United States Environmental Protection Agency

Solid Waste And Emergency Response (OS-220)

Directive 9355.3-01FS3
November 1989

EPA

The Feasibility Study

Development And Screening Of Remedial Action Alternatives

This fact sheet is the third in a series of four that summarizes the remedial investigation/feasibility study (RI/FS) process. The previous two fact sheets in this series discuss scoping the RI/FS (OSWER Directive No. 9355.3-01FS1) and site characterization and treatability studies (OSWER Directive No. 9355.3-01FS2). This fact sheet provides a summary of Chapter 4 of the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (October 1988, OSWER Directive 9355.3-01), which discusses the development and screening of alternatives for remedial action. In addition, this fact sheet provides information intended to assist the Remedial Project Manager (RPM) in managing this portion of the feasibility study (FS) efficiently and effectively.

The FS process consists of the development and screening of remedial action alternatives and a detailed analysis of a limited number of the most promising options to establish the basis for a remedy selection decision.

A range of viable alternatives should be developed that meet the remedial response objectives developed during scoping and refined as the study progresses. This range should reflect the program expectations to address the principal threats posed by the site (i.e., liquids and highly toxic and/or highly mobile waste) through treatment, and consider engineering controls (e.g., containment) to address low-level contaminated materials and wastes for which treatment is impracticable. Institutional controls should be considered primarily as supplements to engineering controls.

In addition to the program expectations, RPMs should consider the types of response actions selected for other sites with similar problems or contaminants to identify only those remedial alternatives that carry high potential of being an effective solution for site problems. As appropriate, the range of source control alternatives should include options employing treatment as a principal element, one or more containment alternatives, and the no-action alternative. The major components that comprise the development and screening process are presented in Figure 1.

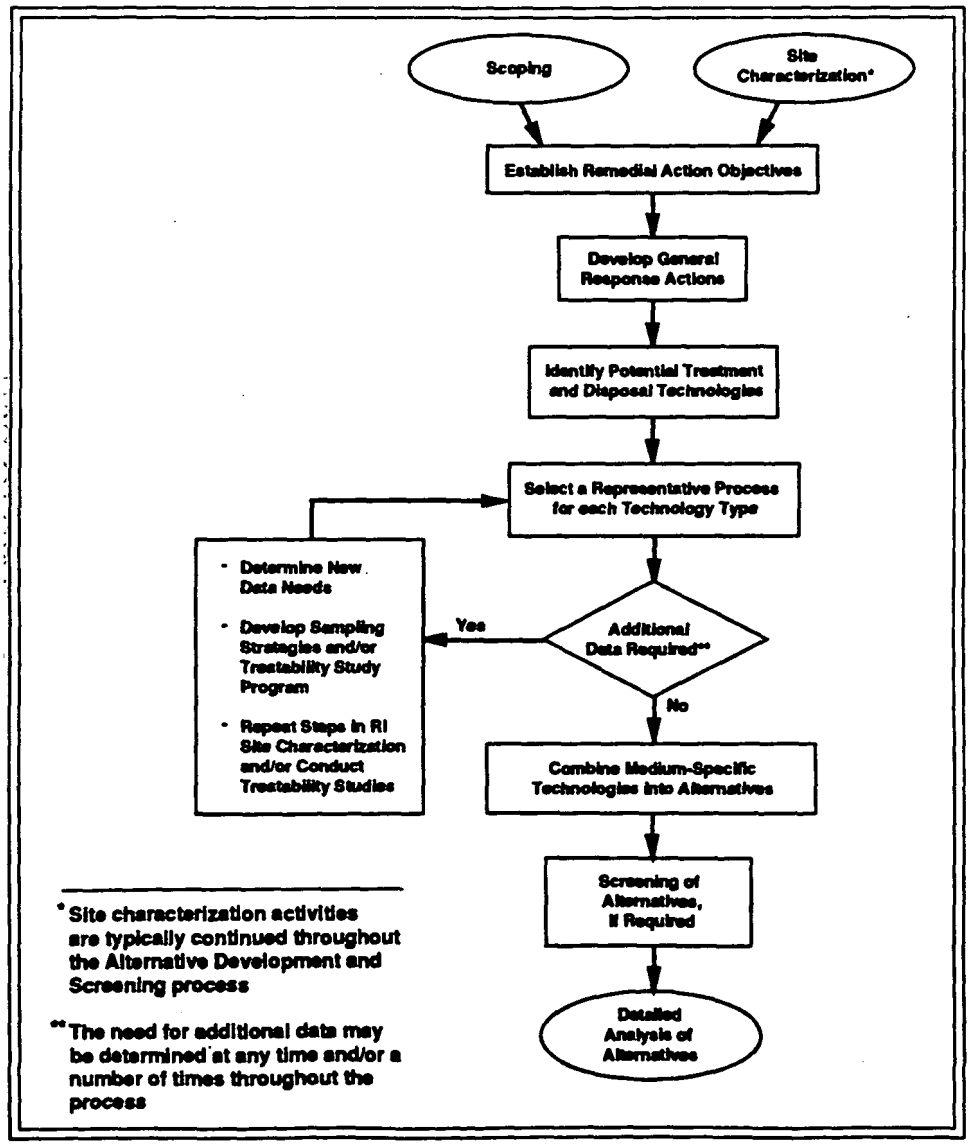


Figure 1. Alternative Development and Screening Process

Note: The no-action alternative is used as a baseline to compare other alternatives. Measures, such as actions taken to reduce the potential for exposure (e.g., site fencing) should not be included as components of no-action alternatives. Such minimal actions should be studied as a separate, limited-action alternative. Environmental monitoring may be included as part of a no-action alternative.

Development and Screening Activities

Establish Remedial Action Objectives

The preliminary remedial action objectives identified during scoping are refined as necessary during this phase of the RI/FS to develop medium-specific goals for protecting human health and the environment. Remedial action objectives specify:

- The contaminant(s) and media of concern
- The exposure route(s) and receptor(s)
- The remediation goal(s) for each exposure route

An example of a remedial action objective is reducing concentrations of TCE in potable ground water to 5 ppb.

The contaminants, media of concern, and exposure routes are the most important preliminary sources of information necessary for the development of alternatives. That is, the identification of appropriate remedial technologies can be initiated without identifying the final remediation goal or the exact cleanup requirement. These requirements will need to be identified prior to the detailed analysis of alternatives.

During the development of alternatives, preliminary remediation goals are established based on readily available information such as applicable or relevant and appropriate requirements (ARARs). Whereas, final remediation goals take into consideration the results of site characterization and the baseline risk assessment. The baseline risk assessment defines the risks posed by a site and establishes the need (or lack thereof) for remedial action.

Note: Identification of location- and chemical-specific ARARs, begun during scoping, should be completed during alternatives development. Examples of such requirements include:

- **Maximum contaminant levels (MCLs)**
- **Water quality criteria**
- **State-action levels for drinking water**
- **State air emission standards**

Develop General Response Actions

General response actions are selected to satisfy the remedial action objectives for each medium of concern. These actions, initially defined during scoping, are refined during this phase and relate to basic methods of protection such as treatment or containment. General response actions may be combined to form alternatives such as treatment of highly toxic material with containment of the treatment residuals.

The volume or area to which general response actions might be applied should be identified at this time and based on: the exposure routes, the known nature and extent of contamination, and preliminary remediation goals and a preliminary list of action-specific ARARs. Action-specific ARARs set restrictions on particular remedial activities as related to the management of hazardous wastes.

Identify and Screen Appropriate Technologies

Throughout the *RI/FS Guidance* and this fact sheet, the term "technology" refers to general categories of technologies, such as chemical treatment or capping. The term "technology process option" refers to specific alternative processes within each technology family, such as ion exchange or use of a soil-clay cap.

Note: Typical sources of information that can be used to identify technology needs and to determine capabilities of technology process options include:

- **ORD technology experts**
- **SITE program staff**
- ***Technology Screening Guide for Treatment of CERCLA Sludges and Soils* (EPA/540/2-88/004, September 1988)**
- **Appendix D of the *RI/FS Guidance***
- **Contractor process engineers**
- **Equipment vendors**

A list of potentially applicable technologies and technology process options, corresponding to the identified general response actions, is compiled and then reduced by evaluating the process options with respect to technical implementability. That is, existing information on technologies and site characterization data are used to screen out process options that cannot be effectively implemented at the site. Figure 4-4 of the *RI/FS Guidance* illustrates the necessary documentation for this evaluation of process implementability and can be included in the FS report.

To the extent possible, design parameters for the technologies being considered should be identified to focus sampling efforts during the site characterization phase. Field investigation activities will be ongoing during the development and screening of alternatives due to the interactive nature of the RI and FS, which are conducted concurrently.

Select Representative Process Options

To simplify the development and evaluation of alternatives, one representative process option should be selected, if possible, for each technology type remaining after the technical implementability screening procedure. Effectiveness, implementability, and cost are the criteria used to evaluate and select representative process options (see page 3 for a description of these criteria). The sources of information used to identify the representative process option are the same as those used to identify technology types. During remedial design, other process options may be selected if they are found to be more advantageous.

Note: Given the performance uncertainty often associated with innovative technologies, it may not be possible to evaluate innovative process options on the same basis as conventional processes. If available information indicates that innovative technologies will provide comparable or superior treatment performance, fewer or lesser adverse impacts, or lower cost for a similar level of performance, they should be retained for further evaluation.

Reevaluate Data Needs

The need for additional data may become apparent after representative process options have been selected. Process engineers, equipment vendors, and PRP in-house engineers and chemists can help in determining which data are re-

quired to assess potential process limitations and which data are required to establish design criteria.

Treatability studies are typically needed whenever treatment has been identified as a viable alternative. These studies provide data on technologies and their effectiveness on a specific waste found at a site. Treatability studies may not be necessary in those instances where information already exists about a treatment process and its performance on the same type of waste found at the site.

Assemble Technologies Into Alternatives

To assemble alternatives, general response actions should be combined, using different process options applicable to different volumes of media or areas of the site, to meet all remedial action objectives. For example, an alternative might call for incinerating the most highly contaminated soil from a portion of the site, while capping other less contaminated areas. When combining alternatives, it is necessary to consider interactions between media, such as the interaction between ground water and soils through dissolution, precipitation, and adsorption processes. Consideration should also be given to how general response actions can be integrated in the most efficient ways. For example, residual streams that could be addressed by two different response actions may be best handled together, such as sludge from a metals precipitation process and ash from onsite incineration. A description of each alternative should be included in the FS report, including the logic behind the assembly of the specific remedial action alternatives.

Screen Alternatives, If Required

The alternative development process should focus only on the most viable options for site remediation. In the event that a large number of viable alternatives remains at the conclusion of the assembly of alternatives, an additional screening process should be used to limit the number of alternatives that must undergo the detailed analysis.

Source control alternatives retained through the screening process should include those options that have a significant potential for being implemented at the site. The range of options that may be retained could include:

- Treatment options that minimize long-term management requirements and address principal threats
- Containment options, used either in conjunction with treatment or alone, that reduce exposure to waste
- A no-action alternative (which should be maintained throughout the analysis)

Note: Generally no more than five source control alternatives should be carried through to detailed analysis. Fewer alternatives may be appropriate in the case of an early action, where options are limited or obvious, or when program guidance or ARARs establish appropriate alternatives.

For ground-water response actions, alternatives should not only address remediation or clean-up levels but also the estimated time frame within which these clean-up levels might be achieved. Although the goal of ground-water response actions is to return the ground water to its beneficial uses (i.e., health-based levels should be achieved for potentially drinkable water), it should be recognized that it may not always be practicable to attain this goal. Contingencies may need to be planned for and discussed in the Record of Decision (see *Considerations in Ground Water Remediation at Superfund Sites*, October 1989, OSWER Directive No. 9355.4-03). Information on the range of alternatives for groundwater remedial response actions may be found in the *Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites* (December 1988, OSWER Directive No. 9283.1-2).

During screening, each alternative should be evaluated with regard to:

- Short- and long-term effectiveness and reductions achieved in toxicity, mobility, or volume
- Implementability including technical and administrative feasibility
- Grossly disproportionate cost

The "short-term" is considered to be the remedial construction and implementation period, while "long-term" begins once the remedial action is complete and remedial action objectives have been met.

Technical feasibility includes the ability to construct, reliably operate, and meet regulations, as well as the ability to meet the operations and maintenance, replacement, and monitoring requirements after completion of the remedial action. Administrative feasibility includes the ability to obtain approvals from other agencies; the availability of treatment, storage, and disposal services; and the availability of equipment and technical expertise.

The objective of the cost evaluation is to eliminate from further consideration those alternatives whose costs are grossly excessive for the effectiveness they provide. Cost estimates for alternatives should be sufficiently accurate to continue to support resulting decisions when their accuracy improves beyond the screening level. Capital, O&M, and present worth costs should be determined. Documentation of the screening process, if conducted, is required. Figure 4-5 of the *RI/FS Guidance* provides an example of adequate documentation.

Note: Potential action-specific ARARs, identified earlier in the process, are evaluated further with respect to the remaining remedial action alternatives. This process continues until the comparative analysis of the detailed analysis. By this time, all action-specific ARARs must be identified.

Development and Screening Deliverables

Although generally no formal report is required during this phase of the FS, it is important that the lead and the support agencies agree in writing on the set of alternatives selected for detailed analysis. Based on agreement between the lead and support agencies, the following information should be documented in the FS report, which is submitted following the detailed analysis of alternatives:

- Chemical- and/or risk-based remedial objectives
- Technologies evaluated and reasons for exclusion or inclusion
- Process option representation rationale
- Rationale for screening out alternatives, if applicable
- Clear, concise description of each alternative, including its respective chemical-, location-, and action-specific ARARs

The *Detailed Analysis Fact Sheet* contains a further description of the con-

tents of the FS report (OSWER Directive No. 9355.3-01FS4.)

RPM Responsibilities

The RPM is responsible for managing this phase of the FS and specifically to ensure that adequate technical support is provided and that control of the project's schedule and cost is maintained.

Technical Supervision

Activities needed to ensure that adequate technical supervision is provided during the development and screening of alternatives include:

- Communication with the support agency, the contractor, and other technical experts (i.e., members of the Technical Advisory Committee [TAC]) to obtain early agreement on the technologies/alternatives to be considered and on ARARs.

  It may be appropriate for ORD's START team to be included on the TAC when treatment will be considered for complex or difficult to treat waste. See the *Scoping Fact Sheet* (OSWER Directive No. 9355.3-01FS1) for additional information on the START team and other technical experts.

- Emphasize, and provide direction to the contractor or potentially responsible parties (PRPs) (if it is a PRP-lead RI/FS), on the need to focus the effort to identify and screen technologies so that only a reasonable range of viable alternatives is developed.

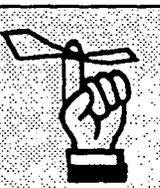
Schedule and Cost Control

Recommendations that should aid in schedule and cost control of this phase of the RI/FS include the following:

- Hold frequent meetings or conference calls to monitor progress. These meetings can be informal, with discussion focusing on work plan activities that need to be accomplished in the immediate future and the status of in-progress tasks that should be completed. Avoid creating delays associated with the preparation of lengthy deliverables to monitor progress.
- Review contractor monthly financial statements and make sure all costs are reasonable and justifiable. If appropriate, monthly financial statements should be supplemented by talking with the contractor's project manager about the schedule and budget.
- Control the schedule for inter- and intra-agency reviews, and schedule review meetings in advance to emphasize the deadlines for completion of reviews.
- Understand the significance of the labor hour cost to determine if the most efficient staffing levels are being used.
- Anticipate cost and schedule problems based on the contractor's previous month's performance and take actions to minimize cost overruns and schedule delays.

Enforcement Considerations

The development and screening of remedial alternatives is conducted much the same whether it is being financed by the Fund or by PRPs. If this phase of the RI/FS is being conducted by the PRPs, they will review, and if necessary, propose refinement of the remedial action objectives proposed by EPA during the project planning phase. Revision of the objectives is subject to EPA approval. After refinement of the remedial action objectives, the PRPs will typically conduct, under the oversight of EPA, all aspects of this phase of the FS. It is suggested that EPA reviews be scheduled after: screening technologies and process options, assembling alternatives, screening alternatives, and identifying action-specific ARARs. Additional information describing PRP participation in the RI/FS and EPA's oversight role can be found in Appendix A of the *RI/FS Guidance* and in OWPE's *Model Statement of Work for PRP-Conducted Remedial Investigations and Feasibility Studies* (June 2, 1989).



Points to Remember

- Apply the framework provided by the *RI/FS Guidance* appropriately, and avoid trying to satisfy each step unnecessarily.
- Begin the development of alternatives as soon as preliminary information on site characteristics is available.
- Draw on the experience of contractor process engineers, vendors, ORD, and other RPMs to help identify appropriate technologies and process options.
- Focus alternative development only on the most viable options for site remediation. Generally, no more then five sitewide source control options should be analyzed in detail.
- Conduct alternatives screening when more alternatives have been developed than can reasonably be evaluated.
- To the extent possible, identify design parameters for the technologies being considered so that relevant data can be collected during site characterization.
- Develop alternatives involving innovative technologies and retain for detailed analysis if they have the potential for comparable or superior treatment performance, fewer or lesser adverse impacts, or lower costs for a similar level of performance than a conventional technology.
- Communicate with key personnel, including the TAC, throughout this portion of the FS.
- Establish project management controls such as status meetings.
- Closely monitor PRP activities