DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTALLATION CONTRACTING AGENCY

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MEMORANDUM FOR POTENTIAL OFFERORS

FROM: DEPARTMENT OF THE AIR FORCE
AFCEC/CZTE
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SUBJECT: Attachment 2 - Field-Scale Demonstration and Validation of Activated Carbon for In Situ Sequestration and Degradation of Chlorinated Organic Contaminants in Groundwater

Background. In situ activated carbon based remediation technology has been available for more than ten years. The core concept is to combine adsorption with chemical or biological degradation processes. Examples of this class of technologies include Trap & Treat BOS-100® and RemRx™ CSI which seek to couple carbon adsorption with metallic iron mediated reductive dechlorination, Chemically Oxygenated Granular Activated Carbon (COGAC™) which seeks to couple carbon adsorption with strong chemical oxidation by activated sodium persulfate, and PlumeStop®, which seeks to couple carbon adsorption with biologically mediated reductive dechlorination.

This class of sorption-degradation technologies has been applied with apparent success at hundreds of sites throughout the country, primarily small underground storage tank petroleum sites with non-chlorinated organic contaminants such as benzene, toluene, ethylbenzene and xylene (BTEX). In addition, projects intended to demonstrate and validate BTEX treatment mechanisms and effectiveness are underway in academia and the private sector. The American Petroleum Institute is funding a bench-scale project at the University of Waterloo to look at effects of activated carbon on long-term anaerobic BTEX degradation. A Clemson University project is evaluating biodegradation associated with activated carbon. Several product vendors have also been working with Microbial Insights, Inc. to collect field evidence of biodegradation.

Experience at Air Force sites with chlorinated contaminants such as trichloroethene (TCE) or carbon tetrachloride (CT) is limited. For example, BOS-100 was used in a pilot test at Vanderberg AFB and in a bedrock source zone at Lowry AFB. In situ sorption-degradation technologies also have been proposed for use at Hansom AFB and Shaw AFB. The USEPA has expressed interest in this technology for application at Edwards AFB. Literature research and case-study review has shown that this class of technologies may be valuable in solving some of the key challenges faced by the Air Force in restoring contaminated groundwater (e.g., back diffusion, desorption, lingering low concentration plumes).

Although there is some evidence that degradation is effective, there is a lack of systematic evaluations of sorption-degradation technologies at chlorinated contaminant sites. Field-scale evaluations of the technologies have not provided high-quality comprehensive data sets needed to demonstrate and validate effectiveness of treatment, or to provide design information needed by practitioners for wide-spread

application, particularly at sites with complex heterogeneous hydrogeology. As a result, remediation practitioners and regulators generally remain skeptical.

Statement of Need. Chlorinated organic contaminant sites, particularly sites with complex hydrogeology, represent a large portion of Air Force restoration liability today and for the foreseeable future. Coupled sorption-degradation technologies show promise for substantially decreasing this liability.

Examples of this class of technologies include Trap & Treat BOS-100®, RemRx™ CSI, COGAC™ and PlumeStop®. Site remedies based on these technologies have been used or are anticipated for use at a number of Air Force installations. However, systematic field-scale evaluations demonstrating and validating degradation effectiveness are lacking. Therefore, the AFCEC restoration program has a need to conduct comprehensive field scale tests of representative in situ sorption-degradation technologies to demonstrate and validate treatment effectiveness.

It is unlikely that all aspects of treatment effectiveness can be addressed within a single field-scale demonstration and validation project. However to be considered responsive, proposal offers must provide for field-scale demonstration and/or validation of amendment delivery, sorption/sequestration, biogeochemistry, and contaminant degradation.

The following specific technical guidance and data needs have been identified.

1. Data demonstrated effective amendment distribution throughout specified target zones, particularly within heterogeneous and/or fractured hydrogeological settings.
2. Guidance for selection of amendment delivery techniques, dosing, and well spacing based on site-specific hydrogeological characteristics.
3. Pilot-scale data demonstrating influence (or lack of influence) of amendments on hydraulic flow patterns after subsurface emplacement, particularly within heterogeneous and/or fractured hydrogeological settings.
4. Pilot-scale data demonstrating treatment effectiveness of amendments after subsurface emplacement of amendments including:
    a. In situ sorption/sequestration characteristics and/or capacity,
    b. Development of in situ biogeochemistry (and microbial community if applicable) required to facilitate the degradation mechanism claimed for the technology,
    c. In situ treatment of contaminant(s) by the degradation mechanism claimed for the technology, as opposed to sequestration without degradation, and
    d. Ability to attain remedial action objectives (RAOs) such as maximum contaminant levels (MCLs), or a specified mass flux rate leaving the targeted treatment zone(s).
5. Data demonstrating sustainability of treatment and/or the degree of contaminant concentration rebound, including long-term sustainability of
    a. In-situ adsorption/sequestration of the targeted contaminant(s),
    b. Biogeochemical characteristics required to facilitate degradation,
    c. In-situ degradation of contaminant(s) throughout the targeted treatment zone(s), and
    d. Ability to attain RAOs.
6. Guidance for up-scaling the treatment technology to full-scale remediation systems, including:
    a. High-resolution characterization or other data needs to support full-scale design,
    b. Design, construction and optimization criteria and strategies for addressing deviations in hydrogeological and/or plume characteristics from those identified at the pilot scale.

c. Performance monitoring criteria for demonstrating effective full-scale application of the technology including adsorption/sequestration, contaminant degradation, and compliance with RAOs.

7. Guidance for designing and implementing effective long-term treatment of the targeted contaminant(s) including strategies for addressing contaminant rebound within treatment zones, short-comings in ability of the technology to attain RAOs, and continuing contaminant migration from up-gradient areas.