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The Plug-In Approach: A Generic Strategy to Expediting Cleanup

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The Department of Energy, in cooperation with the Environmental Protection Agency, is working to expand the use of presumptive remedies and generic approaches as mechanisms to streamline waste site remediation. The use of these approaches can significantly reduce overall costs and schedules whenever remedies are being selected for sites with similar characteristics. This fact sheet describes the components of the plug-in approach and the site-specific characteristics which are conducive to its use.

Introduction

Generic approaches are remedial strategies which use the knowledge gained from previous experience at a waste site(s) to serve as the basis and justification for subsequent responses at similar sites. Although the technical basis and documentation used to implement generic approaches may vary to meet the specific nature of the site problem(s) being addressed, the underlying premise is that similarities between sites can be used to better focus data collection, risk evaluations, and alternative analyses while reducing repetitive documentation and enhancing decision-making consistency.

This concept of utilizing similarities between sites to streamline response planning and implementation is embodied in EPA's presumptive remedy policy (see OSWER Fact Sheet 9355.0-47FS, September 1993, EPA-540-F-93-047) and serves as the basis for implementing generic approaches to site remediation.

The following discussion outlines the key components and decision process for one of the most effective and widely used generic strategies commonly known as the "plug-in" approach. Sites where plug-in approaches have been used previously to accelerate response actions are referenced in Highlight 1.

Identifying a Recurring Site Problem

Many Federal Facility waste sites have similar characteristics due to common waste management practices (e.g., liquid waste disposal trenches), common media, and common contaminant types, and thus offer potential opportunities to cut costs and schedules by utilizing these similarities to focus the remedy selection process. As site problems[1] are identified and defined during initial scoping activities, the core team (DOE, EPA and State project managers) should evaluate existing information to determine the potential for common site problems to exist. A recurrent site problem (see Highlight 2) may be identified based on the following factors:

- Process history (e.g., waste sites received process effluent from the same production facility);
- Contaminant type (e.g., previous sampling data indicate several waste sites contain radioactive sludge);
- Media type (e.g., soil); and,
- Type of waste unit (e.g., solid waste burial grounds).

HIGHLIGHT 1: Example Plug-In Approaches

- **Indian Bend Wash Superfund Site** *(Operable Unit Feasibility Study for VOCs in Vadose Zone*, Indian Bend Wash Superfund Site, South Area; Tempe, Arizona; June 1993).
- **Hanford Site 100 Area** (*100 Area Source Operable Unit Focused Feasibility Study;* DOE/RL-94-61, Rev. 1; August 1995);
- **Air Force PREECA** (*United States Air Force Presumptive Remedy Engineering Evaluation / Cost Analysis (PREECA);* U.S. Army Corps of Engineers Omaha District; May 5, 1995).

Identifying a Likely Response Action

The core team begins identifying likely response actions based on the scope, characteristics, and complexity of the site problems being addressed. In situations where there appears to be a recurrent problem (e.g., several surface impoundments which received similar process waste are located within the facility), the core team should evaluate the potential to utilize the selected remedy and associated decision basis from a previously completed waste site as precedent to better focus and streamline response decision-making for follow-on sites. In situations where a similar waste site has not previously been addressed within the facility, the core team may select a "lead site", (i.e., a site considered to most likely represent expected site conditionsfor a group of sites) to be evaluated first and serve as the basis for determining appropriate response actions. The implicit assumption being that similar waste management practices and site characteristics will have resulted in similar problems and therefore require similar remedial measures. Regardless of which approach is utilized, the core team must reach consensus on the common site problem to be addressed and, as outlined below, the remedy profile of the likely response action.

[1] As used here, a site problem is a site condition where no additional evaluation is considered necessary to determine some type of response is required to address an actual or perceived risk to human health and the environment [see related fact sheet, *Expediting Cleanup Through Problem Identification and Definition,* DOE/EH-413-9904, May 1999.

HIGHLIGHT 2: Example Common Site Problems

Concentrations of radionuclides in soils or pipelines located in a current nuclear use area present an exposure risk greater than 1 x 10^{-4} to future workers.

Concentrations of VOCs in soil have the potential to impact ground water so that the federal Maximum Contaminant Level (MCL) is exceeded.

Developing the Remedy Profile

Once the likely response action (remedial technology) is identified for the common site problem, the range of conditions that the technology can effectively address (i.e., boundary conditions) is used to prepare the "remedy profile". The remedy profile defines those conditions which *must* or *must not* be present for the alternative to be effective. This profile may be composed of technical factors (e.g.,technology can only address certain constituents), as well as administrative factors (e.g., land use requirements) which have the potential to impact the effectivenss or implementability of a response action. Essentially, the core team identifies any uncertainties (i.e., fatal flaws[2]) that if encountered, would require the response to be modified in order to maintain effectiveness. Remedy profile parameters may include (see Highlight 3):

- Depth of effectiveness;
- Concentration limits (e.g., certain contaminants or contaminants above a given concentration may preclude use of treatment technology);
- Land use requirements (e.g., cannot leave waste in place);
- Cost considerations (e.g., cost prohibitive to dispose more than a given volume);
- Site logistics (e.g., placement of a cap may interfere with future underground utility repairs).

The greater the range of conditions a technology can address (i.e., it's robustness), the less degree of similarity between sites (within the plug-in group) is required. Furthermore, the degree of uncertainty in site characteristics which may be considered acceptable by the core team should be greater for those site parameters having little to no affect on the technology's effectiveness.

Plug-in Decision

The plug-in decision is based upon core team consensus that the selected remedy will be utilized to address subsequent waste sites. Specifically, the core team must agree on the site conditions which warrant action under the plug-in response, as well as the decision framework for determining that a site does or does not fall within the bounds of the remedy profile. This decision and associated basis should be communicated to the public in a decision document (e.g., ROD).

Subsequent Waste Site Evaluation

Under the plug-in approach, existing information (e.g., process history) on the various physical and contaminant parameters at a waste site is evaluated to determine whether the site problem is amenable to the plug-in response action. Although there are numerous site characteristics that could be evaluated, particular emphasis should be given to those parameters which will assist in determining whether a problem exists and / or directly impact the effectiveness and implementability of likely remedial technologies.

For example, if soil vapor extraction (SVE) is being considered, information on the air permeability of soils and volatility of contaminants is important, whereas, certain considerations such as leachability of contaminants is not. As subsequent waste sites are evaluated against the remedy profile to determine whether the necessary conditions are met for the site to be "plugged in", several potential outcomes are possible (see Highlight 4):

1) the waste site's characteristics fall within the bounds of the remedy profile **AND** response criteria are met;

As with any response action, there must first be agreement between the core team, (DOE, EPA and state project managers) on the specific circumstances which will require a response (need for action). Typically these response triggers/criteria are risk-based and specific to the various exposure pathways of concern at the site (e.g., concentrations of VOCs in ground water exceed federal Maximum Contaminant Levels);

2) the waste site's characteristics fall just outside the remedy profile.

In these situations, the core team will need to carefully evaluate whether technical enhancements to the remedy can be used to expand the remedy profile, i.e., to increase the range of conditions over which the technology is considered effective, (e.g., a thermal injection component could be used to increase the volatility of organics and enhance the soil vapor extraction process). [NOTE: The selected technology indicates the general response while contingent technology enhancements act as process options. These modifications do not change the response, but rather enhance the selected response.]; and

3) the waste site's characteristics fall outside the remedy profile (even with considered enhancement) and the site cannot be plugged in.

To address the latter situation (or to avoid project delays should a deviation to the expected conditions defined in the site profile occur), more than one technology may be considered and incorporated as contingency technologies into the remedy profile.

Please refer any questions regarding this material to:

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[2] See related fact sheet, *Expediting Cleanup Through Early Identification of Likely Response Actions*, DOE/EH-413-9902, May 1999.

HIGHLIGHT 3: EXAMPLE REMEDY PROFILES			
TECHNOLOGY	REMEDY PROFILE PARAMETER	REMEDY PROFILE BOUNDARY	SIGNIFICANCE OF REMEDY PARAMETER
Soil Vapor Extraction	Contamination in the Vadose Zone	Includes halogenated hydrocarbons.	Previous experience substantiates that SVE is most effective on halogenated hydrocarbons.
	Soil Permeability of the Vadose Zone	Greater than 1 x 10^{-3} darcies.	Soil permeability less than this decreases the ability of the vapor to move through a porous media to a point where SVE is not cost effective.
	Percent Saturation	Less than 60 percent.	Greater than 60 percent saturation decreases the available void volume to a point where there is too much pressure drop through the soils to effectively implement SVE.
	Impact to Ground Water	Contamination is not currently impacting ground water.	If contamination is impacting ground water, remediation of the ground water is required.
	Henry's Law Constant of Contaminant	Greater than 100 atm / mole fraction.	A constant below this will decrease the movement of material from the aqueous phase to the vapor phase to a point where SVE is not cost effective.
	Vapor Pressure of Contaminant	Greater than 1.0 mm Hg @ 20°C.	Vapor pressure below this will decrease volatilization to a level where SVE is not cost effective.
Capping	Contamination in the Vadose Zone	Includes DNAPLs, semivolatiles, or metal / inorganics.	These contaminants are often difficult to remediate and therefore capping is the suitable alternative.
	Area of Capping	Less than 24 acres.	Further evaluation would be required to determine whether cap stability can be maintained over an area greater than 24 areas.
	Depth of Contamination	Greater than 10 feet below ground surface.	If contamination does not exceed the specified depth, excavation and treatment is a more cost effective alternative.
	Impacts of Construction	Construction will not impact environmentally sensitive areas.	Further evaluation would be required should construction impact environmentally sensitive areas.
	Future Land Use	Can be restricted.	Capping is appropriate when future land use is limited since long-term maintenance and controls are required to ensure cap integrity is maintained.

HIGHLIGHT 4: Example Subsequent Site Evaluation

TECHNOLOGY: Soil Vapor Extraction

REMEDY PROFILE PARAMETER	REMEDY PROFILE BOUNDARY	SITE CONDITION	EVALUATION OF WHETHER SITE CONDITIONS PLUG-IN TO THE REMEDY PROFILE	DATA NEEDS
Contamination in the Vadose Zone	Includes halogenated hydrocarbons.	Halogenated VOCs.	Based on existing information, halogenated VOCs is the primary contaminant to be addressed.	None.
Soil Permeability of the Vadose Zone	Greater than 1 x 10^{-3} darcies.	Some soils with greater than, and some soils with less than 1 x 10^{-3} darcies.	Based on a previous site-wide soil survey, there is a possibility that the permeability of pockets of the contaminated area are not amenable to the remedy profile.	Rather than sample to determine the soil permeability, the core team determines that a bench scale test will be used to determine whether SVE will be effective.
Percent Saturation	Less than 60 percent.	45 -50 percent.	Based on a previous site-wide soil survey, site conditions match the remedy profile.	None.
Impact to Ground Water	Contaminants not currently impacting ground water.	Contaminants not currently impacting ground water.	Previous sampling efforts indicate site conditions match the remedy profile.	None.
Henry's Law Constant of Contaminant	Greater than 100 atm / mole fraction.	Greater than 100 atm / mole fraction.	Based on a previous site-wide soil survey, site conditions match the remedy profile.	None.
Vapor Pressure of Contaminant	Greater than 1.0 mm Hg @ 20°C.	Greater than 1.0 mm Hg @ 20°C.	Based on a previous site-wide soil survey, site conditions match the remedy profile.	None.

TECHNOLOGY: Capping

REMEDY PROFILE PARAMETER	REMEDY PROFILE BOUNDARY	SITE CONDITION	EVALUATION OF WHETHER SITE CONDITIONS PLUG-IN TO THE REMEDY PROFILE	DATA NEEDS
Contamination in the Vadose Zone	Includes DNAPLs, semivolatiles, or metal / inorganics.	PCBs, chromium, and lead > acceptable risk levels are migrating to ground water.	Based on existing information, the potential for contaminants to migrate to ground water exists. Site conditions match the remedy profile.	None.
Area of Capping	Less than 24 acres.	8 to 11 acres.	Existing information on the extent of contamination substantiates that it is highly unlikely contamination extends beyond 11 acres. Therefore, site conditions match the remedy profile. Although the extent of contamination does not exceed 24 acres, there is uncertainty as to the actual area to be capped.	Additional information is not required to confirm whether site conditions fit the remedy profile, but rather to bound the area to be capped. After reviewing the locations of previous sampling events, the core team determines that five more samples will be taken in a two acre area to delineate the lateral extent of contamination.
Depth of Contamination	Contamination is not currently impacting ground water.	Contamination is not currently impacting ground water.	Previous sampling indicates that site conditions match the remedy profile.	None.
Impacts of Construction	Construction will not impact environmentally sensitive areas.	No environmentally sensitive areas present on site.	Based on a previous ecological assessment, none of the ecological receptors with habitat on site are currently listed as threatened and endangered species. Furthermore, these receptors are not likely to become endangered. Site conditions match the remedy profile.	None.
Future Land Use	Can be restricted.	Future land use is industrial only.	Future land use has already been designated as industrial and is not anticipated to change. Site conditions match the remedy profile.	None.