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. Plume Containment

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

   (a) no further migration or expansion of the chromium plume to locations where hexavalent chromium is below the background level, or

   (b) no further migration or expansion of the 50 µg/L total chromium plume.

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

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

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

3.1. **By December 31, 2008**, achieve containment of the chromium plume in groundwater as defined in (a) above. Compliance will be determined by comparing groundwater samples collected after this date to the control limits established using data through the third quarter 2008 using the methodology contained in the *Boundary Control Monitoring Program* (see Finding No. 16, above, and Order 6.2, below), except that only the last eight samples for each well through the 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 Dated: August 6, 2008

HAROLD J. SINGER
EXECUTIVE OFFICER