysis will include a detailed evaluation of several factors, including the overall benefit of cleanup to the background concentrations for Cr(VI) and Cr(T) as compared to cleanup to a higher concentration [up to the beneficial use standard, currently 50 µg/L for Cr(T)]. Until this analysis is complete, the degree to which PG&E will be required to perform cleanup has yet to be determined, and the final approved cleanup goals could be higher than the background concentration.

In consideration of the various factors specified in SWRCB Resolution 92-49, the Water Board may adopt a cleanup standard that is higher than background. Should the Water Board adopt the amended Order as proposed at this time and require PG&E to contain the Cr(VI) plume to 3.09 µg/L, and then later determine that final cleanup to a higher concentration is appropriate, then significant effort and resources would have been wasted from December 31, 2008 (containment date – Req. 3.1 of the CAO) to September 1, 2010 (when the SWRCB Resolution 92-49 analysis must be submitted).

One specific example of the problems created by prematurely requiring plume containment at 3.09 µg/L for Cr(VI) is PG&E's recently approved project to enhance plume control in the northwest portion of the site. PG&E is currently implementing groundwater extraction at the northern limits of the plume with an overall objective of containing the plume to 4 µg/L for Cr(VI). As you are aware, PG&E submitted a

Notice of Intent (NOI) for coverage under the General Permit for Site-Wide Remediation Activities (General Permit) on September 24, 2008 to supplement the on-going groundwater extraction with additional hydraulic control remedies (additional pumping and injection of water outside the plume). These projects were not developed assuming the background concentrations included in the proposed amended CAO and the existing and proposed plume containment facilities and projects may need to be significantly altered to comply with the proposed amended CAO.

6) <u>It is Impractical--and Likely Physically Impossible--to Comply with the Proposed Amended CAO</u>

Requirement 3(a) of the existing CAO requires "*...no further migration or expansion of the chromium plume to locations where hexavalent chromium is below the background level.*" Requirement 3.1 of the existing CAO states that compliance will be achieved by December 31, 2008 and that "*...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 methodology contained in the Boundary Control Monitoring Program...*"

The Boundary Control Monitoring Program (BCMP) establishes control limits for wells located throughout the plume area, to evaluate stability of the plume boundary and plume core (i.e., that portion of the plume where Cr(T) concentrations are equal to or greater than 50 µg/L). The plume boundary control portion of the BCMP is predicated on the interim background limit for Cr(VI) of 4 µg/L. Existing monitoring wells located outside the plume that exhibit concentrations of Cr(VI) less than 4 µg/L are used as "sentry wells." There are three sentry wells that currently have Cr(VI) concentrations in the range from 3.09 µg/L to 4 µg/L: MW-50A, MW-54, and MW-62A. The inclusion of these sentry wells as being within the plume will require a detailed evaluation by PG&E on two fronts: what revisions to the BCMP would be required, and what potential revisions to the existing remediation systems may be necessary to comply with the plume containment requirement?

Following submittal of the Background Study in 2007, PG&E was instructed by Water Board staff to construct boundary control and monitoring infrastructure at the 4 µg/L Cr(VI) level. Further, PG&E was told by Water Board staff and the Executive Officer that they did not intend to require PG&E to install costly infrastructure at the 4 µg/L level for Cr(VI) only to see the compliance level lowered immediately thereafter. Nevertheless, that is exactly what is proposed in the amended CAO.

The December 31, 2008 compliance date for plume containment is not appropriate for two reasons. First, PG&E would likely need to install additional sentry wells down-gradient of the above-referenced wells, to define the boundaries of the plume to 3.09 µg/L. Until these new wells are installed and sampled sufficiently to establish control limits, methods to demonstrate compliance with Requirement 3.1 would not be in place.

04-0043

Second, it is also impossible for PG&E to comply with a December 31, 2008 date without considering the changes to plume definition (the overall "footprint") of the plume based on a 3.09 Cr(VI) background concentration. Depending on the outcome of sampling additional well installations, the existing hydraulic control measures will likely require enhancement, and the NOI that was recently submitted will require substantial revisions to achieve a new and unexpected objective. It would be impossible for PG&E to install and operate sufficient hydraulic containment in such a limited amount of time.

7) <u>Average Concentrations Should Not Be Used in the Development of Final Cleanup Goals for the Site</u>

Requirement No. 1 of the draft amended CAO proposes that the maximum concentrations referenced above be used to evaluate plume containment and the average concentrations be used when evaluating final cleanup strategies. The average concentrations are 1.19 µg/L for Cr(VI) and 1.52 µg/L for Cr(T). The CAO is unclear as to how these average concentrations would be considered when evaluating final cleanup strategies. Specifically, would concentrations across the current plume area be averaged together and compared to these concentrations? Regardless, the use of average concentrations from the background study as a starting point to evaluate plume cleanup lacks technical basis and could not be reasonably implemented as the plume remediation progresses. Consider the following:

- The average concentrations for Cr(VI) and Cr(T) provide nothing more than a overall median concentration of the chromium concentrations naturally present in groundwater over an area comprised of several square miles. It is inappropriate to compare the future results from an individual well located within the plume to such average concentrations.

- No wells within or down-gradient of the plume were sampled as part of the background study. It would be inappropriate to conclude that the average chromium concentrations in wells sampled as part of the study would be identical to average concentrations of theoretical background data collected from wells within the plume (i.e., before the plume was present).

- The background study was intended to determine statistically defensible concentrations of Cr(VI) and Cr(T) that could be present in groundwater throughout the Hinkley valley groundwater basin. The 95 upper tolerance limit (95 UTL) concentrations proposed in the background study, including the acceptable method derived analytical uncertainty, provides a technically defensible upper limit of what should be detected in any given well sampled throughout the Hinkley valley. These concentrations are 3.55 µg/L for Cr(VI) and 4.04 µg/L for Cr(T), if one actually considers the inclusion of so many significant figures to have any validity whatsoever.

04-0044

- As the plume remediation progresses, different portions of the aquifer will 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.

PG&E proposes that a single concentration be set for Cr(VI) (and Cr(T) if necessary) for future comparison to individual well data. PG&E envisions that, as Cr(VI) concentrations in some wells meet or approximate this goal during the Site cleanup, active remediation in the areas monitored by those wells would be considered complete. Using site-wide average results derived from the background study would not provide a practical tool to assess remediation progress, or to make decisions regarding the design of specific remedial elements.

PG&E recommends that the concentrations of 3.55 µg/L for Cr(VI) and 4.09 µg/L for Cr(T) be the starting point for development of cleanup goals at Hinkley, and that decisions associated with cleanup goals should be made after an analysis pursuant to SWRCB Resolution 92-49 analysis has been completed in September 2010.

Conclusion

PG&E's position on the proposed adopted CAO can be summarized as follows. First, the background concentrations established should recognize the fact that state-of the-art laboratory test methods and practices can not accurately and precisely measure Cr(VI) at the levels required by the proposed amended CAO. Establishing a single background concentration without consideration of laboratory uncertainty with precision to hundredths of a part per billion is misleading and alarming to the public, implying that the laboratory can analyze and report samples at such low concentrations to this level of accuracy. Second, Cr(T) should not be used to define a plume of Cr(VI), as required by the proposed amended CAO. Third, it is premature to establish a background level in the CAO for the purpose of developing cleanup standards. And finally, it is impractical, and likely physically impossible, to comply with the timetables contained within the proposed amended CAO.

For these reasons, PG&E recommends that Water Board staff revise the amended CAO to continue use of the interim background concentration of 4 µg/L of Cr(VI) for the purposes of plume delineation and boundary control.

PG&E does not support the adoption of the proposed amended CAO, and we respectfully request that Water Board staff modify the proposed amended CAO to address PG&E's concerns as documented in this letter. At a minimum, we see no reason that this item could not be removed from the Water Board agenda until the necessary discussions on the important technical points raised in this analysis can take place.

If you have any questions or comments regarding this letter commenting on the proposed amended CAO, please contact me at (530) 520-2959.

Sincerely

Eric P. Johnson
Hinkley Remediation Manager

cc: Lisa Dernbach/ RWQCB Lahontan Region, South Lake Tahoe
Mike Plaziak/ RWQCB Lahontan Region, Victorville

04-0046

ENCLOSURE 5

California Regional Water Quality Control Board
Lahontan Region

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Arnold Schwarzenegger
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October 15, 2008

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RESPONSE TO PACIFIC GAS AND ELECTRIC COMPANY (PG&E) COMMENTS ON DRAFT AMENDED CLEANUP AND ABATEMENT ORDER FOR THE PG&E COMPRESSOR STATION, HINKLEY, SAN BERNARDINO COUNTY

Thank you for your October 10, 2008 comments on the draft amended cleanup and abatement order (CAO) for the PG&E Compressor Station, Hinkley. The draft amended CAO establishes background chromium concentrations in groundwater to be considered at the November 12-13, 2008 Water Board meeting.

COMMENTS AND RESPONSES

The comments list seven areas of disagreement in the draft amended CAO. Most comments provide recommendations. Water Board staff has reviewed your comments and recommendations and has the following responses in numerical order.

Comment No. 1: State of the art laboratory test methods and practices can not accurately measure Cr(VI) (hexavalent chromium) at the concentrations that would be required under the proposed amended CAO. To provide for laboratory uncertainties, PG&E recommends that the interim concentration of 4 µg/L for Cr(VI) be used to define the plume boundary.

Response: The proposed amended CAO incorporates PG&E's recommendation to maintain the interim concentration for Cr(VI) of 4 µg/L to define the plume boundary for containment purposes. This change is based on the potentially significant short-term costs associated with complying with the proposed background concentrations rather than the interim value, considering that both values are low and close to each other. The concentration associated with plume boundary control may change based on the remediation strategy assessment that is required.

PG&E's discussions about laboratory accuracy and precision should be considered in the context of the background study that determined the maximum and average chromium concentrations detected and the maximum likely background chromium concentrations present in the Hinkley area (calculated as the 95% Upper Tolerance Limits). Actual concentrations may have been greater or lower than reported by the

laboratory. These variabilities were present in the samples reported and that underwent the statistical analysis that determined the maximum likely concentrations. This variability results in expanded tolerance limits that, in effect, take the accuracy and precision into account.

The revised workplan for the Background Chromium Study, submitted by PG&E in September 2004, took these same laboratory uncertainties into consideration. Despite these uncertainties, no mention was made for adding a laboratory uncertainty value to chromium value calculations. Peer reviewers of the revised workplan agreed with PG&E's recommendation to use the 95% upper tolerance limit of the background study sample results as the maximum likely background chromium concentrations. Staff's review of literature on setting background concentrations has not identified a single case where laboratory method accuracy limits were added to the maximum concentrations derived through statistical analysis, such as the 95% upper tolerance limit method. PG&E has had opportunity to provide case examples where laboratory method accuracy limits were added to the maximum concentrations, but to date has not provided any such examples.

PG&E's discussions of field sampling methods, variability among laboratories and other laboratory quality assurance/quality control issues are not relevant, as the CAO is for PG&E and not others, and PG&E uses consistent, approved methods and a single laboratory. The Water Board will consider samples collected by others on a case-by-case basis, and verification sampling will be conducted before any significant change is directed by the Water Board.

Comment No. 2: Adopting a background value with precision to the hundredth of a part per billion and without consideration of laboratory uncertainty would be unnecessarily alarming to the public. PG&E recommends establishing a maximum background concentration of 4 µg/L Cr(VI) as it is commensurate with the results of the background study and is a reasonable accuracy of the laboratory and sampling methods.

Response: Water Board staff disagrees that establishing a maximum background concentration of 4 µg/L Cr(VI) is commensurate with the results of the background study, is a reasonable accuracy of the laboratory and sampling methods, and will prevent unnecessary public alarm. Water Board staff agrees that background concentrations should be represented in tenths rather than hundredths of micrograms per liter.

The results of sampling 48 wells for the background study showed a range of chromium concentrations for Cr(VI) in groundwater from 0.2 to 2.69 µg/L. Neither the values in the range nor the calculated maximum background concentration of 3.09 µg/L are commensurate with PG&E's suggested concentration of 4 µg/L. The subject of laboratory uncertainties is discussed in Board staff's response to Comment No. 1. Water Board staff believe the public is no more likely to show alarm for exceedances of the maximum background value of 3.1 µg/L Cr(VI) than it has in the past for exceedances of the interim value of 4 µg/L.

Comment No. 3: Existing data demonstrates that plume containment can not be accurately or precisely measured at concentrations expressed to the hundredths of a part per billion. PG&E recommends that the interim background concentration of 4 µg/L for Cr(VI) be used for defining the plume boundary.

Response: See responses to Comment Nos. 1 and 2.

Comment No. 4: Cr(T) (total chromium) should not be used to define a plume of Cr(VI).

Response: While Water Board staff concurs that the original discharge at the PG&E Compressor Station consisted of Cr(VI), there is no way to be sure that the resulting chromium plume in groundwater has stayed that way. Due to hydrogeologic conditions along the 2 mile length and 1.3 mile width of the plume, some Cr(VI) has likely converted to trivalent chromium [Cr(III)]. Your comments even admit this likelihood. The addition and increase in Cr(III) concentrations to groundwater in the Hinkley Valley as a consequence of the discharge at the Compressor Station is subject to cleanup and abatement in the form of Cr(T) in the CAO and proposed amended CAO. It is therefore appropriate and necessary that Cr(T) be used to define the plume in groundwater.

Comment No. 5: Establishing a background level in the CAO for the purpose of developing cleanup standards is premature. PG&E suggests waiting to establish cleanup goals for the site until after a State Water Resources Control Board (State Water Board) Resolution No. 92-49 analysis is completed by PG&E in September 2010.

Response: Water Board staff disagrees. In establishing cleanup standards, the Water Board is required to comply with state statues, regulations, and policies. State Board Resolution No. 68-16 affirms that "waters of the State shall be so regulated as to achieve highest water quality consistent with maximum benefit to the people..." The draft amended CAO complies with the policy by establishing background concentrations for total and hexavalent chromium in groundwater based on the results of PG&E Background Chromium Study. The background level is the basis for assessing final cleanup strategies. State Water Board Resolution 92-49 requires cleanup to background levels unless it is found to be unreasonable. Following that assessment pursuant to Resolution 92-49, the Water Board may consider cleanup standards greater than background levels.

Comment No. 6: It is impractical—and likely physically impossible—to comply with the proposed amended CAO (with regards to containing plume migration to background levels and the December 31, 2008 compliance date). No recommendation or alternate compliance date is offered.

Response: Board staff believes that the Boundary Control Monitoring Program developed by PG&E for evaluating plume containment can just as easily accommodate the proposed maximum background concentrations of 3.1 µg/L for Cr(VI) as it does for the interim background concentrations of 4 µg/L Cr(VI). For years this agency has been

up-front in informing PG&E that interim values would change to final values upon acceptance of background chromium values.

However, due to the potentially significant short-term costs associated with complying with proposed background concentrations rather than the interim value, considering that both values are low and close to each other, Water Board staff is recommending the interim value of 4 µg/L Cr(VI) be used for defining the plume boundary and plume containment at this time. The concentration associated with plume boundary control may change based on the remediation strategy assessment that is required.

Comment No. 7: Average concentrations should not be used in the development of final cleanup goals for the site. PG&E recommends that calculated maximum background concentrations of 3.55 µg/L Cr(VI) and 4.09 µg/L Cr(T) be the starting point for development of cleanup goals at Hinkley.

Response: Board staff believes it is appropriate to use average background concentrations when it comes time to evaluate the ability of proposed cleanup strategies for site-wide cleanup. Just as the 2007 Background Chromium Study completed by PG&E demonstrated that background chromium values in groundwater in the Hinkley Valley have a range, mean, and maximum concentration, so it would be expected in the chromium plume following implementation of cleanup strategies. The proposed amended CAO clarifies that remediation strategy assessment must include an evaluation of achieving average concentrations within the cleanup area that meet the average background concentrations, with discrete samples within the cleanup area not exceeding the maximum background concentrations. If implementation of cleanup strategies show the inability to achieve either average or maximum background chromium values listed in the amended CAO, PG&E will have the to promoting a higher cleanup value based on the Resolution 92-49 analysis.

Thank you for your comments. Please contact Lisa Dernbach at (530) 542-5424 or me at (530) 542-5460, if you have any questions.

Chuck Curtis, P.E.
Manager, Cleanup and Enforcement Division

cc: Mailing List

LSD/adw/ T:PG&E amended CAO comments.doc
[Send to file: WDID No. 6B369107001 (VVL)]

04-0051

ENCLOSURE 6

NOV 0 4 2008

By CLC/LSD

Ken Berry 10567 Mariposa Avenue, Jackson, CA 95642 berry-k@sbcglobal.net

October 30, 2008

Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
Lake Tahoe, CA 96150

Re: Pacific Gas and Electric Company
Hinkley Compressor Station
Cleanup And Abatement Order No. [R6V-2008-0002A1]

The Lahontan Regional Water Quality Control Board (R6WB) proposes to approve a Cleanup and Abatement Order (CAO) as Item 4 on its agenda for its regular meeting to be held on November 12-13, 2008. Approval of the proposed CAO would amend site cleanup requirements.

The proposed action is unlawful because it violates the requirements of the California Environmental Quality Act (CEQA, Public Resources Code (PRC) §21000 and following). In particular, Finding No. 22 of the proposed CAO cites Title 14 of the California Code of Regulations (14 CCR) §15321 as the authority for not preparing an environmental analysis. 14 CCR §15321 is a Categorical Exemption.

However, 14 CCR §15300.2(e) prohibits any categorical exemption from being utilized to avoid preparing an environmental analysis for any site on any list compiled pursuant to Government Code (GC) §65962.5. GC §65962.5(c)(3) requires the listing of any site for which a CAO is issued pursuant to Water Code (WC) §13304 concerning the discharge of hazardous materials. "Hazardous materials" are defined in Health and Safety Code (HSC) §25501(o).

The imperative statement of the proposed CAO identifies the authority for taking the action as WC §13304.

This comment is submitted pursuant to CEQA and is submitted on my behalf and behalf of the California Citizens for Environmental Justice. Violation of GC §65962.5 and 14 CCR §15300.2 are is long standing and widespread practice of the State Water Resources Control Boards (SWB) and the Regional Water Quality Control Boards (RWBs), of which R6WB is one.

You may call me at 209-223-1769 if you have any questions.

Sincerely,

Ken Berry

Ken Berry,
California Citizens For Environmental Justice

04-0053

NOV 0 4 2008

LSD/CLC

Ken Berry 10567 Mariposa Avenue, Jackson, CA 95642 berry-k@sbcglobal.net

October 29, 2008

Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
Lake Tahoe, CA 96150

Re: CEQA Comments

Please find enclosed a letter commenting on CEQA compliance and a letter requesting notice of future actions for the following project(s):

1) Pacific Gas and Electric Company Hinkley Compressor Station

You may call me at 209-223-1769 if you have any questions.

Sincerely,

Ken Berry

Ken Berry,
California Citizens For Environmental Justice

04-0054

ENCLOSURE 7

04-0055

Pacific Gas and Electric Company®

Robert C. Doss, P.E.
Principal Engineer
GT&D Remediation

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November 3, 2008

Mr. Harold Singer
Executive Officer
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Subject: Use of Average Background Values in Proposed Amended Cleanup and Abatement Order No. R6V-2008-0002A1
PG&E Groundwater Remediation Project
Hinkley, San Bernardino County

Dear Mr. Singer:

Thank you for taking time on October 30, 2008 to discuss the average background values contained in the proposed amended Cleanup and Abatement Order (CAO) for the Pacific Gas and Electric Company (PG&E) Hinkley Groundwater Remediation Project (Proposed Order No. R6V-2008-0002A1). The purpose of this letter is to confirm our understandings from that conversation, and to briefly describe PG&E's concern regarding future uses of these average background concentrations.

During our conversation on October 30th, you clarified that the draft amended CAO requires only an *evaluation* of average background concentrations as one of several potential remediation goals for the Hinkley site. You made it clear that the proposed amended CAO does not require PG&E to perform cleanup to these concentrations, and that the actual cleanup standards will be determined through the State Water Resources Control Board Resolution 92-49 process. We appreciate your clarifying the distinction between a requirement to consider the average concentration and the actual process of setting a cleanup standard.

Although PG&E believes that any cleanup goal based on average background concentrations would be without precedent, contrary to Resolution 92-49 and the related California Code of Regulations, and inconsistent with the traditional use of the upper tolerance limit (*i.e.*, maximum background) value in similar regulatory and legal settings, your explanation allows PG&E to defer its complete objection to the use of average background as a potential cleanup level until the cleanup level selection process. Nevertheless, PG&E wishes to go on record as opposing the use of average background concentrations as cleanup goals.

In the context of PG&E's background study, the relevant background number is the upper tolerance limit or maximum background number reported in the study. In SWRCB

04-0056

Resolution 92-49, background conditions are defined by reference to 23 CCR Section 2550.7(e). The statistical method used in PG&E's background study is outlined in 23 CCR Section 2550.7(e) and it specifies the use of the upper tolerance limit or, in other words, the maximum background level, rather than the average background level. PG&E is unaware of any regulatory regime where average background concentrations have been used as remedial goals, in contrast with the frequent use of maximum background concentrations in regulatory requirements. For example, in the case of waste management units such as landfills and surface impoundments, up-gradient or pre-disposal sampling produces a maximum background number based on statistical upper tolerance limits. The calculation of a 95 percent UTL of 3.1 µg/L for Cr(VI) at Hinkley is analogous to that approach, in that groundwater unaffected by the plume was collected for analysis and the data were used to develop a statistical upper tolerance limit.

Moreover, the regulations that govern water quality monitoring for waste management units, such as those promulgated under the federal RCRA Subtitle D and California Title 27, do not discuss the use of average background values. Neither does Resolution 92-49 specify that background concentrations be calculated based on averages. PG&E is aware of instances where different background values are used when different sections of a waste management unit can be spatially divided (i.e., completely separate water quality monitoring programs). However, that situation is not the case at Hinkley.

Resolution 92-49 requires cleanup to background concentrations, unless PG&E demonstrates it is unreasonable to attain these conditions in consideration of technical and/or economic factors. PG&E believes that the 92-49 analysis will show that it is technically infeasible to attain (or even to measure the attainment of) background water quality as defined by the average values included in the proposed amended CAO. That is, once concentrations are reduced throughout the existing plume area below the 95 percent upper confidence limit (UCL) of 3.1 µg/L for Cr(VI) and 3.2 µg/L for Cr(T) (the "maximum background concentrations") there is no scientifically reliable method for determining what groundwater has been restored to "natural" conditions and what water may represent the "residual plume." Thus, further treatment of the groundwater within the current plume boundaries to attain the average background levels overall carries the strong possibility that PG&E would be treating water that has already been restored to natural conditions. PG&E believes that such a requirement would be inconsistent with State Water Resources Control Board Resolution 68-16.

PG&E's preference would be for the amended CAO to acknowledge the potential impracticality of using the average background values as cleanup goals by not including these values in the requirements section of the proposed amended CAO. However, we are proceeding without requesting further changes to the proposed amended CAO, on the basis that both PG&E and the Water Board staff fully understand that the amended CAO requires only an evaluation of cleanup to these values, and does not require the use of average background concentrations as cleanup standards.

Again, thank you for taking the time to provide clarification regarding these issues. If I misunderstood our conversation or if you have any questions or comments regarding PG&E's understanding as described in this letter, please do not hesitate to contact me.

Sincerely,

Robert C. Doss

cc: Lisa Dernbach/RWQCB Lahontan Region, South Lake Tahoe
Mike Plaziak/ RWQCB Lahontan Region, Victorville

04-0058