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Design Considerations for In Situ Chemical Oxidation

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
ARTT	Alternative Restoration Technology Team
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CO_2	carbon dioxide
COC	contaminant of concern
CORT3D	Chemical Oxidation Reactive Transport in 3-D
CQC	contractor quality control
CSI	Construction Specifications Institute
CSM	conceptual site model
DB	Design-Build
DBB	Design-Bid-Build
DMF	diesel multistage filter
DO	dissolved oxygen
DOC	diesel oxidation catalyst
DON	United States Department of the Navy
DPF	diesel particulate filter
DPT	direct push technology
EDTA	ethylenediaminetetraacetic acid
ESTCP	Environmental Security Technology Certification Program
f_{oc}	fraction organic carbon
FEAD	Facilities Engineering and Acquisition Division
FEC	Facilities Engineering Command
GSR	green and sustainable remediation
ISCO	in situ chemical oxidation
ITRC	Interstate Technology and Regulatory Council
K_{oc}	organic carbon-water partition coefficient
K_d	distribution coefficient
MCL	maximum contaminant level
NAPL	non-aqueous phase liquid
NASA	National Aeronautics and Space Administration

NAVFAC	Naval Facilities Engineering Command
NOD	natural oxidant demand
NOM	natural organic material
ORP	oxidation-reduction potential
PG	professional geologist
PE	professional engineer
PV	pore volume
QA/QC	quality assurance/quality control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
RAC	Remedial Action Contract
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RG	remedial goal
ROI	radius of influence
RPM	Remedial Project Manager
SCR	selective catalytic reduction
SMART	specific, measureable, attainable, relevant, and time-bound
SOD	soil oxidant demand
TOC	total organic carbon
TOD	total oxidant demand
TTZ	target treatment zone
UFC	Uniform Federal Criteria
U.S. EPA	United States Environmental Protection Agency
WBDG	Whole Building Design Guide

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1.0 PURPOSE

Most in situ remediation systems including in situ chemical oxidation (ISCO) are less mature than ex situ remediation systems (e.g., pump and treat) and other conventional environmental systems (e.g., wastewater treatment systems); therefore, design information, formats, and standards for in situ remediation systems are generally not as readily available or as consistent. The lack of available standards causes the design submittals for in situ remediation systems to vary widely from one project to another.

The purpose of this course is to provide a framework for design submittals of ISCO systems. The course provides a summary of best practices for ISCO design, tips for appropriate quality assurance and quality control (QA/QC) measures, and a listing of available standards and references. The goal is to assist in the development of improved and consistent design submittals within the U.S. Department of the Navy (DON) Environmental Restoration Program.

2.0 REMEDIAL DESIGN SUBMITTALS

Remedial design submittals should comprise the following components, at a minimum:

- **Basis of Design**: Conceptual site model (CSM), rationale for the design, calculations to support the design, and a description of the design
- **Drawings**: Detailed drawings to describe (prescriptive or performance-based) how to construct, operate, and maintain the system
- **Specifications**: Details of performance-based specifications on how to construct, operate, and maintain the system
- **QA/QC Plans**: Project-specific Contractor Quality Control (CQC) Plan with QA/QC provisions for monitoring construction (if required by the contract and as necessary to convey design-specific requirements [see Section 4])
- **Monitoring Plans:** Details of process and performance monitoring plans, including locations, monitoring parameters, sampling frequency (see Section 4.4).
- **Schedule and Milestones**: Remedial designs are typically performed in several phases. The first phase is the conceptual design (10 to 15% design). The conceptual design provides basic information about the project and includes the conceptual site plan and other preliminary drawings (see Section 5.0). The second set of design submittals (35 to 50% design) should convey the complete design, but in a preliminary manner. All necessary drawings should be included, but are not finalized and might not include all of the details necessary for implementation of the design. However, although all of the details may not be included, many times for environmental projects, the level of detail included in the 35 to 50% design package is sufficient for project execution. The 90 to 100% design consists of a very detailed design package, which could be required for very complex projects and would include all of the necessary details required for execution. The final 100% design package consists of submittal and acceptance of all reviewed and previously approved drawings and design elements.
- **Cost Estimate:** In some cases, a construction cost estimate is included with +/- 10% accuracy for bidding purposes.

Because of the simple nature of in situ remediation systems, remedial design submittals can be streamlined. However, regardless of the streamlining effort, the submittals should contain the design components discussed above. Streamlining efforts could be performed in the following ways:

- **Work Plan Approach**. This approach involves combining all components of the design submittals into a work plan format and submitting the work plan for Naval Facilities Engineering Command (NAVFAC) and base approval in a three-phase review process: draft review, draft-final review, and final submittal. In some cases, if required, the draft review, draft-final review, and final submittal could correspond to the 15% to 35% design, which is equivalent to the conceptual design, 50% to 60%