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Date: NOV 16 2009
Refer To: EP2009-0604

James Bearzi, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Request for Approval of Permeable Reactive Barrier Design Modifications for Consolidated Unit 16-021(c)-99

Dear Mr. Bearzi:

Los Alamos National Laboratory's (the Laboratory) Environmental Programs Directorate is requesting approval for design modifications to the permeable reactive barrier (PRB) to be installed in Cañon de Valle per the New Mexico Environment Department–(NMED-) approved revised corrective measures implementation (CMI) plan for Consolidated Unit 16-021(c)-99. In the course of excavating test pits during the week of September 28, 2009, several significant changes in field conditions were observed, resulting in impacts to the execution of this project. These changes in field conditions and the proposed design changes were discussed with Dave Cobrain, Jerzy Kulis, and Michael Dale of your staff in a meeting held on October 9, 2009.

Based on results from the test pits, the Laboratory proposes several design modifications necessary to improve the performance of the original design and that were developed primarily in response to current field conditions. While in the field, it was determined the width of the canyon bottom and the depth of alluvium had been underestimated in the CMI plan. The cutoff wall will need to be approximately 100 ft long rather than 45 ft as originally proposed, and the depth of alluvium will be approximately 9 ft rather than 4 to 5 ft. The original design of the PRB was presented in the CMI plan and is attached as Figure 1.

Design modifications focused on ensuring the mechanical, hydrological, and geochemical performance of the PRB include the following.

(1) Substitution of a high-density polyethylene (HDPE) or vinyl sheet piling for the diversion wall instead of a soil/bentonite mixture wall. Plastic sheet piling will be keyed to bedrock with a bentonite seal. This PRB design modification is shown in the attached Figures 2 and 3. It should be noted that the engineered erosion controls specified for the location where the stream

crosses the PRB cutoff wall in the original design will be retained. The new proposed design has the following advantages.

a. Mechanical advantage: continuous impermeable wall with water piped directly to PRB reaction cell, resulting in reduced opportunity for leakage through wall and reduced degradation or erosion of the wall.
b. Hydrological advantage: very low conductivity (1×10^{-10} cm/s).
c. Geochemical advantage: no degradation or erosion of plastic-sheet piling over time, adding confidence in long-term water cutoff performance.

(2) Offset of the PRB reactive cell downgradient of diversion wall instead of direct connection to the diversion wall (Figures 2 and 3).

a. Mechanical advantage: downgradient location of the vessel allows for increased hydraulic head without increasing the mounding depth behind the cutoff wall beyond the original design.
b. Hydrological advantage: minimizing potential for mounding will reduce the probability of alluvial water leakage downward via fractures in the tuff.
c. Geochemical advantage: increased hydraulic head will help maintain consistent flow through the reactive cell.

(3) Installation of 20 shallow monitoring wells (2-in.-diameter polyvinyl chloride [PVC] pipe). Approximately 10 wells will be installed upstream and 10 downstream of the diversion wall. The wells will be 10 ft deep with approximately 5-ft screens and will provide additional water-level and geochemical monitoring points. The preliminary additional monitoring-well locations are shown in Figure 2.

a. Mechanical advantage: perform hydraulic check of diversion wall.
b. Hydrological advantage: measure water-level elevations, determine hydraulic gradients, and interpret flow paths. This information will help determine hydraulic capture zone, providing confidence the groundwater flow is directed through PRB reaction cell.
c. Geochemical advantage: additional sampling points to monitor geochemistry, including measuring pH and oxidation-reduction potential at several locations upgradient and downgradient of the filter media and allow for sampling for high explosives and barium to assess the performance of the PRB filter media.

(4) Addition of an infiltration gallery immediately downgradient of PRB reaction cell. A high permeable gravel bed located downgradient of the PRB vessel would be installed. The volume of the gravel bed would be similar to the volume of the PRB cell (see Figures 2 and 3).

a. Mechanical advantage: easy pathway for water leaving the PRB reaction cell.
b. Hydrological advantage: increase in cross-sectional area at PRB outlet to prevent potential upgradient mounding of groundwater from a bottleneck at water release point; will also help maintain the designed flow rate through PRB cell.
c. Geochemical advantage: no stagnation within the cell, thereby enhancing treatment.

To address concerns of the PRB system plugging downgradient of the cutoff wall, a surface bypass system will be plumbed inline during construction of the PRB. The bypass system will be a siphon/overflow pipe plumbed into the piping downgradient of the diversion wall, bypassing the PRB treatment cell, and connected directly to the infiltration gallery downgradient of the PRB treatment vessel. The bypass system will be used if excessive groundwater

mounding occurs upgradient of the diversion wall and during maintenance of the PRB treatment cell.

(5) Expansion of pea-gravel gallery on the upstream side of diversion wall. If the HPDE sheet piling option is used, a 1- to 2-ft wide layer of pea gravel would line the entire diversion wall on the upgradient side. Perforated PVC collection piping would be installed at the bottom of the pea-gravel layer to drain to the PRB reaction cell (Figures 2 and 3).
   a. Mechanical advantage: increased groundwater-capture efficiency.
   b. Hydrological advantage: reduced effect of heterogeneity of the upgradient formation, thereby minimizing preferential flow paths and upgradient groundwater mounding.
   c. Geochemical advantage: can pretreat groundwater by removing dissolved oxygen and providing a surface for mineral precipitation to help extend the life of the PRB media.

(6) Installation of flow meters at interception trench and downgradient of PRB treatment cell. Flow meters will be installed if sufficient flow of alluvial groundwater is observed during the installation of the PRB. Initial flow data indicate that the alluvial groundwater flow is inadequate to support accurate flow metering; however, the advantages of flow meters are important enough to warrant delay of a final decision until PRB construction begins.
   a. Mechanical advantage: provides performance check of PRB system.
   b. Hydrological advantage: when combined with the water level results, determines total flow of alluvial groundwater and provide a mass balance on the canyon water; increases confidence in assessing how much of the total available water is flowing through the PRB and predicting contaminant breakthrough (PRB longevity) based on previously collected data from laboratory treatability studies and literature reviews.
   c. Geochemical advantage: ability to quantify the amount of water flow through the PRB. When combined with the geochemical results, can provide an accurate total of how much water has been treated in the Cañon de Valle alluvial system. Information can be presented in terms of contaminant load or mass removed from the system.

(7) Modification of PRB reaction cell to include multiple baffles. The baffles will be anchored to the sides of the vessel and will alternately extend from the top or bottom of the vessel. This modification is depicted in the side view of the revised PRB design presented as Figures 2 and 3 of the attachment to this letter. Baffles will eliminate the potential for water to bypass the treatment media, thereby ensuring the treatment residence (contact) time is met and the media remains continuously saturated.
   a. Mechanical advantage: controls flow path through entire filter medium and minimizes potential for preferential flow paths within treatment vessel.
   b. Hydrological advantage: continuous saturation of media minimizes impacts from intermittent wet and dry cycles, thereby reducing mineral precipitation that erodes filter media porosity and hydraulic conductivity of PRB filter media.
   c. Geochemical advantage: greater saturated zone increases surface area for chemical reactions to occur.

Detailed design drawings are being developed, and as-built drawings will be provided as required by the approved CMI plan.

The changes in field conditions pose technical challenges of installing the modified PRB. Construction of a deeper trench requires extra care to ensure worker safety and minimize environmental impacts to Cañon de Valle. Therefore, the Laboratory respectfully requests a 1-month extension from the current date of December 31, 2009, to January 31, 2010, to install the barrier.

If you have any questions, please contact John McCann at (505) 665-1091 (jmccann@lanl.gov) or Woody Woodworth at (505) 665-5820 (lwoodworth@doeal.gov).

Sincerely,

Michael J. Graham, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

David R. Gregory, Project Director
Environmental Operations
Los Alamos Site Office

MG/DG/DM/JM:sm

Attachment: Figures 1, 2, and 3 Pilot Permeable Reactive Barrier Plan and Side Views (LA-UR-09-7398)

Cy: (w/att)
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