



## U.S. Navy Human Health Risk Assessment Guidance

# Chapter 10 – Tier III Risk Evaluation of Remedial Alternatives

### Table of Contents

10.0	Introduction.....	10-1
10.1	Purpose and Objectives .....	10-1
10.2	Elements of Tier III .....	10-1
10.3	When RERAs are Performed.....	10-2
10.3.1	Evaluating Remedial Alternatives .....	10-2
10.3.2	Complexity of RERAs .....	10-3
10.4	Decision Criteria .....	10-5
10.4.1	Nine Decision Criteria .....	10-5
10.4.2	Background Information on Remedy Selection Criteria.....	10-6
10.5	Development of Preliminary Remediation Goals and Final Remediation Levels .....	10-7
10.5.1	Preliminary Remediation Goals and Final Remediation Levels .....	10-7
10.5.2	Key Considerations for Developing Preliminary Remediation Goals and Final Remediation Levels .....	10-8
10.6	Impact of Ecological PRGs.....	10-9
10.7	Site Closeout and Long-Term Monitoring.....	10-9
10.7.1	Risk Evaluations After Remedy Selection.....	10-9
10.7.2	Risk Evaluation During Remedial Design and Remedial Action.....	10-10
10.7.3	Five-Year Review.....	10-10
10.8	References .....	10-11

### List of Tables

Table 10.1	– Summary of Short-Term Risk Evaluations of Remedial Alternatives .....	10-4
Table 10.2	– Summary of Long-Term Risk Evaluations of Remedial Alternatives .....	10-4
Table 10.3	– Balancing Criteria for Evaluating Remedial Alternatives.....	10-6

### List of Figures

Figure 10.1	– Relationship Between the Remedy Selection Process and Risk Evaluation of Remedial Alternatives .....	10-3
-------------	--	------



## 10.0 Introduction

A Tier III Risk Evaluation of Remedial Alternatives (RERA) is initiated when the results of the Tier I or Tier II assessment indicate that:

- 1.) site-related Chemicals of Concern (COCs) pose unacceptable risks; or
- 2.) site-related COCs pose acceptable risks with implementation of Institutional Controls (ICs) or Engineering Controls (ECs).

The ultimate goal of the remedy selection process is to choose a remedy that reduces, controls, or eliminates the risks to human health and the environment. RERAs are one component of this process. Information from RERAs is used in conjunction with other information, such as assessments of technical feasibility, identification of applicable or relevant and appropriate requirements (ARARs), determination of costs, and implementability, to select a remedy for a site. The process of evaluating remedial alternatives begins in the development and screening stage of the Feasibility Study (FS), and may extend to Site Closeout and Long-Term Monitoring (LTM).

## 10.1 Purpose and Objectives

The purpose of RERAs is to provide Remedial Project Managers (RPMs) with a qualitative or quantitative assessment of the short-term and long-term health risks associated with remedial alternatives. These alternatives are evaluated, using the nine remedy selection criteria identified in the National Contingency Plan (NCP), to select the remedy for a site.

## 10.2 Elements of Tier III

The approach for performing RERAs is consistent with the approach for evaluating risks via a Tier I Risk-Based Screen and a Tier II Baseline Risk Assessment: exposure and toxicity information are combined to provide estimates of risk. However, RERAs differ from Tier I and Tier II evaluations in that:

- ◆ Typically, both short-term and long-term risk evaluations are performed. Short-term risks are those that occur during implementation of a remedial alternative (e.g., risk associated with inhalation of fugitive dust during excavation of impacted soil at a site). Long-term risks include those that remain after the remedial action has been completed. They also consider the alternative's ability to provide protection over time. These risks are often called "residual" risks.
- ◆ The exposed populations, exposure pathways, and exposure durations may be different than were evaluated in the Tier I and Tier II assessment. For example, remediation workers and the surrounding community will typically be evaluated in a RERA.
- ◆ Short-term exposures (i.e., days, weeks, months, or a few years) are typically evaluated and may require short-term (e.g., sub-chronic, and acute) toxicity values.
- ◆ Additional media and chemicals may be evaluated in the RERA that were not evaluated in the original Tier I or Tier II assessments. For example, there may be new chemicals emitted to air from an air stripper that is used to remediate groundwater contamination.
- ◆ RERAs are often qualitative and the level of effort will vary with each remedial alternative and with each site being evaluated. For example, in some instances only a qualitative evaluation of the risks may be necessary. In other instances a quantitative evaluation of risks using Preliminary Remediation Goals (PRGs) or deterministic risk assessment may be necessary.



## 10.3 When RERAs are Performed

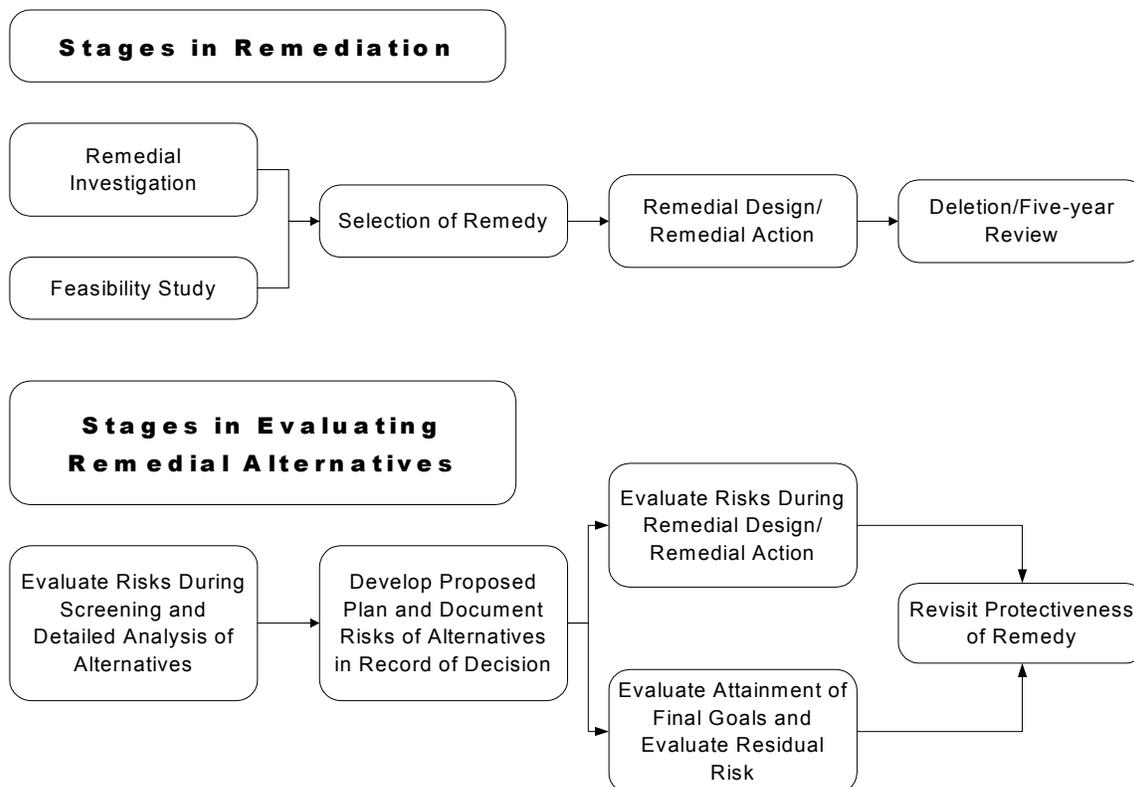
### 10.3.1 EVALUATING REMEDIAL ALTERNATIVES

Remedial alternatives are evaluated throughout the remedy selection process. Consequently, RERAs may be conducted at various stages including:

- ◆ Identification and Screening of Technologies and Alternatives (part of the FS);
- ◆ Detailed Analysis of Alternatives (part of the FS);
- ◆ Development of the Proposed Plan;
- ◆ Development of the Record of Decision (ROD);
- ◆ Remedial Design;
- ◆ Remedial Action; and
- ◆ Five-year Review.

Figure 10.1 presents an overview of the relationship between the remedy selection process and RERAs.

**Figure 10.1 – Relationship Between the Remedy Selection Process and Risk Evaluation of Remedial Alternatives**



### 10.3.2 COMPLEXITY OF RERAS

The complexity of RERAs should be commensurate with the complexity of the remedial alternatives and the concentrations and relative toxicity of the chemicals being remediated (USEPA, 1991b). At some sites there may be few remedial alternatives; the potential short-term and long-term human health exposure pathways may be limited. For these sites a qualitative evaluation of the risks of remedial alternatives may be sufficient. At other sites, a complete deterministic risk assessment may be appropriate.

The type of analysis that should be performed for each step of the RERA process depends on two factors:

- 1.) whether the relative short-term or long-term effectiveness of alternatives is an important consideration; and
- 2.) the "perceived risk" associated with the alternative.

The perceived risk includes both the professional judgment of the site engineers and risk assessors and the concerns of the neighboring communities. The United States Environmental Protection Agency (USEPA) has identified the following factors that generally lead to a higher perceived risk:

- ◆ close proximity of populations;
- ◆ presence of highly- or acutely-toxic chemicals;
- ◆ technologies with high release potential, either planned or "accidental;"



- ◆ technologies where the amount and identity of releases are uncertain, such as might exist with use of certain innovative technologies;
- ◆ multiple contaminants and/or exposure pathways affecting the same individuals;
- ◆ multiple releases occurring simultaneously, such as the case when there are several different remedial technologies that operate in close proximity; and
- ◆ releases occurring over long periods of time (USEPA, 1991b).

The USEPA recommends that if these or other factors lead to a higher perceived risk, then a more quantitative evaluation for short-term or long-term risks may be helpful in the decision-making process. Tables 10.1 and 10.2 present the USEPA’s recommendations on whether the evaluation should be qualitative or quantitative for each step in the remedy selection process, for short-term and long-term risks, respectively.

**Table 10.1 – Summary of Short-Term Risk Evaluations of Remedial Alternatives (USEPA, 1991b)**

Stage in the Process	Type of Evaluation	Primary Purpose
Screening of Alternatives	Qualitative	To identify (and eliminate from consideration) alternatives with clearly unacceptable short-term risks.
Detailed Analysis of Alternatives	Qualitative or Quantitative	To evaluate short-term risks, of each alternative, to the community and on-site remediation workers during implementation so that these risks can be compared among alternatives.
Proposed Plan	Qualitative or Quantitative	To refine previous analyses, as needed, based on newly-developed information.
Record of Decision	Qualitative or Quantitative	To document short-term risks that may occur during remedy implementation.
Remedial Design	Qualitative or Quantitative	To refine previous analyses, as needed, and identify the need for engineering controls or other measures to mitigate risks.
Remedial Action	Quantitative	To ensure protection of workers and community by monitoring emissions or exposure concentrations, as needed.
Five-year Review	Generally not applicable	(Generally not applicable because all of the potential risks would be long-term in nature.)

Note: Short-term risks are those that occur during implementation of the remedial action. In some cases short-term risks may occur over a number of years.

**Table 10.2 – Summary of Long-Term Risk Evaluations of Remedial Alternatives (USEPA, 1991b)**

Stage in the Process	Type of Evaluation	Primary Purpose
Screening of Alternatives	Qualitative	To identify (and eliminate from consideration) alternatives with clearly unacceptable long-term risks.
Detailed Analysis of Alternatives	Qualitative or Quantitative	To evaluate each alternative’s long-term residual risk and its ability to provide continued protection, over time, so that these risks can be compared to other remedial alternatives.
Proposed Plan	Qualitative or Quantitative	To refine previous analyses, as needed, based on newly-developed information.
Record of Decision	Qualitative or Quantitative	To document risks that may remain after completion of remedy and determine need for five-year reviews.
Remedial Design	Qualitative or Quantitative	To refine previous analyses, as needed, and identify need for engineering controls or other measures to mitigate risks.



Table 10.2 – Summary of Long-Term Risk Evaluations of Remedial Alternatives (USEPA, 1991b)

Stage in the Process	Type of Evaluation	Primary Purpose
Remedial Action	Quantitative	To evaluate whether remediation levels specified in the Record of Decision (ROD) have been attained, and to evaluate residual risk after completion of remedy to ensure protectiveness.
Five-year Review	Generally not applicable	To confirm that remedy (including any engineering or institutional controls) remains operational and functional and to evaluate whether or not cleanup standards are still protective.

Note: Long-term risks include those that remain after implementation of the remedy has been completed and also consider the alternative's ability to provide protection over time.

## 10.4 Decision Criteria

### 10.4.1 NINE DECISION CRITERIA

The results of RERAs are used by RPMs, in conjunction with other information, to evaluate each remedial alternative with respect to nine evaluation criteria identified in the NCP [40 CFR 300.430(e)(9)(iii)]:

**Threshold Criteria** – Must be met for a remedial alternative to be acceptable.

- 1.) overall protection of human health and the environment;
- 2.) compliance with ARARs (unless a waiver is obtained);

**Balancing Criteria** – Additional criteria used to help rank the remedial alternatives that meet the Threshold Criteria.

- 3.) long-term effectiveness and permanence;
- 4.) reduction of toxicity, mobility, or volume;
- 5.) short-term effectiveness;
- 6.) implementability;
- 7.) cost;

**Modifying Criteria** – Criteria that may result in the selection of a less desirable (i.e., less desirable in terms of the Threshold and Balancing Criteria) remedial alternative as the remedy for a site.

- 8.) state acceptance; and
- 9.) community acceptance.

The alternatives are analyzed individually against each criterion; and then compared against one another, to determine their respective strengths and weaknesses and to identify the key trade-offs that must be balanced for the site. The results of the detailed analysis are summarized so that an appropriate remedy may be selected.



### 10.4.2 BACKGROUND INFORMATION ON REMEDY SELECTION CRITERIA

#### Threshold Criteria

The goal of the remedy selection process is to choose alternative(s) that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. Section 121 of the Superfund statute (i.e., CERCLA) established two principal requirements for the selection of remedies. Remedies must:

- 1.) protect human health and the environment; and
- 2.) comply with ARARs unless a waiver is justified (USEPA, 1997).

The remedy selection process links the analysis of site-cleanup alternatives with the documentation of the selected remedy.

#### Balancing Criteria

Once a limited number of viable alternatives have been developed and ARARs have been identified, the alternatives are then evaluated using the five primary balancing criteria. The five criteria and their associated components are presented in [Table 10.3](#).

**Table 10.3 – Balancing Criteria for Evaluating Remedial Alternatives (USNAVY, 2001)**

Criteria	Explanation
Long-term effectiveness and permanence	<ul style="list-style-type: none"> <li>◆ Residual risk from untreated waste or treatment residuals remaining after remediation.</li> <li>◆ Adequacy and reliability of protective measures – including reliance on land-disposal, potential need to replace, and risk posed should components need replacement.</li> </ul>
Reduction of toxicity, mobility, or volume through treatment	<ul style="list-style-type: none"> <li>◆ Processes used.</li> <li>◆ Amount of hazardous substances, pollutants, or chemicals that are destroyed, treated, or recycled.</li> <li>◆ Degrees of reduction in toxicity, mobility, and volume.</li> <li>◆ Irreversibility of treatment.</li> <li>◆ Type, quantity, persistence, toxicity, and mobility of the remaining chemicals and their propensity for bioaccumulation.</li> <li>◆ Reduction in principal threats at the site.</li> </ul>
Short-term effectiveness	<ul style="list-style-type: none"> <li>◆ Community impacts during implementation.</li> <li>◆ Impact on workers and the effectiveness and reliability of protective measures.</li> <li>◆ Environmental impacts during implementation and the effectiveness and reliability of mitigating measures.</li> </ul>
Implementability	<ul style="list-style-type: none"> <li>◆ Technical feasibility including technical difficulties and unknowns in construction and operation, reliability, ease of replacement or augmentation, and ability to monitor effectiveness.</li> <li>◆ Administrative feasibility, including the need to coordinate with other agencies and ability and time required for permits and approvals.</li> <li>◆ Availability of services, materials, equipment, and specialists.</li> </ul>
Cost	<ul style="list-style-type: none"> <li>◆ Indirect and direct capital costs.</li> <li>◆ Annual operation and maintenance.</li> <li>◆ Net present value.</li> </ul>



## Modifying Criteria

The two other criteria that are used to evaluate potential alternatives are state and community acceptance. State and local community acceptance may not be evaluated fully until the proposed plan is published and public review is completed during the remedy selection step. State and community acceptance are important factors that may result in the selection of a less desirable (i.e., less desirable in terms of the Threshold and Balancing Criteria) remedial alternative for a site.

## 10.5 Development of Preliminary Remediation Goals and Final Remediation Levels

### 10.5.1 PRELIMINARY REMEDIATION GOALS AND FINAL REMEDIATION LEVELS

Preliminary Remediation Goals (PRGs) are developed to quantify the standards (i.e., chemical-specific media concentrations) that selected remedial alternatives must meet, to achieve the Threshold Criteria stipulated in the NCP (i.e., overall protection of human health and the environment and compliance with ARARs). The NCP [300.430(e)(2)] states that:

Remediation goals shall establish acceptable exposure levels that are protective of human health and the environment and shall be developed by considering the following:

(A) Applicable or relevant and appropriate requirements ..., and the following factors:

- (1) For systemic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety;
- (2) For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between  $10^{-4}$  and  $10^{-6}$  using the information on the relationship between dose and response. The  $10^{-6}$  risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of multiple contaminants at a site or multiple pathways of exposure...

PRGs are developed early in the site evaluation process for each chemical and media of concern. These values are typically calculated based on a hazard quotient of 1 and a cancer risk of  $1E-06$ . Tier IA and Tier IB risk-based screening concentrations (RBCs) may be used to develop PRGs (see Chapter 7 – Tier IA and Tier IB Risk-Based Screening for more information). However, when Tier IA RBCs are used to develop PRGs, the conceptual site model should be compared with the assumptions used to develop the RBCs, to ensure that they are consistent. If they are not, then site-specific PRGs should be developed (this approach is similar to developing site-specific RBCs in Tier IB).

PRGs may be modified as additional information becomes available during the site evaluation process. For example, the results of the Tier II BHHRA are typically used to refine the PRGs based on site-specific factors (e.g., land use, exposure, and uncertainty). Cumulative risks (i.e., the risks associated with exposure to multiple chemicals and multiple media) are also considered and used to modify the PRGs to ensure that the cumulative risks at a site are consistent with the target risks identified in the NCP. Consequently, the PRGs developed early in the process may be adjusted downward (i.e., made more protective), to account for exposures to multiple chemicals and/or media.

*Note: PRGs and RBCs are developed using similar approaches and assumptions and yet their purposes are different. PRGs are chemical- and media-specific concentration goals for a site that are used during analysis and selection of remedial alternatives. PRGs are similar to RBCs in that they are developed*



*based on conservative exposure assumptions and target risk goals. However, PRGs differ from RBCs in that they may be adjusted downward or upward based on site-specific information (e.g., cumulative risks associated with multiple chemical exposures and ARARs). RBCs are chemical- and media-specific concentrations used to determine whether or not a site poses a risk to human health. If it is determined that a site poses a risk to human health, then PRGs are developed, often initially based on the RBCs, to provide the remedial design staff with long-term target cleanup goals to assist in the selection of remedial alternatives.*

Final Remediation Levels (FRLs) are chemical- and media-specific remediation levels that are to be attained at the site after implementation of the remedy is complete. FRLs are documented in the ROD for a site and are developed using the PRGs identified during the RI/FS process. However, it is important to note that regardless of the approach used to develop and refine the PRGs, the FRLs may differ substantially from the PRGs because of modifications resulting from consideration of uncertainties, technical limitations, exposure factors, as well as from all nine remedy selection criteria outlined in the NCP.

### **10.5.2 KEY CONSIDERATIONS FOR DEVELOPING PRELIMINARY REMEDIATION GOALS AND FINAL REMEDIATION LEVELS**

Presented below are a variety of key factors that should be considered by RPMs when evaluating PRGs and potential FRLs.

- ◆ **Current and Future Land Use** – Land use plays an important part in developing PRGs and FRLs for a site. For example, risk-based PRGs for residential land use sites will typically be more protective (i.e., the chemical and media-specific concentrations will be lower) than risk-based PRGs for industrial land use sites. USEPA guidance states, "...the most appropriate future land use for a site should be selected so that the appropriate exposure pathways, parameters, and equations can be used to develop risk-based PRGs (USEPA, 1991a)." Consequently, residential land use should not be assumed for every site. Other land uses, such as industrial, recreational, and agricultural, should be used to develop PRGs and FRLs, if appropriate. In general, future land use assumptions should be based on current land use conditions. In instances where it is difficult to use current land use to predict future land use (e.g., a vacant lot), the RPM should consult base master development plans and other land use planning documents to assist in determining the most plausible future land use for a site. It is important to note that if the appropriate future land use for a site is not residential, then typically it will be necessary to implement institutional controls (e.g., a deed restriction) and perform long-term monitoring at the site.
- ◆ **Institutional Controls** – PRGs and FRLs should reflect institutional or engineering controls that are part of the remedy. For example, if a deed restriction is in place that limits land use to commercial purposes, then PRGs and FRLs should be based on a conceptual site model (CSM) that reflects this land use. Another example is an engineering control, such as a cap, that would eliminate or severely reduce potential exposure to COCs. The PRGs and FRLs should be based on a CSM that reflects the implementation of the engineering control.
- ◆ **Site-Specific Background Concentrations** – Site-specific background concentrations of chemicals should be used during the Tier I and Tier II risk evaluations to eliminate chemicals that are present at or below background concentrations from further consideration in the risk assessment. However, in some situations this step may have been omitted. Therefore, it is important that the PRGs and FRLs are compared to background concentrations to ensure that they are not below background.
- ◆ **Multi-Media Fate and Transport Issues** – The conceptual site model should be re-evaluated during the remedy selection process to determine if PRGs or FRLs need to be developed for



media that may not have been evaluated, or were determined to not be of concern, in the Tier I or Tier II risk evaluations. For example, the results of the BHHRA may have indicated that, for a site with soil and groundwater issues, exposures to soil were of concern while exposures to groundwater were not of concern. In this instance, PRGs and FRLs would be developed for exposures to soil and not to groundwater. However, in some cases, potential migration of contaminants in soil to groundwater may be of concern and should be considered when developing the PRGs and FRLs for soil.

- ◆ **Risk Goals** – For chemicals lacking Maximum Contaminant Levels (MCLs) or non-zero Maximum Contaminant Level Goals (MCLGs), PRGs and FRLs should be established at concentrations that achieve 1E-06 excess cancer risk or a hazard quotient of 1 (for noncarcinogens), modified as appropriate based on exposure, uncertainty, and technical feasibility factors. It should be noted, however, that the risk goals identified in the NCP, and further clarified in the USEPA Memo “*Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*,” are not discrete values that, if exceeded, automatically indicate that remedial action is warranted at a site (USEPA, 1991c). For example, a site with a cumulative cancer risk greater than 1E-04 may be considered protective of human health based on site-specific conditions and, therefore, remedial action would not be warranted. Conversely, in other situations a site with cumulative cancer risk less than 1E-04 may not be considered protective of human health and, therefore, remedial action would be warranted.
- ◆ **Multiple Descriptors of Risk** – RPMs and other decision makers should incorporate multiple risk descriptors, such as the Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) risk estimates from a Tier II BHHRA or Probabilistic Risk Assessment (PRA), to assist in developing PRGs and FRLs for a site. This is consistent with USEPA Policy, which states, “Information should be presented on the range of exposures derived from exposure scenarios and on the use of multiple risk descriptors (e.g., central tendency, high end of individual risk, population risk, important subgroups, if known) consistent with the guidance on Risk Characterization, Agency risk assessment guidelines, and program-specific guidance. In decision-making, risk managers should use information appropriate to their program legislation (USEPA, 1994).”

## 10.6 Impact of Ecological PRGs

The first of the nine evaluation criteria identified in the NCP for analysis of remedial alternatives states that the remedial alternative shall be protective of human health and the environment. Consequently, ecologically-based PRGs should also be considered along with human health-based PRGs and ARARs, when evaluating remedial alternatives at a site. Ecologically-based PRGs may impact the selection of a remedial alternative at some sites because the ecologically-based PRGs may be lower (i.e., more protective) than their corresponding human health-based PRGs (e.g., copper). See the *Navy Guidance on Performing Ecological Risk Assessments* for more information on developing ecological PRGs: <http://web.ead.anl.gov/ecorisk/>.

## 10.7 Site Closeout and Long-Term Monitoring

### 10.7.1 RISK EVALUATIONS AFTER REMEDY SELECTION

After the remedy has been implemented, the Site Closeout phase begins. During this phase additional RERAs may be needed to determine if the remedy has achieved the goals identified in the ROD. This may include an evaluation of media, chemicals, exposed populations, and exposure pathways that were not originally considered in the initial risk assessment or previous risk evaluations. However, the USEPA suggests that risk evaluations may not be needed at every site, and that if an evaluation is necessary, then it may be qualitative or quantitative in nature. The guiding principle is that risk evaluations after the



FS should be conducted as necessary to ensure that the remedy is protective (USEPA, 1991b). Additionally, whenever possible, risk information generated early in the process (e.g., BHHRA results) should be utilized in order to minimize the level of effort.

### 10.7.2 RISK EVALUATION DURING REMEDIAL DESIGN AND REMEDIAL ACTION

The activities that occur during remedial design and implementation may require consideration of human health risks in order to monitor short-term risks, evaluate attainment of FRLs in the ROD, and/or evaluate residual risks.

#### Short-Term Risks

If short-term risks are a concern at a site, then it may be necessary to develop a sampling plan and sample potentially-affected media to quantify the short-term risks. The short-term risks should be evaluated using short-term (i.e., subchronic or acute) toxicity criteria based on actual exposure scenarios.

#### Confirmation Sampling

Depending on the type of remedial alternative selected for a site, confirmation sampling may take place once the remedy has been implemented to ensure that the site complies with the FRLs identified in the ROD. The sampling plan should identify chemicals that will be evaluated and the statistical methodology that will be used to evaluate compliance.

#### Residual Risk

It also may be necessary to evaluate the residual risk at a site after the remedy has been implemented. For example, the residual risk may be evaluated using the BHHRA but substituting the final confirmation sampling results for the earlier data. The residual risk evaluation should take into account any differences from the BHHRA including:

- ◆ new chemicals that were not identified during the BHHRA or that were introduced as part of the remediation process;
- ◆ any land use changes; and
- ◆ changes in toxicity values (USEPA, 1991b).

If institutional or engineering controls have been implemented, then it is important to document that either there are incomplete exposure pathways or that the residual risks are acceptable based on the controls in place.

### 10.7.3 FIVE-YEAR REVIEW

Remedies that result in hazardous substances remaining at the site are reviewed at least every five years after the initiation of the remedies. The two types of five-year reviews are statutory and policy. Statutory reviews are completed for sites where hazardous substances are present above levels that allow for unlimited use and unrestricted exposure. These generally include sites with remedies requiring access or land use restriction controls (i.e., remedies that achieve protectiveness through the use of engineering or institutional controls). Policy reviews are conducted for:

- 1.) sites with remedies that require five years or longer (i.e., long-term) to achieve levels that would allow for unlimited use and unrestricted exposure; or
- 2.) sites where the remedies were selected before the Superfund Amendments Reauthorization Act (SARA), and where hazardous substances are present above levels that allow for unlimited use and unrestricted exposure.

Statutory reviews may be discontinued only if levels of hazardous substances fall permanently to a point that would allow unlimited use and unrestricted exposure. Policy reviews should be discontinued when the remediation goals specified in the ROD are achieved, assuming these levels allow for unlimited use and unrestricted exposure (USEPA, 1991b).



## 10.8 References

- USEPA. 1991a. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Interim. Office of Emergency Response, Washington, D.C. Publication 9285.7-01C.  
<http://www.epa.gov/superfund/programs/risk/ragsb/index.htm>.
- USEPA. 1991b. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives). Interim. Office of Emergency Response, Washington, D.C. Publication 9285.7-01C.  
<http://www.epa.gov/superfund/programs/risk/ragsc/index.htm>.
- USEPA. 1991c. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, D.C. OSWER Directive 9355.0-30.  
<http://www.epa.gov/superfund/programs/risk/baseline.htm>.
- USEPA. 1994. EPA Risk Characterization Program, Policy for Risk Characterization, Guidance For Risk Characterization. Carol Browner Memorandum.
- USEPA. 1997. Rules of Thumb for Superfund Remedy Selection. Office of Solid Waste and Emergency Response, Washington, DC 20460. OSWER 9355.0-69. EPA 540-R-97-013. PB97-963301.  
<http://www.epa.gov/superfund/resources/rules/index.htm>.
- USNAVY. 2001. Navy/Marine Corps Installation Restoration Manual (Draft) 2001 Update. Naval Facilities Engineering Command, Alexandria, VA.  
[http://enviro.nfesc.navy.mil/erb/erb\\_a/restoration/ir\\_manual/Default.htm](http://enviro.nfesc.navy.mil/erb/erb_a/restoration/ir_manual/Default.htm).