

## Remediation of a 3-Mile Hexavalent Chromium Plume in Hinkley, California

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**Background/Objectives.** Pacific Gas and Electric (PG&E) is conducting assessment and cleanup of hexavalent chromium (Cr[VI]) in groundwater related to industrial activities from the 1950s and 1960s at the PG&E Hinkley Compressor Station near Barstow, California (the Site). The plume core undergoing remediation is approximately 3 miles long and 1 mile wide. In December 2015, a Cleanup and Abatement Order was issued which established cleanup requirements for the site, including required cleanup timeframes for plume core undergoing remediation to reach 50 parts per billion (ppb) across 90% of the plume by 2025 and to reach 10 ppb across 80% of the plume by 2032 at specified monitoring wells. To reach these milestones at the scale of the site, remedy design includes a series of remedial system expansions and remedy implementation relies on an adaptive management scheme for continual performance evaluation and optimization. This presentation will detail the remedial approach, implementation and remedy performance to date.

**Approach/Activities.** PG&E began actively remediating chromium-impacted groundwater at the Site in 1992. Initial remedial activities (1992 through 2001) included groundwater extraction and treatment via agricultural application. In 2004, PG&E began implementing several key remediation components that were expanded over time and comprise the current remedy, including:

- Hydraulic containment through operation of a network of 45 groundwater extraction wells, nine agricultural treatment units covering 296 acres and a freshwater injection system comprised of 4 supply wells and six injection wells.
- In situ treatment of Cr(VI) through operation of three IRZs utilizing groundwater recirculation through a network of 92 injection wells amended with ethanol to stimulate biologically mediated Cr(VI) reduction.

Recent remedial optimizations have included reconfiguration of the hydraulic extraction system to improve efficiency of water use, revision of the containment strategy at the site to refocus mass removal in the plume core and foster retreat of the leading edge of the plume, and expansion of the IRZ systems. Smaller scale optimizations in response to performance data are implemented on a continual basis.

**Results/Lessons Learned.** Project results to date demonstrate the effectiveness of the hydraulic containment system for plume control and the recirculation systems for the in situ remediation of Cr(VI) at large spatial scales. Progress to date includes:

- Contraction of the plume leading edge, including approximately 2,500-foot retreat of the 50 ppb plume
- Significant progress in removing chromium mass from groundwater. To date, more Cr(VI) was removed than remains in the groundwater.
- Treatment of areas ranging from 10s of ppb to several parts per million Cr(VI) with in situ remediation, with migration of clean water observed over 3,000 feet from the IRZ.

The case study results presented herein will illustrate the heterogeneity that can be encountered when working at large scales within complex geologic systems and the importance of adaptively managing the remedial systems over time to improve performance.