United States Environmental Protection Agency

Office of Solid Waste and Emergency Response

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EPA

A Guide to Selecting Superfund Remedial Actions

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220

Quick Reference Fact Sheet

INTRODUCTION

The Superfund program's remedy selection process is the decision-making bridge between the analysis of remedial alternatives for cleaning up a site conducted in a remedial investigation/feasibility study (RI/FS) and the explanation of the selected remedy that is documented in a Record of Decision (ROD). This fact sheet describes statutory requirements for CERCLA remedies and the process EPA has established in the 1990 revised National Contingency Plan (55 FR 8666 (3/8/90)) for meeting these requirements. This process is a general framework for reaching a judgment as to the most appropriate method of achieving protection of human health and the environment at a particular site. This framework can be streamlined as appropriate to the site.

STATUTORY REQUIREMENTS

Section 121 of CERCLA mandates that the remedial action must:

1. Protect human health and the environment;
2. Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3. Be cost-effective;
4. Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable;
5. Satisfy the preference for treatment as a principal element, or provide an explanation in the ROD why the preference was not met.

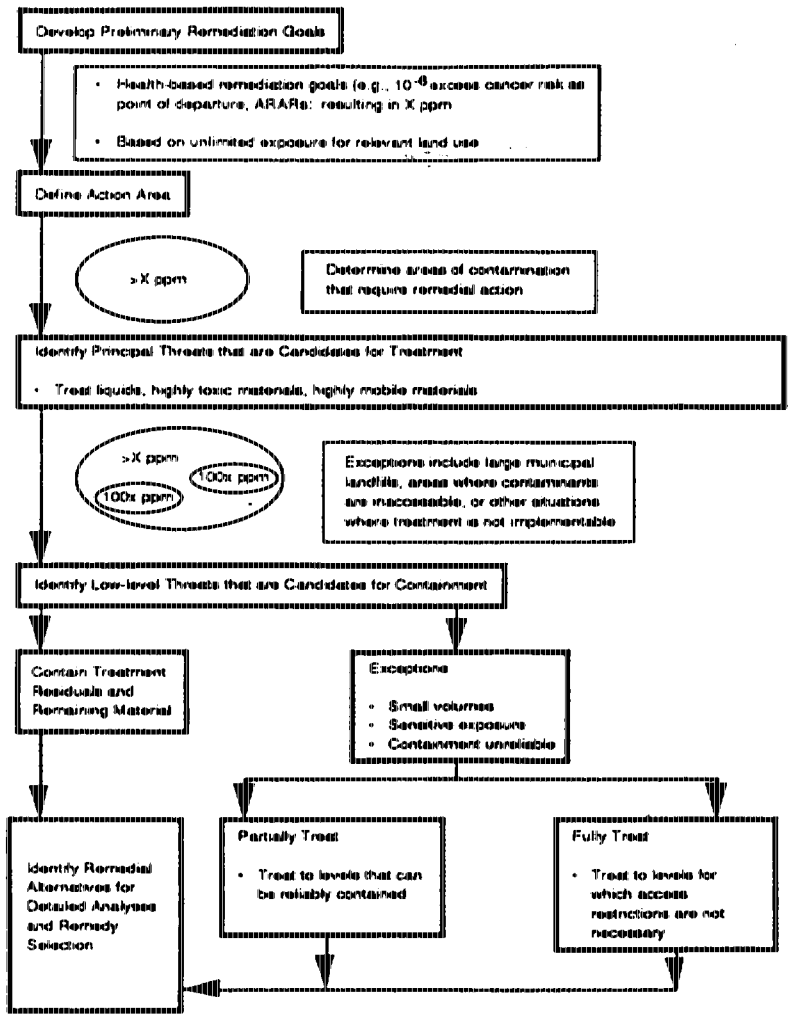
EPA has established a national goal and expectations reflecting these requirements in the 1990 NCP (Sec. 300.430(a)(1)(i) and (iii). The NCP also defines nine criteria that are to be used to compare remedial alternatives, to establish the basis for the selection decision, and to

EXHIBIT 1: PROGRAM EXPECTATIONS

Protection of human health and the environment can be achieved through a variety of methods: treatment to destroy or reduce the inherent hazards posed by hazardous substances, engineering controls (such as containment), and institutional controls to prevent exposure to hazardous substances. The NCP sets out the types of remedies that are expected to result from the remedy selection process (Sec. 300.430(a)(1)(iii)).

- ***Treat principal threats, wherever practicable.*** **Principal threats for which treatment is most likely to be appropriate are characterized as:**
  - **Areas contaminated with high concentrations of toxic compounds;**
  - **Liquids and other highly mobile materials;**
  - **Contaminated media (e.g., contaminated ground water, sediment, soil) that pose significant risk of exposure; or**
  - **Media containing contaminants several orders of magnitude above health-based levels.**
- ***Appropriate remedies often will combine treatment and containment.*** **For a specific site, treatment of the principal threat(s) may be combined with containment of treatment residuals and low-level contaminated material.**
- ***Containment will be considered for wastes that pose a relatively low long-term threat or where treatment is impracticable.*** **These include wastes that are near health-based levels, are substantially immobile, or otherwise can be reliably contained over long periods of time; wastes that are technically difficult to treat or for which treatment is infeasible or unavailable; situations where treatment-based remedies would result in greater overall risk to the human health or the environment during implementation due to potential explosiveness, volatilization, or other materials handling problems; or sites that are extraordinarily large where the scope of the problem may make treatment of all wastes impracticable, such as municipal landfills or mining sites.**
- ***Institutional controls are most useful as a supplement to engineering controls for short- and long-term management.*** **Institutional controls (e.g. deed restrictions, prohibitions of well construction) are important in controlling exposures during remedial action implementation and as a supplement to long-term engineering controls. Institutional controls alone should not substitute for more active measures (treatment or containment) unless such active measures are found to be impracticable.**
- ***Innovative technologies should be considered if they offer the potential for comparable or superior treatment performance, fewer/lesser adverse impacts, or lower costs for similar levels of performance than demonstrated technologies.***
- ***Ground waters will be returned to their beneficial uses within reasonable periods of time wherever practicable.***

Exhibit 2
Key Steps in the Development of Remedial Alternatives



demonstrate that statutory requirements have been satisfied (Sec. 300.430(f)(1)). Each of these aspects of EPA's remedy selection approach are described below.

GOAL AND EXPECTATIONS OF THE REMEDY SELECTION PROCESS

The national goal of the remedy selection process is "to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste" (NCP Sec. 300.430(a)(1)(i)).

While protection of human health and the environment can be achieved through a variety of methods, this goal reflects CERCLA's emphasis on achieving protection through the aggressive, but realistic use of treatment. The 1990 NCP presents EPA's expectations regarding circumstances under which treatment, as well as engineering and institutional controls, are most likely to be appropriate (Sec. 300.430(a)(1)(iii), see Exhibit 1). These expectations are intended primarily to assist in focusing the development of alternatives in the FS (see The Feasibility Study: Development and Screening of Alternatives, OSWER Directive 9355.3-01FS). These expectations do not substitute for site-specific balancing of the nine criteria to determine the maximum extent to which treatment can be practicably used in a cost-effective manner for a operable unit.

Exhibit 2 illustrates the alternatives development process, as shaped by the expectations. The process begins with the identification of preliminary remediation goals, which provide initial estimates of the contaminant concentrations/risk levels of concern. Based on ARARs, readily available toxicity information, and current and future land use, preliminary remediation goals are initial health-based levels and are used to define site areas that may require remedial action (i.e., action areas). Areas onsite with contaminant concentrations several orders of magnitude (e.g., 2) above these preliminary remediation goals are candidate areas for treatment. Areas onsite with contaminant concentrations within several orders of magnitude of these preliminary remediation goal levels are candidate areas for containment. The remediation goals, action areas, and target treatment/containment areas are refined throughout the RI/FS process as additional information becomes available. The final determination of remediation goals, action areas, and the appropriate degree of treatment and containment are made as part of the remedy selection.

THE REMEDY SELECTION PROCESS

Overview

The remedy selection process begins with the identification of a preferred alternative from among those evaluated in detail in the FS by the lead agency, in consultation with the support agency. The preferred alternative is presented to the public in a Proposed Plan that is

EXHIBIT 3: NINE EVALUATION CRITERIA

EPA has developed nine criteria to be used to evaluate remedial alternatives to ensure all important considerations are factored into remedy selection decisions. These criteria are derived from the statutory requirements of Section 121, particularly the long-term effectiveness and related considerations specified in Section 121(b)(1), as well as other additional technical and policy considerations that have proven to be important for selecting among remedial alternatives.

Threshold Criteria

The two most important criteria are statutory requirements that must be satisfied by any alternative in order for it to be eligible for selection.

1. *Overall protection of human health and the environment* addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (assuming a reasonable maximum exposure) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. *Compliance with applicable or relevant and appropriate requirements* (ARARs) addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental laws or whether a waiver can be justified.

Primary Balancing Criteria

Five primary balancing criteria are used to identify major trade-offs between remedial alternatives. These trade-offs are ultimately balanced to identify the preferred alternative and to select the final remedy.

1. *Long-term effectiveness and permanence* refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

2. *Reduction of toxicity, mobility, or volume through treatment* is the anticipated performance of the treatment technologies a remedy may employ.

3. *Short-term effectiveness* addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

4. *Implementability* is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

5. *Cost* includes estimated capital and operation and maintenance costs, and net present worth costs.

Modifying Criteria

These criteria may not be considered fully until after the formal public comment period on the Proposed Plan and RI/FS report is complete, although EPA works with the State and community throughout the project.

1. *State acceptance* addresses the support agency's comments. Where the State or other Federal agency is the lead agency, EPA's acceptance of the selected remedy should be addressed under this criterion. State views on compliance with State ARARs are especially important.

2. *Community acceptance* refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS report.

The 1990 NCP at 55 FR 8719-23 describes how the detailed analysis of alternatives is to be performed using these criteria. The detailed analysis is the information base upon which the remedy selection decision is made. Chapter 7 of the "Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (October 1988) provides further detail on the process.

issued for comment along with the RI/FS. Upon receipt of public comments on the Proposed Plan, the lead agency consults with the support agency to determine if the preferred alternative remains the most appropriate remedial action for the site or operable unit. The final remedy is selected and documented in a Record of Decision.

Considering the Nine Criteria

The identification of a preferred alternative and final selection of a remedy is derived from consideration of nine evaluation criteria in three major steps, as described in the 1990 NCP (Sec. 300.430(f)(1)(ii)(E)). The nine criteria are presented in Exhibit 3. The steps in which the criteria are considered are depicted in Exhibit 4 and discussed below.

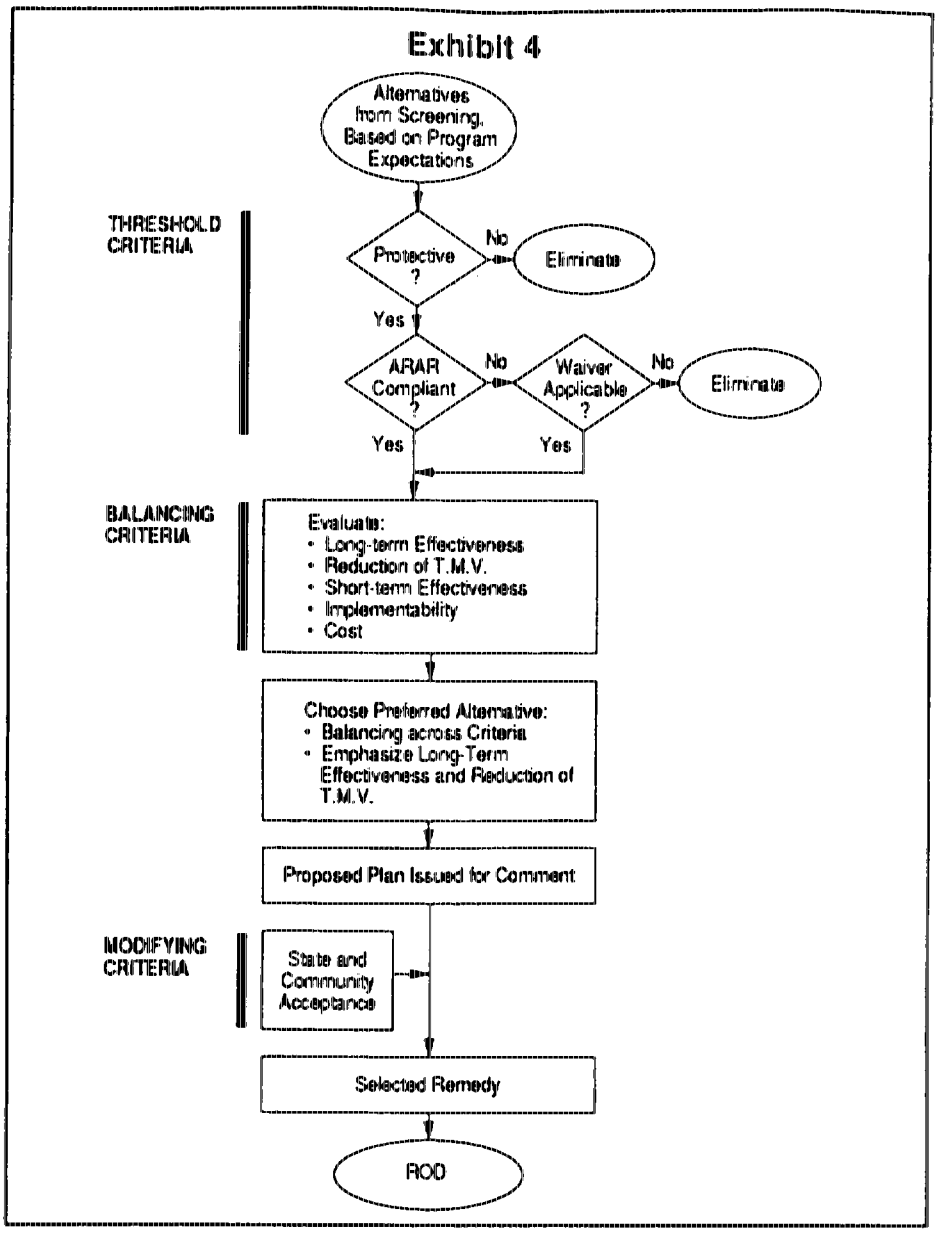
Threshold Criteria

The first step of remedy selection is to identify those alternatives that satisfy the threshold criteria. Only those alternatives that provide adequate protection of human health and the environment and comply with ARARs (or justify a waiver) are eligible for selection. Alternatives that do not satisfy the threshold criteria should not be evaluated further.

Primary Balancing Criteria

The second step involves the balancing of tradeoffs among protective and ARAR-compliant alternatives with respect to the five primary balancing criteria (and modifying criteria, if known). In this step, alternatives are compared with each other based on their long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, implementability, short-term effectiveness, and cost. The sequence in which the criteria are generally considered, and pertinent considerations related to each, are noted below.

1. Long-term effectiveness and permanence is a major theme of CERCLA Section 121, and, therefore, is one of the two most important criteria used during remedy selection to determine the maximum extent to which permanence and treatment are practicable. This factor will often be decisive where alternatives vary significantly in the types of residuals that will remain onsite and/or their respective long-term management controls.



2. Reduction in the toxicity, mobility, or volume of contaminants achieved through the application of treatment technologies is the other criterion that will be emphasized during remedy selection in determining the maximum extent to which permanent solutions and treatment are practicable. Remedies that use treatment to address materials comprising the principal threats posed by a site are preferred over those that do not. Treatment as part of CERCLA remedies should generally achieve reductions of 90 to 99 percent in the concentrations or mobility of individual contaminants of concern. There will, however, be situations where reductions outside the 90 to 99 percent range will be appropriate to achieve site-specific remediation goals.

3. The short-term effectiveness of an alternative includes consideration of the time required for each alternative to achieve protection, as well as adverse short-term impacts that may be posed by their implementation. Many potential adverse impacts can be avoided by incorporating mitigative steps into the alternative. Poor short-term effectiveness can weigh significantly against an option and can, in fact, result in an alternative being rejected as unprotective if adverse impacts cannot be adequately mitigated.

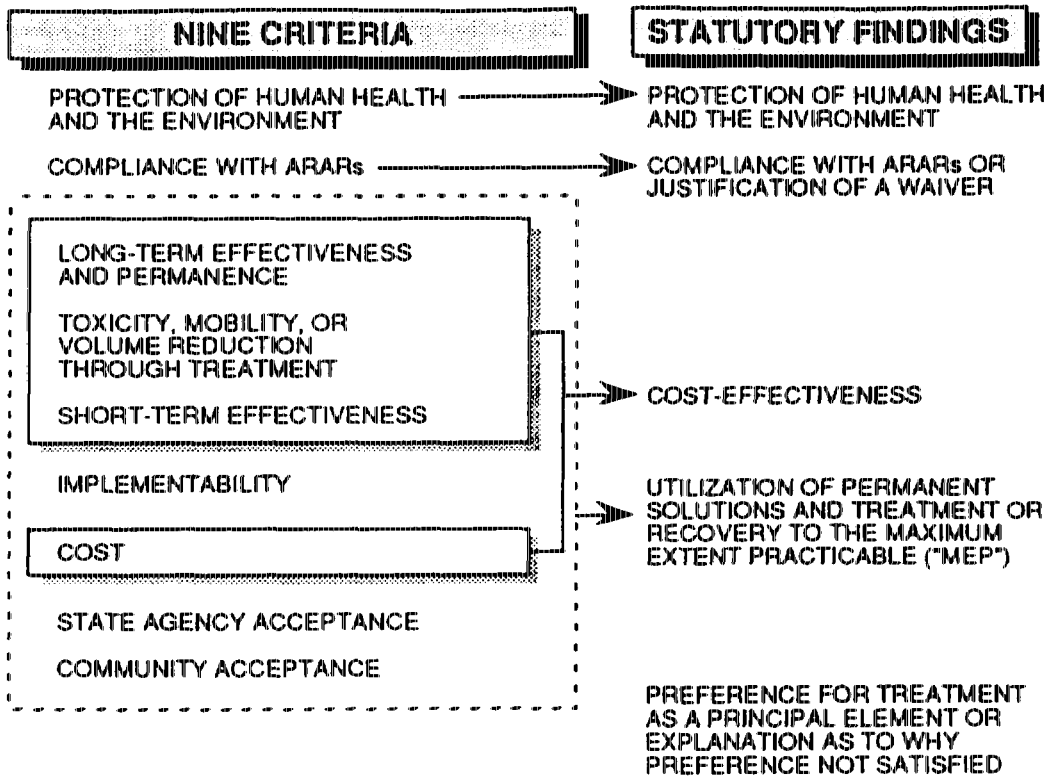
4. Implementability is particularly important for evaluating remedies at sites with highly heterogeneous wastes or media that make the performance of certain technologies highly uncertain. Implementability is also significant when evaluating technologies that are less proven and remedies that are dependent on a limited supply of facilities (e.g., TSCA - permitted land disposal facility), equipment (e..g., in-situ vitrification units), or experts.

5. Cost may play a significant role in selecting between options that appear comparable with respect to the other criteria, particularly long-term effectiveness and permanence, or when choosing among treatment options that provide similar performance. Cost generally will not be used to determine whether or not principal threats will be treated, except under special circumstances that make treatment impracticable (see expectations). Cost can never be used to pick a remedy that is not protective.

Modifying Criteria

If known at the completion of the RI/FS, state (support agency) and community acceptance of the alternatives should be considered with the results of the balancing criteria evaluation to identify the preferred alternative. After the public comment period, state and community acceptance are again considered, along with any new information, and may prompt modification of the preferred alternative.

Exhibit 5
Relationship of the Nine Criteria to the Statutory Findings



Identification of a Preferred Alternative

Once the relative performance of the protective and ARAR-compliant alternatives under each criterion has been established, preliminary determinations of which options are cost-effective and which alternatives utilize permanent solutions and treatment technologies to the maximum extent practicable are made to identify the preferred alternative. Exhibit 5 illustrates the relationship between the nine criteria and the statutory requirements for remedy selection.

Cost-effectiveness is determined by comparing the costs of all alternatives being considered with their overall effectiveness to determine whether the costs are proportional to the effectiveness achieved. Overall effectiveness for the purpose of this determination includes long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness. More than one alternative can be cost-effective.

The determination of which cost-effective alternative utilizes permanent solutions and treatment to the maximum extent practicable is a risk management judgment made by the decisionmaker who balances the tradeoffs among the alternatives with respect to the balancing criteria (and modifying criteria to the extent they are known). As a general rule, those criteria that distinguish the alternatives the most will be the most decisive factors in the balancing. See Exhibit 6 for a summary of criteria likely to be important in certain site situations. The alternative determined to provide the best balance of trade-offs, as considered in light of the statutory mandates and preferences, as well as the NCP goal and expectations, is identified as the preferred alternative and presented to the public for comment in a Proposed Plan.

Final Selection of Remedy

Upon receipt of public comments, the preferred alternative is reevaluated in light of any new information that has become available, including State and community acceptance, if previously unknown. This new information should be considered to determine whether an option other than the preferred alternative better fulfills the statutory requirements. The decisionmaker's final judgment is documented in a Record of Decision.

Exhibit 6

EXAMPLES OF PROMINENT CRITERIA AND EXPECTATIONS FOR SELECTED SITE SITUATIONS

SITUATION	PROMINENT CRITERIA	EXPECTED RESULT OF REMEDY SELECTION*
Small area of high levels of toxic contaminants (e.g., lagoon, hot spots)	Long-term effectiveness, Reduction of toxicity, mobility, or volume through treatment	Treatment is preferred when highly toxic material is a principal threat at a site
Highly mobile contaminants (e.g., liquids, volatiles, metals)	Long-term effectiveness, Reduction of mobility through treatment	Treatment is preferred when highly mobile material is a principal threat at a site
Very large volume of material contaminated marginally above health-based levels (e.g., mine tailings one order of magnitude above health-based levels in soil)	Implementability, Cost	Containment may afford high level of long-term effectiveness; treatment may be difficult to implement because of insufficient treatment capacity for large volume of material, and cost of treatment may be prohibitive due to large scope of site
Complex mixture of heterogeneous waste without discrete hot spots (e.g., heterogeneous municipal landfill waste)	Implementability, Short-term effectiveness, Cost	Treatment of heterogeneous waste often difficult or infeasible, reducing implementability; containment avoids short-term impacts and uncertainties associated with excavation; cost of treatment may be prohibitive
Soils contaminated with high concentrations of VOCs	Long-term effectiveness, Short-term effectiveness	In-situ treatment may be preferred over excavation because of negative short-term impacts and high cost of excavation
Contaminated ground water	Long-term effectiveness, Short-term effectiveness	Ground waters should be returned to beneficial use as soon as is practicable

* These are only examples and have been highly simplified for illustration purposes. They are not intended to prescribe certain remedies for certain situations.

NOTICE: The policies set out in this memorandum are intended solely for the guidance of Government personnel. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. Remedy selection decisions are made and justified on a case-specific basis. The Agency also reserves the right to change this guidance at any time without public notice.