COMMENTS

on
"Draft Technical Memorandum
Alternative 5A for NAPL Present in
Groundwater Contamination Source Areas SA12, SA3, and SA11
Soil and NAPL Feasibility Study

Oxidant Types

1. Please explain the rationale for the different chemicals being used at the different source areas (i.e., Fentons versus Peroxone). (EPA-Hill)

Response: The tech memo stated that “oxidant selection” (if an ISCO alternative was selected) would be based on treatability testing and field pilot testing results during the RD phase. For the evaluation in this memo, we assumed Fenton’s for SA12 and SA3 that are considered more impacted NAPL accumulation areas; and, Peroxone for SA11 that is considered a less impacted, residual NAPL area. The oxidant selection is consistent with the Final FS issued to USEPA on September 14, 2009.

2. The memo proposes Fenton's reagent for SA12 and SA3, and peroxone (peroxide and ozone) for SA11. Persulfate is not proposed in the FS but should be retained as a possible oxidant. Its greater persistence would result in greater transport and the potential to remediate more of the subsurface, especially given the widely spaced injection wells being proposed. Include a statement that no oxidants are being ruled out at this time, and that the final selection would be made during remedial design. (EPA-Ada)

Response: Persulfate is discussed as a potentially applicable oxidant in the Final FS issued on September 14, 2009. We did not intend to rule out any oxidant and have included statements to that effect in the Final FS. We will incorporate similar text into the revised tech memo as well.

Oxidant Mass/Volume

3. What is the basis for the injection volumes and frequency at the different source areas? Are they based on the stoichiometric ratio to the mass of contaminant at each area, or the extent of volumetric displacement in the zone of contamination at each site? Is it something else? (EPA-Hill)

Response: The total oxidant injection volume is intended to be based on total contaminant mass. However, we do not have reliable estimates of contaminant mass in the source areas and hence the oxidant dosages are assumed values. As stated in the memo, the oxidant dosages, injection frequency and other design parameters will
be decided based on treatability and/or field pilot testing. This is the same approach presented in the Final FS issued on September 14, 2009.

4. The memo provides the total oxidant dosage (in gallons) of a 20% Fenton's reagent solution for each source area and injection well. Are you assuming that the solution will be injected at a 20% Fenton's reagent concentration, or are you assuming that you will further dilute the solution before injecting? A 20% Fenton's reagent solution is a relatively high concentration to be used for injection, and is not recommended. Fenton's reagent is generally injected at lower concentrations. Clarify. (EPA-Ada)

Response: We assumed a 17.5% H₂O₂ solution (approximated as 20% in the text of the memo) would be injected. Based on our experience with ISCO and a review of the literature, a wide range of peroxide concentrations have been used, with a concentration range of 8.75% to 17.5% being the most common. As stated in the memo and the Final FS, the oxidant type and concentration would be determined based on treatability and/or pilot testing.

Performance/Effectiveness

5. The conceptual approach described in the memo appears to have some effectiveness shortcomings, as described below. The agencies would like to discuss this issue with you.

The issue is described as follows:

The volume of oxidant solution injected semiannually into each 10-ft interval of the injection wells in SA-12 and SA-3 is very low (assuming the stated dosage in gallons is the actual volume to be injected). The volume injected each time is only 5% of the total volume of the target area shown in the figures, over the two 10-ft injection intervals. This would only be sufficient for a small radius of influence. For an idealized complete displacement of the pore volume in a cylindrical region around the entire injection interval of the injection well, the oxidant volume would be sufficient for a radius of only 5-1/2 ft (this ideal scenario is unlikely, but provides a starting point for evaluating reagent distribution). If it is assumed that the oxidant volume displaces only a fifth of the pore volume (e.g. if it mixes with the ground water surrounding the well, or moves preferentially in limited flow paths), the radius is still just about 12 ft. If it is assumed that there is more and more mixing of the oxidant and ground water, greater radii of influence result; however, the oxidant concentrations become lower and less effective, distribution will be less uniform, and there will be more portions of the subsurface that will not be contacted by oxidant. Is our reading of the conceptual approach correct? Discuss.

Response: Our intention in this memo was to present a reduced intensity ISCO approach compared to the approach presented in the Final FS. We believe that a combination of chemical oxidation and bioremediation is an efficient and cost-effective approach to achieving the FS objectives of treating contaminants and
reducing the source. We understand that there are numerous variations in the conceptual design for such a “Modified ISCO” option, and we would plan to investigate these options further if such an alternative is selected. In addition, groundwater monitoring activities would be performed to ensure that the overall objectives are being met and to identify any necessary modification to the injection program required to meet these objectives.

Further, if Fenton’s oxidation is used, subsequent injections will result in the oxidant being consumed in the regions already contacted by previous injections. The Fenton’s reagent will not travel unreacted past that region, and thus, will mostly be wasted in terms of chemical oxidation (except to oxidize any contaminant mass that has rebounded in, or migrated into, the immediate vicinity of the injection well). Discuss. (EPA-Ada)

Response: We proposed this approach of ISCO and bioremediation using fixed wells as a less intensive, cost-effective remediation that also has the benefit of minimizing operational impacts to the property owner compared to the more aggressive alternatives. However, we understand your concern relating to maximizing oxidation effectiveness and would consider other injection approaches or oxidants. For example, an alternate approach would be semi-annual Fenton’s injections using a direct push rig with injection points placed at the same spacing as in the tech memo with subsequent injection events occurring at points in between the original points. In this manner, over several semi-annual injection cycles (say 3-4 years) we can effectively cover the source area at the equivalent of a 15-foot spacing (see attached Figure 1'). This approach may improve contaminant destruction effectiveness relying more on oxidation than biodegradation, though it may be somewhat more intrusive to the property owners. Another variation on this direct push approach could be the use of persulfate injection along with an activator (hydrogen peroxide or a base) rather than Fenton’s reagent. As stated in the memo and the Final FS, the oxidant type and concentration would be determined based on treatability and/or pilot testing. Groundwater monitoring activities would be performed to ensure that the overall objectives are being met and to identify any necessary modifications to the injection program required to meet these objectives.

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Figure 1 shows the injection and SVE well locations for an alternate approach to “Modified ISCO” at SA12. The locations for each injection event (9 or 10 locations) are shown spaced in a staggered array with well spacing in the 45 to 60-foot range with different symbols. Each injection location is assumed to involve oxidant injection from 40 feet bgs to 70 feet bgs in 5-foot injection intervals. Over 4 years, this approach would cover the entire source area with 76 discrete injection locations that are spaced about 15 feet apart.

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URS
Alternative 5A is rated the same as Alternative 5 in LTE and RTMV although Alternative 5A is less intense (less wells, lower injection volumes, etc). Alternative 5A remediates the contaminant using ISCO in the immediate vicinity of the less dense injection points, and relies on biodegradation in between injections and injection points. Alternative 5 works more on straight ISCO (i.e., contact with the chemical). Given that peroxide/ozone persists for a relatively short time in the subsurface (hours or days) and given the limited 5 to 6 foot lateral displacement of the Fenton's reagent from the well after injection (with wells/points spaced at 45 feet and less injection points vertically), the effectiveness in maintaining higher DO levels (and promoting biodegradation) for any significant duration in between the injection points and in between semi-annual injections is questionable. Please explain how higher DO will be maintained in between the injection points and between the semi-annual injection events in Alternative 5A. It seems that the LTE and RTMV would be slightly lower for Alternative 5A. (EPA-Hill)

**Response:** Based on experience at other sites and the literature research, we assumed that we would be able to maintain elevated DO levels about 20 feet away from an injection point for a period of one to two months. We believe that the “Modified ISCO” alternative, including the alternate direct push injection approach described earlier will ultimately match the effectiveness of the ISCO alternative presented in the Final FS. Groundwater monitoring activities would be performed to ensure that the overall objectives of the injection program are being met and to identify any necessary modifications to the injection program required to meet these objectives.

**Discussion Item:** Additional Impact to Groundwater

**Response:** Given that Alternative 5A will take 6 years more than Alternative 5, would there be off-site migration of contaminants during this time? Would there be additional contaminant impact to groundwater during this time? Discuss. (DTSC)

**Response:** Based on numerous years of groundwater monitoring activities, the dissolved-phase benzene plume in groundwater is stable and concentrations in many locations are declining. The proposed Modified ISCO remedial approach is less intensive than the more aggressive alternatives and should not result in additional contaminant migration, either within or at the margins of the dissolved phase plume. Groundwater monitoring activities would be performed during application of the remedy to verify that this is the case.

**Biodegradation**

The memo proposes that the areas between the oxidant injection wells will be remediated through bioremediation enhanced by the dissolved oxygen resulting from the decomposition of the oxidant. Conceptually, some bioremediation and enhancement of aerobic bioremediation is likely to occur. However, it is unclear if there is sufficient information available or presented to be reasonably certain of the current and future...
occurrence and extent of bioremediation. It is unclear if bioremediation will be effective to destroy a significant portion of the contaminant mass remaining after the chemical oxidation occurs in the immediate vicinities of the ISCO injection wells. For example, the distribution patterns and extent of the DO-enriched ground water are not clear. In addition, there is likely to be some short-term negative impact of the oxidant on the microbial activity (i.e., suppression of microbial activity) in the vicinity of the injection wells (especially at 20% hydrogen peroxide). While this negative impact may not extend very far, and while negative impacts due to oxidants are generally short term, in this case the negative impacts will be recurring due to the semiannual oxidant injections over the eight-year period.

The site-specific coupling of aerobic bioremediation with ISCO, which requires interaction of the two technologies in space and time (since it is dependent on residual oxygen from the chemical oxidation subsequently being used for bioremediation away from the injection wells), will require further data to demonstrate the concept and prepare the design. This could include (a) evaluation of dissolved oxygen distribution and (b) estimates of the expected contaminant loss based on the oxidation and bioremediation reaction stoichiometries and the amount of oxidant and dissolved oxygen introduced into the subsurface. Include a statement to this effect. (EPA-Ada)

Response: Based on experience at other sites and the literature research, we assumed that we would be able to maintain elevated DO levels about 20 feet away from an injection point for a period of one to two months. However, we would propose to gather such data during pilot testing to support remedial design. We believe that the "Modified ISCO" alternative, including the alternate direct push injection approach described earlier will ultimately match the effectiveness of the ISCO alternative presented in the Final FS. Groundwater monitoring activities would be performed to ensure that the overall objectives are being met and to identify any necessary modifications to the injection program required to meet these objectives.

Costs
9. The monthly cost of electricity seems excessive. For example, at Source Area 12, the SVE unit specified is 400 cfm. A unit this size typically has a blower motor (the main electricity consumer) in the range of 20 horsepower. At $0.10 per kwh, 20 HP equates to ~$1,000 per month at full load and 100% up time. Electricity cost of $3,500 per month is included. Please reconcile the difference in costs. (EPA-Hill)

Response: After further review, we agree that the electricity cost estimate for operation of a 400 cfm unit appears high and we will present a revised cost estimate.
10. The monthly cost of Waste/Water disposal at Source Area 12 seems high at $4,000 per month. This equates to the disposal of ~ 4,000 gallons of water at $1.00 per gallon. Although water will be generated in the SVE knockout pot, 4,000 gallons per month seems very high. Also, no significant solid waste should be generated on a monthly basis. Please explain. (EPA-Hill)

Response: After further review, we agree that the waste/water disposal cost estimate at Source Area 12 appears high, and we will present a revised cost estimate.

11. The monthly cost for Miscellaneous items at Source Area 12 also seems high at $6,000 per month. Provide further explanation of assumptions. (EPA-Hill)

Response: After further review, the miscellaneous items cost estimate appears high and we will present a revised cost estimate.

12. Costs for the bench scale testing and pilot testing are not provided as individual line items in the cost estimate. Are they included in the design task? (EPA-Hill)

Response: The cost estimates included within the tech memo and Final FS did not include a separate line item for bench scale or pilot testing; however, the cost estimates did include costs associated with “engineering, design, and permitting”, to include and account for performance of these activities. These activities will be required and the ISCO cost estimate provided in the Final FS and the “Modified ISCO” cost estimate provided in the tech memo were prepared with like components for consistency.

Weighting

13. Tables 2, 5, and 8 - A weighted average is calculated for Alternatives 5 and 5A and used to “rate” Alternative 5A above Alternative 5, and even above Alternative 6 (which is not the focus of the document). A weighted average should not be used to compare or select alternatives in the FS. Remove this item from the tables. (EPA)

Response: The weighted average concept was presented in a separate section of the Final FS (Section 11 - Respondents Preferred Remedial Approach). Therefore, for consistency we would propose to present the same information under a separate sub-section indicating the following:

“This sub-section of the tech memo presents the Respondents’ opinion regarding implementation of the “Modified ISCO” technology for the source areas presented herein. USEPA will utilize the information provided within this tech memo, along with information presented in the Final FS, to select remedial
alternatives for the Del Amo Superfund Site. USEPA’s selected alternatives may or may not match the Respondents’ preferred remedial alternatives.”

Miscellaneous

14. Alternative 5 included extending some of the interior SVE wells into the water table to serve as interim groundwater monitoring wells during the remediation. Is this included in Alternative 5A? (EPA-Hill)

Response: Extending the SVE wells into the groundwater in Alternative 5A would pose a problem due to the co-located injection points. Rather, we have included the installation of monitor wells within the source area to monitor groundwater temperature, constituent of concern concentrations, and ensure that the overall objectives are being met. With the alternate approach of using direct push oxidant injections mentioned earlier, the option of extending some of the interior SVE wells into the water table to serve as monitoring wells would be appropriate.

15. Page 1, Section 1.0, second paragraph – The text states that Alternative 5 has the highest uncertainty in cost and ratings of the active alternatives due to uncertainty in remedial design parameters, one of which is “impacted area.” The uncertainty associated with the impacted area is actually shared by all of the alternatives, and thus “impacted area” should not be listed here. Remove the reference to this item. (EPA-Hill)

Response: We will remove this reference.
The document contains a diagram and a table with the following key points:

Legend:
- Assumed extent of NAPL source area based on LNAPL accumulations or observed ROST NAPL signatures within one or more water table monitoring wells, temporary well points or borings.
- Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility).
- Parcel boundary.
- SVE well.
- SVE sanitary well.
- Vapor Extraction Treatment System (VETS).

Notes:
1. Temperature monitoring points are not shown on the figure. These points would typically be distributed throughout the source area at a 50-75 foot spacing.
2. SVE radius of influence circles are not shown for each well due to the large number of closely spaced wells in the figure.

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* Nine injection points per event

Figure 1:
- Alternative 58: IN-SITU CHEMICAL OXIDATION
- DIRECT PUSH INJECTION, SVE, ICS AND MONITORING
- Parcel No. 7351-033-017
- Source Area 12

Scale in Feet
Dante,

Attached is a brief response to USEPA comments (dated 7/31/09) on the ISCO tech memo that is intended to serve as a prelude to our ISCO conference call on 10/19. Additional details relating to these comments will be presented during our discussion on 10/19. If you think it's appropriate, you can share this with your EPA/DTSC team members. Please call or email if you have any questions or clarifications.

Regards,

Jude Francis PhD PE
Principal Engineer
URS - Los Angeles
213-996-2461 tel