Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater

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EXECUTIVE SUMMARY

The contamination of groundwater and subsurface soil in the United States is a challenging problem. There are estimated to be 217,083 sites requiring some form of remediation (U.S. EPA, 1997). All of these sites potentially threaten groundwater resources. They are frequently impediments to the reuse of "brownfield" sites. Conventional treatment methods, such as pump-and-treat technology, are often costly and less than effective. Emerging in situ groundwater and subsurface soil treatment technologies may provide effective, lower-cost alternatives. It is important to fully understand all aspects of any innovative technology. This guidance document was developed to outline the technical and regulatory requirements of In Situ Chemical Oxidation (ISCO). ISCO refers to a general group of specific technologies, with each technology representing specific combinations of oxidants and delivery techniques. Specific primary oxidants addressed in this document are hydrogen peroxide, potassium and sodium permanganate, and ozone. Additionally this document is intended to expedite movement to a consensus on regulatory requirements through the ITRC concurrence process. It should prove useful to regulators, stakeholders, consultants, and technology implementers.

The document is divided into sections consisting of technology overview, remedial investigations, safety concerns, regulatory concerns, applicability, injection design, monitoring, and stakeholder concerns. From a regulatory perspective, the most important sections of the document are identification of injection restrictions, implementation and post closure monitoring. Appendix B provides case studies of ISCO implementations, and the reference list includes documents with additional case study data.

Site characterization is a critical step in effectively applying ISCO or any other remedial technology. A complete understanding of the site geology, hydrogeology, and geochemistry, as well as the contaminant profile, is necessary. Specifics on field and laboratory analytical parameters are provided in Section 2. Once a complete understanding of the site has been accomplished, it is important to develop a conceptual site model in order to relate the data in three-dimensions. Numerous hydrogeological and geochemical models are available to further evaluate site conditions.

Regulatory issues associated with ISCO include the state or federal programs associated with Underground Injection Control (UIC), and Air Quality. Permitting will typically not be an extensive process in ISCO deployment, as required permits may be limited to UIC concerns. Air Quality concerns are limited to controlling fugitive vapors that may be produced by the heat of reaction. Monitoring issues are discussed in this document.

Health and safety issues for ISCO include the following: (1) safely handling the oxidants, as hydrogen peroxide, potassium permanganate, and sodium permanganate solutions are strong nonspecific oxidants; (2) permanganate dust is hazardous; (3) the presence of ozone will increase the flammability of many materials; and (4) the generation of ozone usually includes high-voltage equipment concerns.

Tribal and stakeholder concerns should be addressed in detail. This requires frank public discussion about the potential risks and benefits of the technology and about site-specific issues. This document provides detail on tribal and stakeholder concerns in Section 7.