REMEDIAL DESIGNS AND PILOT STUDIES

CUPA

Training Course for Project Managers

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Outline of Presentation

Remedial Design

- What is the purpose of a Remedial Design?
- Document Content
- Fast Tracking

Implementation/Remedy Construction

- Purpose of this phase
- Long Term obligations:
    1. Financial Assurance Instruments,
    2. O&M Agreements?

Outline of Presentation

Operation and Maintenance Activities

- Annual Inspection of LUC
- Five Year Reviews
- Notification requirements

Purpose of Remedial Design

- The Remedial Design (RD) establishes the general size, scope, and character of a project. It details and addresses the technical requirements (construction plans and specifications) of the Remedial Action and its implementation.

- At this stage of the process, the full extent of contamination at the site and the associated cleanup goals should be well defined.

Purpose of Remedial Design

- The primary sources of information include the RI/FS and the RAW/RAP.
- The information contained in the RI/FS/RAW/RAP serves as the initial building block for developing the Statement of Work (SOW) and for identifying accurately the technical requirements to be fulfilled by the RD.

Purpose of Remedial Design

- It is recommended to have a Pre-Design planning phase.
- Pre-Design planning moves a project from the RAP/ROD into the remedial design. During this phase, the State's permits and technical requirements in design terms should be developed.

Purpose of Remedial Design

- Information included in the design should cover the following points:
  - A thorough description of the site conditions
  - The remedy, technology, and design approach to be used for site cleanup.
  - Any Applicable or Relevant and Appropriate Requirements (ARARs).
  - A summary of data already gathered
  - The identification of other possible data needs or studies.

Purpose of Remedial Design

- Information included in the design should cover the following points (Continue):

  - A statement of all unresolved or pending issues. (data gaps in defining the full extent of contamination in soil, sediment, or groundwater).

- This uncertainty can complicate the design process, e.g. determining excavation footprints or locating extraction/injection wells.

Remedial Design Standard Tasks Or Document Content

- Project Planning and Support
- Community Involvement
- Data Acquisition
- Sample Analysis
- Analytical Support and Data Validation
- Data Evaluation
- Treatability Study/Pilot Testing

Remedial Design Standard Tasks Or Document Content

- Preliminary Design
- Equipment/Services/Utilities
- Intermediate Design
- Pre- Final/Final Design
- Post-Remedial Design Support
- Work Assignment Close Out

Statement Of Work (SOW) For Remedial Design

- Five key implementation-related items should be included in the SOW:

  1.The treatment system or technology

  2. Performance standards

  3. Points of compliance

  4. Demonstration of compliance

  5. Schedule

Statement Of Work (SOW) For Remedial Design

- The treatment or remedy specified in the RAP should be incorporated verbatim into the SOW.
- The section in the SOW on performance standards is extremely important and must be clearly written to ensure enforceability.
- Performance standards should be specified for each medium and remedy component involved in the Remedial Design.

Statement Of Work (SOW) For Remedial Design

- Methods of demonstrating compliance with the specified standards and requirements of the remedy must be described in the SOW so that the PM will know when criteria have been met and so that fulfillment of the RAP.

- It is the PM's responsibility to monitor compliance with all RD requirements included by incorporation or reference within the RAP and SOW.

Statement Of Work (SOW) For Remedial Design

- The PM should coordinate with **all parties** the proposed location of the treatment systems and long-term monitoring wells and location of future site development.

- The overall objective of oversight is to focus the PM's efforts on environmental protection, consideration of public health concerns, overall project quality, scheduling, and preparation of design documents.

Statement Of Work (SOW) For Remedial Design

- When developing a site-specific SOW for RD oversight, it is the responsibility of the PM to track the progress of the RD effort and to establish the level of oversight for the project accordingly.

- Depending on the complexity of the RD activities the level of involvement varies in terms of what the PM deems necessary to perform adequate oversight.

Statement Of Work (SOW) For Remedial Design

- In most instances, the PM will conduct/ perform the following activities:
    1. Review RD plan submittals (e.g., Work Plan, Health and Safety Plan, Quality Assurance Project Plan).
    2. Conduct periodic progress meetings with the RPs.
    3. Ensure that information collection activities are proceeding safely and correctly.
    4. Coordinate among all involved Government entities.
    5. Verify task completion and compliance with all requirements.
    6. Provide status reports as part of the community involvement task.

Remedial Design Fast-Tracked

- There are several techniques in which RD can be fast tracked:
  - PM can use data collected during the RI/FS for design.
  - Data gaps identified in the RI/FS phase could be filled during the RD phase.
  - Reduce the details required in the design document. For small project, soil excavation or simple SVE systems, the design need only include a site layout drawing and a basic description of the work to be performed.

Remedial Design Fast-Tracked

- There are several techniques in which RD can be fast tracked (continued):
  - Use standard specifications, in whole or with appropriate modifications, enable the design to be completed in significantly less time.
  - For simple projects, utilize the Health and Safety Plan, Quality Assurance Project Plan, and Community Relations plan, from the RI/FS for the RD, and possibly with minor changes for the Implementation of RA.

Remedial Design Fast-Tracked

- Another method to optimize the RD is to rearrange the sequence in which the RD elements are performed to enhance the overall schedule. For example:
  - The site preparation of a design can be completed and constructions initiated while the rest of the design is still on-going.
  - PM can schedule all design reviews in parallel with continuing design work so they are not on the critical path.
  - Do all reviews simultaneously to expedite resolutions of comments from all parties involved.

Remedial Design Fast-Tracked

- Method to optimize and fast-track the RD (continued):
  - PM can develop agreements for RI/FS site access to allow for access during RD/RA activities, if needed.
  - Prepare work assignments for remedy implementation before completion of RD.

Remedial Design

The greatest design that is poorly constructed will still fail.

CASE STUDY

- SOIL VAPOR EXTRACTION CASE STUDY
  - A Soil Vapor Extraction (SVE) System has been proposed for a site where the primary chemical of concern is m-chlorophenol. Chlorophenol are used in pressure treatment in the wood preservation Industry. In addition, Chlorophenol are also used as additives to inhibit microbial growth in a wide array of products, such as adhesives, oils, textiles, and pharmaceutical products. The soil is primarily silts. Groundwater is at a depth of 8 feet.

CASE STUDY

- Physical Properties of m-chlorophynol:
  - Melting point: 33°C
  - Boiling point: 214°C
  - MW 128.56
  - Relative density (water = 1): 1.245
  - Solubility in water, g/100 ml at 20°C: 2.6
  - Vapor pressure, 1.0 mm Hg at 111.6 ° F ; 5 mm Hg at 162° F (NTP, 1992)
  - Flash point: >112°C

CASE STUDY

- SVE is widely used remediation technology
- Uses vacuum pressure to remove volatile and some semi-volatile contaminants (VOCs and SVOCs) from the vadose zone.
- The SVE process is an in situ technique

SOIL VAPOR EXTRACTION SYSTEM

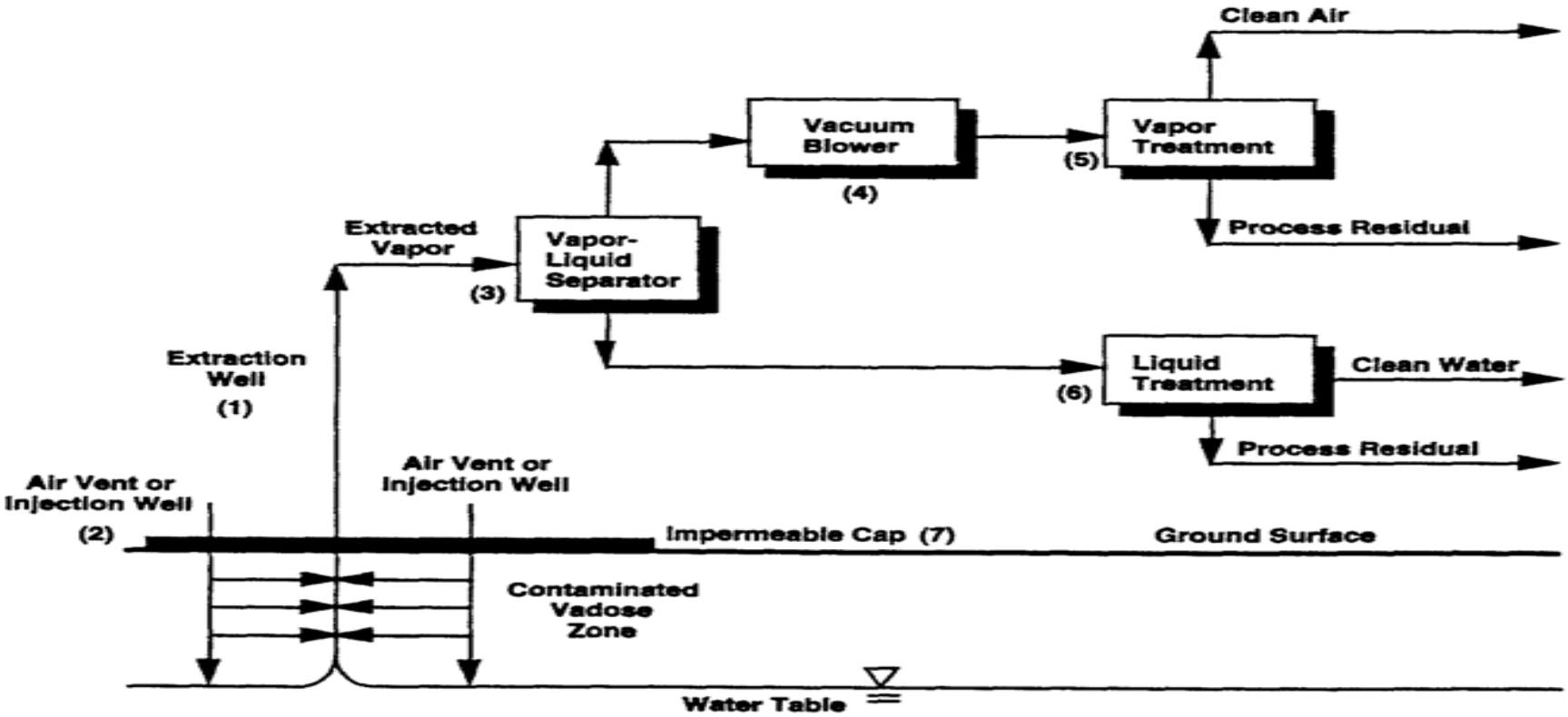

Figure 1. Generic Soil Vapor Extraction System.

SOIL VAPOR EXTRACTION SYSTEM

- Vapor extraction wells or vents (1) are installed in the contaminated zone
- As air is removed from the soil, ambient air is injected (2)
- When ambient air passes through the soil (3), contaminants are volatilized and removed.
- the contaminated air stream is treated (6) to remove contaminants

SOIL VAPOR EXTRACTION SYSTEM

- The contaminated gas Is contaminant properties will dictate whether SVE is feasible. SVE drawn through a blower (4)
- treated (5), and discharged to the atmosphere.

CAN WE IMPLEMENT THIS TECHNOLOGY TO REMEDIATE THIS SITE?

SOIL VAPOR EXTRACTION SYSTEM LIMITATIONS

- A literature search should be performed to determine the physical and chemical properties of the contaminants of interest. In conjunction with the site conditions and soil properties, contaminant properties will dictate whether SVE is feasible.

SOIL VAPOR EXTRACTION SYSTEM LIMITATIONS

- SVE is most effective at removing compounds which have high vapor pressure and which exhibit significant volatility at ambient temperatures in contaminated soil.
- Low molecular weight, volatile compounds are most easily removed by SVE.
- Less volatile contaminants such as m-chlorophenol heavy oils, metals, PCBs, or dioxins are less suitable for standard SVE.

SOIL VAPOR EXTRACTION SYSTEM LIMITATIONS

- The soil characteristics of the site have a significant effect on the applicability of SVE.
  - Soil with high moisture requires higher vacuums, hindering the operation of the SVE system.
  - Soils with high organic content or soils that are extremely dry have a high sorption capacity of VOCs.
  - Soils with low permeability limit the effectiveness of SVE.

SOIL VAPOR EXTRACTION SYSTEM LIMITATIONS

- SVE is not effective in the saturated zone or were the contaminants are submerged.
- Because SVE applies vacuum pressure to subsurface soils, it can raise groundwater levels.
- Some contaminants may dissolve into the water. As a result, groundwater could show increases in contamination levels, especially when this process begins.

SOIL VAPOR EXTRACTION SYSTEM ADJUSTMENTS

- Standard SVE may not be effective in removing the m-chlorophenol at the site.
- Thermally enhanced SVE could be considered to raise the vapor pressure of the contaminant to mobilize it (volatilize it).
- GAC may work to treat the air stream, although it may be too expensive.
- Other technologies may need to be considered, such as thermal blankets or thermal wells.

SOIL VAPOR EXTRACTION SYSTEM ADJUSTMENTS

- M-chlorophenol is heavier than water (sinker) and could be found in the deep saturated zones.
- Groundwater pumps may be used in conjunction with SVE to keep groundwater from rising into the unsaturated zone as a result of vacuum pressure, or to increase the depth of the unsaturated zone.

PILOT TESTS AND TREATABILITY STUDIES

- Before going into a RD, a field pilot study is necessary to establish the feasibility of the method as well as to obtain information necessary to design and configure the system.
- Remedy screening studies provide a quick and relatively inexpensive indication of whether SVE is a potentially viable remedial technology.

PILOT TESTS AND TREATABILITY STUDIES

- Prescreening of SVE examines the field data for types of contaminant, concentration of the contaminant, and soil temperature to determine contaminant vapor pressure.
  - If the vapor pressure of the contaminants of concern is below 0.5 mm of Hg, SVE is considered to be generally unsuitable.
  - If above 0.5 mm of Hg, treatability testing should be conducted.

PILOT TESTS AND TREATABILITY STUDIES

Remedy Selection Phase:

- Due to the high degree of uncertainty associated with implementation of SVE, pilot-scale testing is often appropriate to support the remedy selection phase.
- Treatability studies may be supplemented with column tests, field air permeability tests and mathematical modeling during the remedy selection phase.

PILOT-SCALE TESTS

- Pilot-scale or field venting tests usually encompass the operation of a mobile SVE treatment unit onsite for a period of 1 to 2 months.
- Pilot-scale tests conducted during remedy selection determine whether sufficient air flow can be attained in the zones of contamination to produce adequate cleanup rates.

PILOT-SCALE TESTS

- The pilot-scale unit typically consists of an extraction well, and three or more probes or monitoring wells to measure soil pressures at various depths and distances from the extraction point.
- An air injection well may also be used to examine the effect of air injection.
- The same system can be used for remedy design studies.

REMEDY SELECTION PHASE COLUMN TESTS

- Column tests establish whether SVE can potentially meet expected target concentrations or cleanup goals for a given site.
- The duration and cost of column testing for SVE depend primarily on the soil characteristics, the contaminants, and the analyses being performed.
- Most remedy selection column testing can be performed within 3 to 7 weeks at a cost between $30,000 and $50,000.

REMEDY SELECTION PHASE
AIR PERMEABILITY TESTS

- Air permeability tests should be conducted at the site after the column tests show that SVE can meet the expected target concentrations.
- Air permeability data can be used during the initial design to determine the radius of influence of vapor extraction wells, expected air-flow rates, moisture removal rates, and initial contaminant flow rate.
- The air permeability tests cost about $1,500 to $2,500 per well. They are normally performed within a time range of 2 to 5 days.

REMEDY SELECTION PHASE
AIR PERMEABILITY TESTS

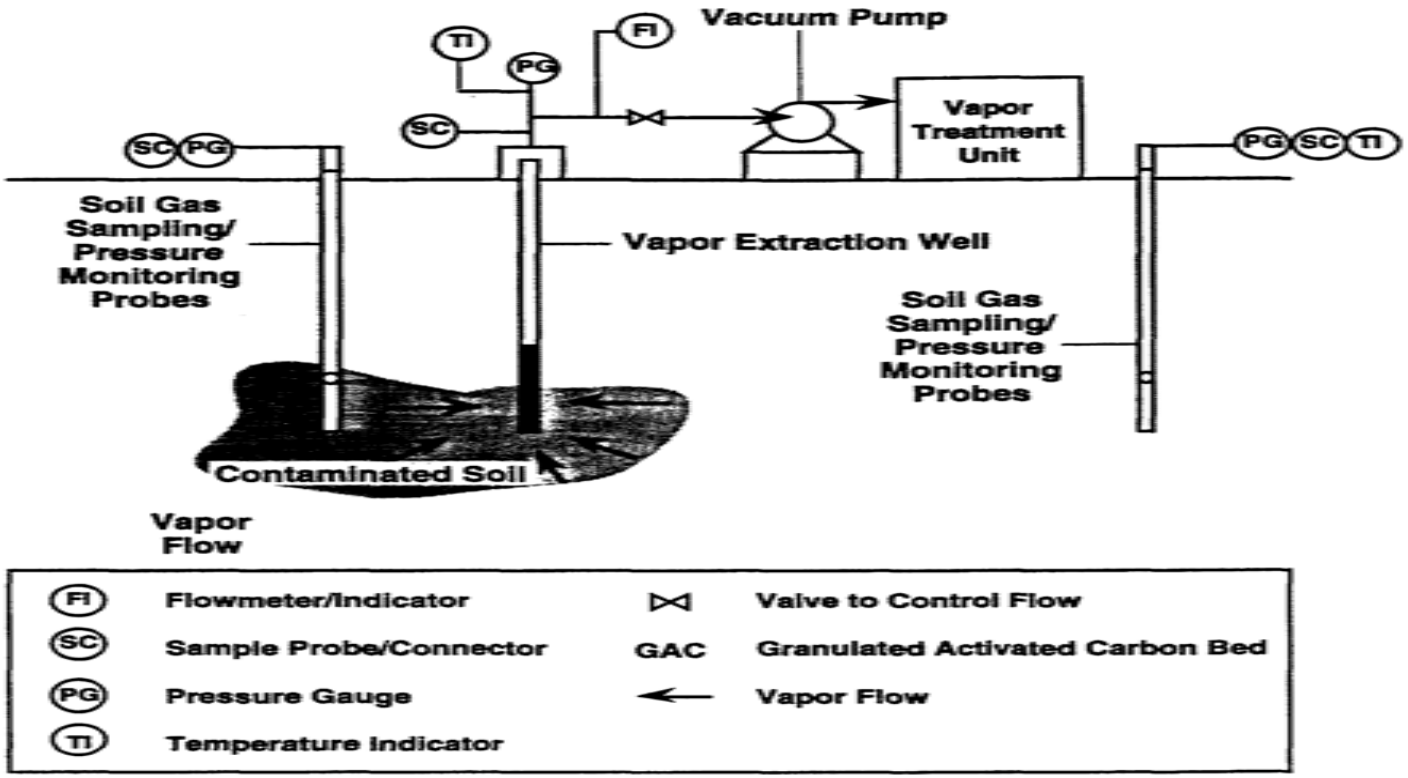

Figure 3. Schematic for Typical Air Permeability Test.

REMEDY SELECTION PHASE MATHEMATICAL MODELING

- Mathematical modeling can be used to provide rough estimates of the cleanup times required to achieve contaminant reductions to the target goals.
- Mathematical modeling can also provide sensitivity analyses for critical variables such as air permeability, radius of influence, and vacuum applied.

PILOT TESTS AND TREATABILITY STUDIES

- Carefully planned treatability studies are necessary to ensure that the data generated are useful for evaluating the validity or performance of the technology.
- **USEPA: Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance,** EPA/540/2-91/019A September 1991.

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 1. Introduction
  - 1.1 Background
  - 1.2 Purpose and Scope
  - 1.3 Intended Audience
  - 1.4 Use of This Guide

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 2. Technology Description and Preliminary Screening
  - 2.1 Technology Description
  - 2.2 Preliminary Screening and Technology Limitations

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 3. The Use of Treatability Tests in Remedy Evaluation
  - 3.1 The Process of Treatability Testing in Evaluating a Remedy
  - 3.2 Application of Treatability Tests to SVE

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 4. Treatability Study Work Plan
  - 4.1 Test Goals
  - 4.2 Experimental Design and Procedures
  - 4.3 Equipment and Materials
  - 4.4 Sampling and Analysis
  - 4.5 Data Analysis and Interpretation
  - 4.6 Reports
  - 4.7 Schedule
  - 4.8 Management and Staffing
  - 4.9 Budget

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 5. Sampling and Analysis Plan
  - 5.1 Field Sampling Plan
  - 5.2 Quality Assurance Project Plan

Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction Interim Guidance

- 6. Treatability Data Interpretation for Technology Selection
  - 6.1 Technical Evaluation
  - 6.2 Cost Estimation from Data

Post-Remediation Long Term Obligations

- Financial Assurance Instruments.
- Land Use Covenant (LUC)
- Certification
- Five-Year Review