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DIST.	LTR	ENC
BERARDINI, J.H.	X	X
BOGNAR, E.S.	X	X
BROOKS, L.	X	X
CARPENTER, M.	X	X
CROCKETT, G. A.	X	X
DECK, C. A.	X	X
DEGENHART, K. R.	X	X
FERRERA, D. W.		
GIACOMINI, J. J.		
GILPIN, H.		
LINDSAY, D. C.	X	X
LONG, J. W.		
NESTA, S.		
~~SHELTON, D. C.~~	X	X
TUOR, N. R.	X	X
WARD, D.	X	X
WIEMELT, K.	X	X
ZAHM, C.	X	X
Dininger, R	X	X
Cable, J	X	X
Fleburg, R	X	X
Rokavina, F	X	X
COR. CONTROL	X	X
ADMIN. RECORD	X	X

Reviewed for Addressee Corres. Control RFP

8/8/05 [initials]

Date By

Ref. Ltr. #

DOE ORDER #

5400.1

PM:JJR:05-00485

East Trenches Groundwater Treatment System

Gregg Crockett
Vice President, Director of Administration and Chief Financial Officer
Kaiser-Hill Company, LLC

Kaiser-Hill (K-H) has informed the U.S. Department of Energy, Rocky Flats Project Office (DOE, RFPO) that the East Trenches groundwater treatment system is no longer fully operational, due to clogging and solidification of the treatment medium. The purpose of this memorandum is to direct K-H to make the necessary repairs to make the system fully operational. This is to include conformance with the specifications contained in the decision document for the East Trenches groundwater plume, as well as compliance with all applicable surface water standards. At the completion of the repair work, K-H is to submit to RFPO an evaluation demonstrating that the repaired treatment system will have a projected longevity of one year post-physical completion, consistent with Paragraph 4.8.b of Section 4 (Physical Conditions) of the *Omnibus* Agreement between K-H and RFPO. As you are aware, our staffs have met with representatives of DOE Legacy Management and S. M. Stoller to receive their recommendations on specific corrective actions for the East Trenches treatment system. These recommendations are attached for K-H consideration; however, K-H is free to take the approach of its choosing in order to make the system fully operational once more.

This correspondence is not intended to direct a change in the scope, cost, terms or conditions of the contract of our existing contract. Should you disagree with this assumption, contact me at extension 8485. If K-H has questions regarding the technical content of this correspondence, they may be directed to Norma Castaneda of RFPO at extension 4226.

Charles A. Dan, Jr.
Contracting Officer

Attachment

cc:
F. Lockhart, DOE-RFPO
J. Rampe, DOE-RFPO
N. Castaneda, DOE-RFPO
S. Surovchak, DOE-LM

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ADMIN RECORD

BZ-A-000866

Suggestions for Changeout of Reactive Media and Monitoring System Enhancements for the East Trenches Treatment Cells: July 28, 2005

Dr. Stan Morrison, S. M. Stoller (970)248-6373

Following are several concepts that could be considered for changeout of reactive media at the East Trenches treatment cells. Enhancements to the monitoring system that could improve future optimization and operations of the system are also suggested. Values provided are approximate and should be checked for accuracy.

Summary of Suggestions:

1. Plumb treatment tanks for upflow rather than downflow. Add an access port so that a pump could be added in the future.
2. Use Peerless ZVI of a coarser texture such as -4 + 10 mesh.
3. Use ZVI/gravel mixture: Place mixtures of 10, 20, and 30 % ZVI, (gradational upwards with pea gravel) in Tank 1. Place 10 % gravel/ZVI in bottom of Tank 2, overlain by 100% ZVI.
4. Add 2 access (and vent) pipes to each tank.
5. Upgrade monitoring system. Add instruments to measure and record: a) additional flow rates, b) pH, and c) pressures. Conduct regular monitoring of major ions.
6. Sample spent ZVI.

Discussion of Suggestions:

1. Upflow Verses Downflow. The cells should be plumbed so that water moves upward through the treatment media instead of downward.

Advantages to Upflow:

1. Increased Pressure Differential. Using downflow, the maximum pressure difference that can be used to drive water through the media is equivalent to the head of water in Tank 1, about 5 ft maximum. About 10-ft of head is available between Tank 1 and the collection sump. A total of 20 ft of additional head is available if the collection trench is backed up to its midpoint (40 ft if backed up all the way). This additional head can be used to force water through the treatment media; thus, if the hydraulic conductivity decreased, there may still be sufficient pressure to allow water flow.
2. Adaptable to Pumping. With an upflow configuration, a pump could be added to apply more pressure for extending the life of the system.
3. Gas Flushing. Because gravity is the main driving force for downflow, the media is not always completely saturated, which can lead to preferential flow. In

addition, hydrogen gas generated by corrosion is flowing upwards opposite to the direction of water flow. Upflow would be more efficient in completely saturating pore space and helping to remove gas from the system.

4. Limit Oxygen. Because the water is not exposed to the atmosphere, no atmospheric oxygen enters the system, thus limiting crust formation.
5. Control Flow Rate. Flow rate can be controlled by adjusting a valve or kept constant using a dole valve. Treatment effectiveness should be more constant in a system with a more constant flow rate.

Disadvantages to Upflow:

1. Historical Operation. For the first 4 years the treatment system performed well with downflow. This history suggests that downflow should be an acceptable configuration.
2. Access to Crusted Media. If crust forms, it will be at the bottom of the treatment media where the water enters the system. Thus, there is no means to disrupt (e.g. by raking) or remove it.
3. Requires New Plumbing. The system would require some additional plumbing to configure to upflow.
4. Lines Under Pressure. Pressure in lines makes them more susceptible to leaks.

2. Use Peerless Iron. The treatment cells contained Peerless ZVI when they operated for 4 years. When the system was changed to Connelly ZVI, problems developed. Other factors may explain the decreased efficiency but it seems that the type of ZVI may have been a factor. Although, both types of ZVI are nearly 100 % metallic iron and each lot is likely somewhat variable, processing of the ZVI may be conducted differently by the two companies. Processing includes firing the ZVI at high temperature to remove cutting oils. Variations in the firing process could result in variation of surface chemistry, such as oxidation state.

3. Use More Gravel/ZVI Mix and Coarser ZVI. The treatment media are clogging in the zone containing 100 % ZVI. Media containing a mixture of ZVI (10 to 40 % by volume) have a better chance of maintaining permeability than a 100 % ZVI zone. Also, coarser ZVI (e.g. –4 + 10 mesh) has less tendency to clog than finer ZVI (e.g. –8 +50 mesh). A disadvantage is that using mixtures will lead to less effective treatment because the amount of reactive surface area is less. However, effluent concentrations of TCE have nearly always been significantly less than the 5 ug/L concentration goal except when the system was plugged. Thus, treatment of VOCs may be possible with less ZVI.

4. Vent Pipes. Two or more vent pipes should be installed to help release gas from the system. Each vent consists of a 2-inch PVC pipe extending across the tank. The pipes are perforated (~1/4 inch holes at the bottom only) and are tilted slightly upwards to allow gas to migrate to a 2-inch riser that is open at the top. These pipes could also be used to collect samples, to measure hydraulic conductivity (slug testing), or to deliver chemicals (e.g. biocides, acid) to the ZVI.

5. Upgrade Monitoring System. Currently, the flow rate exiting Tank 2 is logged and provided as daily averages. Contaminant concentrations for contaminants, TCE, DCE, and CT are measured semi-annually. Given the recent problems with treatment cell performance, additional monitoring would be useful.

Following is a list of monitoring tools that could help to optimize performance of treatment systems. Although focused on the East Trench System, these tools are of general application and are currently being used at a ZVI-based treatment system at Monticello, Utah.

- Flow rate and pressure (head) at inlet to west tank. Hydraulic conductivity through the bulk media can be calculated from these two measurements. Decreasing hydraulic conductivity is an indication of system degradation.
- Flow rate and pressure (head) at inlet to east tank. These measurements are used to evaluate hydraulic conductivity in the east tank similar to bullet one. Also, the flow rate is used as a quality control – if it does not match the inflow to the west tank then instrumentation is in error or the system may have leaks.
- Flow rate at the east tank outlet. This measurement is a redundant check to insure quality flow rate data.
- pH at outlet from east and west tanks. The effluent pH values indicate the relative degree of reaction (residence time) of the groundwater with the ZVI. Corrosion of ZVI causes pH values to increase to as high as 9 or 10. Higher pH values suggest increased precipitation of carbonate minerals. Low pH values suggest incomplete reaction such as might occur if flow is along preferential paths.
- Regular water analysis for major ions (e.g. alkalinity, Ca, Mg, K, Na, Fe, SO_4, Cl, NO_3).

Data described by the first four bullets should be automatically collected using conventional tools and data transmitted through phone lines to project operations personnel. The data should be viewed regularly (daily?) to spot problems with the system.

6. Sampling of Spent ZVI. Following are suggestions on sampling and analysis of the spent treatment media. The analysis is intended to provide data that could help to understand the nature of the plugging in the treatment cell and optimize future designs.

- A person knowledgeable in PRB chemistry and operation should be present during the ZVI removal to take notes and photographs. The presence of carbonate minerals should be tested using 10% HCl and a binocular microscope should be used to observe the mineral matrix.
- Collect samples on a grid. For example, for every 1-ft lift collect a sample from the middle and four additional samples about 2/3 way between the center and the wall (5 samples each lift; 7 lifts = 35 samples per tank). Collect additional samples at discretion of PI based on unusual features.
- Samples should be about tennis ball size and placed in plastic or glass containers (plastic bags should suffice - double bagged). Drain free water as much as

4

possible before bagging. These samples will not be suitable for detailed mineralogical investigation because they will oxidize (rust) very quickly; however, they can be analyzed for bulk chemistry.

- Analysis. Samples should be air dried, crushed, and subsampled for analysis. Subsamples should be ground. Subsamples should be dried at 90 degrees C. Most useful analyses are: Ca, Mg, TIC, TOC, and S.
- Chemical distributions should be portrayed on 3D maps and documented in a report.

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