FEASIBILITY STUDY REPORT
ANNOTATED OUTLINE
CONTENTS

ACRONYMS

ARAR	applicable or relevant and appropriate requirement
BLRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
FS	Feasibility Study
NEPA	National Environmental Policy Act
PRG	preliminary remediation goal
RAO	remedial action objective
RI	remedial investigation
ROD	Record of Decision
TBC	to be considered

This annotated outline was written to be used as a guide for preparation of Feasibility Study (FS) reports under the U.S. Department of Energy (DOE) Oak Ridge Operations Environmental Management program. This document addresses preparation of an FS report for a particular project; study area; operable unit; watershed; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) area; or release site, hereinafter referred to as the "site." This outline has not been approved by the Environmental Protection Agency or the Tennessee Department of Environment and Conservation and may be modified to meet their needs.

EXECUTIVE SUMMARY

An executive summary must be included in all FS reports. The executive summary appears on a separate page or pages in the front matter of the document and briefly summarizes the overall FS process, alternatives considered, and results of the evaluation of those alternatives. The executive summary should be on blue paper.

1. INTRODUCTION

Chapter 1 should include background information and a description of the purpose and organization of the report. The background information, which is summarized from the remedial investigation (RI) report, includes site description, history, nature and extent of contamination, contaminant fate and transport, and a summary of the Baseline Risk Assessment (BLRA).

1.1 PURPOSE AND ORGANIZATION OF THE STUDY

Specify in this section the underlying purpose and need for the study, providing introductory background information and a statement of the problem to be solved. Introduce the decision to be made as a result of the FS evaluations, and how that decision is related to other decisions within the watershed. Describe how the results will be used in developing a Proposed Plan and Record of Decision (ROD) for the site. Cite the DOE-Oak Ridge policy concerning CERCLA/National Environmental Policy Act of 1969 (NEPA) integration. Finally, discuss the report's organization and the content of each chapter.

1.2 SITE BACKGROUND

Reference and briefly summarize corresponding chapters of the RI report.

1.2.1 Site Description

Include a map showing the site's general location and surrounding features. Briefly explain the location of the site with respect to other features in the area. Include population and commercial centers, parks, schools, and agricultural areas within a 5-mile radius (or other radius, as appropriate), as well as major roads, highways, railroads, federal facility boundaries, ecological communities, and surface water bodies. Discuss the vegetation and wildlife in the surrounding area. Provide descriptions of the physical condition of the site, including topography, geology, surface water and groundwater hydrology, rainfall,

and atmospheric conditions, as well as current land uses, waste types, and estimates of waste volume. Also discuss potential cultural resources on the site.

1.2.2 Site History

Discuss the history of facility operations, including any ownership changes; the types and volumes of waste(s) produced, disposed of, or handled; remedial investigations and cleanup actions that have taken place; and regulatory background. Present the historical management practices of the facility.

1.2.3 Nature and Extent of Contamination

Discuss contaminants detected at the site. List contaminants and their concentrations for comparison to background values, preliminary remediation goals (PRG), or applicable or relevant and appropriate requirements (ARARs) for all media. Also discuss approximate boundaries of contaminant plumes if they can be determined. Present any information pertinent to soils and vadose zone characteristics, groundwater, surface water, and sediments. In particular, discuss any source materials present and any principal threat(s).

1.2.4 Contaminant Fate and Transport

Describe potential contaminant pathways through which the pollutant(s) can move. These pathways may include atmospheric dispersion, physical contact, surface water runoff, and groundwater migration. To support this section, summarize the conceptual model developed in the RI report. Provide a graphic illustration of sources, releases, contaminated media, migration pathways, "intermediate" media, exposure pathways, and receptors (human and environmental). Use analytical or numerical modeling to describe contaminant migration and transfer. Identify factors affecting the contaminant's movement and persistence.

1.2.5 Summary of BLRA

Summarize the contaminants of concern and the predominant exposure pathways to human and environmental receptors presented in the RI report. If any ecological assessments were developed during the risk assessments, summarize those conclusions. Summarize the risk for the most likely future land use, but ensure residential risk results are mentioned so that appropriate land use controls can be applied.

1.3 SUMMARY OF EXPECTED CONDITIONS AND REASONABLE DEVIATIONS

Discuss the management of uncertainties in the FS process to support decision making in the ROD. Emphasize that uncertainty is inherent in all hazardous and radioactive waste management. Indicate that the uncertainties have been bounded sufficiently in the site conceptual model (1) to allow meaningful description of the most probable site conditions and reasonable variations in those conditions, and (2) to develop and compare alternative remediation approaches to adequately mitigate the hazards to receptors posed by the site. Uncertainties will be addressed in the ROD through identification of base actions to address the most probable conditions and contingent actions to address reasonable deviations from those conditions.

Discuss the site conceptual model in terms of expected conditions and potential deviations. Any assumptions used in developing the conceptual model that cannot be confirmed establish the basis for identifying conceivable or reasonable deviations. A strategy for monitoring these potential deviations should be discussed and used to develop contingent remedies.

1.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CERCLA 121(d)(2)(A) and 40 *CFR* 300.430(c)(9)(iii)(B) requires that remedial actions comply with or waive any identified ARARs. Three types of ARARs must be considered during the alternatives analysis: chemical-specific, location-specific, and action-specific. In this section, present a list of chemical- and location-specific ARARs/to be considered (TBC). If the FS is part of a concurrent RI/FS submittal, chemical- and location-specific ARARs do not need to be repeated here. Action-specific ARARs will be developed in Sect. 3.2 in conjunction with alternative development. ARARs will be discussed again in Sect. 4.2 when the alternatives are evaluated against the selection criteria to verify compliance with ARARs.

1.5 PRELIMINARY REMEDIATION GOALS

Discuss the PRGs identified in the RI report. PRGs consist of medium-specific or site-specific chemical concentrations that are considered safe for human health and the environment.

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This chapter summarizes the identification and screening of technologies based on the RI report characterization findings.

2.1 INTRODUCTION

Provide a general description of the process used to identify and screen technologies on the basis of investigation information gathered, including, but not limited to, the nature and extent of contamination, the potential contaminant fate and transport, and the BLRA results.

2.2 REMEDIAL ACTION OBJECTIVES

Discuss the remedial action objectives (RAOs), which include both a contaminant level (remediation goal) and an exposure route, recognizing that protectiveness may be achieved by reducing exposure as well as reducing contaminant levels. Discuss the points of compliance for attaining the RAO for the appropriate environmental media. The RAOs should specify contaminants of concern, exposure route(s) and receptors, and an acceptable contaminant level for each exposure route (i.e., a remediation goal). The RAOs will also address natural resources. A single set of RAOs can be developed for all alternatives, or a range of RAOs can be developed to derive a range of alternatives.

2.3 GENERAL RESPONSE ACTIONS

Identify the categories of response actions that satisfy the RAOs (e.g., treatment, containment, removal, disposal, institutional controls, or some combination of these). Define the site areas, and provide estimates of areas or volumes to which action may be applied to meet the RAOs.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

Identify and perform a two-step screening process on process options. First, eliminate nonapplicable options. Then, select representative process options for each medium of concern based on effectiveness, technical implementability, and cost. Technologies are eliminated if not applicable to site conditions including types of contaminants and physical setting. Present justifications for retention or elimination of technologies or process options for further analysis. For large complex sites, much of this work can be relegated to an appendix.

3. DEVELOPMENT OF ALTERNATIVES

This chapter discusses the process used to develop viable alternatives. As required by NEPA and CERCLA, the no-action scenario will receive full consideration. No action is typically defined as the cessation of all existing protective controls. Besides the no-action alternative, different levels of containment and treatment will be evaluated. Base and contingent actions will be developed for each alternative so that uncertainties will be addressed. Results from bench scale and treatability studies will be discussed, if appropriate, to bound the uncertainties. Specific monitoring requirements will be delineated as an indicating mechanism for defining the need for contingent action during implementation of remedial action.

3.1 DEVELOPMENT AND SCREENING OF ALTERNATIVES

To develop the appropriate range of alternatives, consider the key questions that must be answered. For instance, what land use should be selected? What is the appropriate level of protection for groundwater? Where is the final disposal location? Potential answers to these questions serve as the basis for each alternative. Combine these answers appropriately with varying remediation strategies (source control versus migration control; containment versus treatment) to develop the alternatives.

Combine those technologies that passed the initial screening process into reasonable alternatives for the site. In addition to the no-action alternative, a limited action alternative, which may include monitoring and institutional controls, may also need to be evaluated in order to provide a range of alternatives.

If appropriate, evaluate the alternatives developed in this section for effectiveness, implementability, and cost. The result will be a range of viable alternatives that can be evaluated further.

3.2 SUMMARY OF ACTION-SPECIFIC ARARs FOR EACH ALTERNATIVE

Identify the action-specific ARARs for each remedial action alternative developed that remains after the optional alternative screening. Each alternative will be evaluated for compliance with these ARARs in Chap. 4. Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and remedial activities.

3.3 DETAILED DESCRIPTION OF ALTERNATIVES

Describe components common to the range of alternatives being considered. This will reduce redundancy in the discussion of alternatives. Insert the following or similar text in the discussion of common components of all action alternatives:

> The DOE and its contractors will systematically integrate safety into management and work practices at all levels so that the implementation of the remedial actions is accomplished while protecting the public, the worker, and the environment. This will be accomplished through effective integration of safety management into all facets of work planning and execution.

Further develop those alternatives that are retained as feasible options following the analysis in Sect. 3.1. Develop the alternatives with enough detail so that they can be analyzed in relation to the criteria in Sect. 4.1. Costs and implementability evaluations will typically require a significant level of detail.

Identify the required land use controls for each alternative and describe their purpose, duration, implementation, and affected areas using the attached summary tables as appropriate. [Note: will add tables 2.32 and 2.33 from the Bethel Valley ROD as examples]

Discuss the management of uncertainties in the FS to support decision making in the ROD. Describe the base actions under each remedial alternative that would be used to address the most probable site conditions, and describe the contingent actions that would be used to address reasonable deviations from those conditions and uncertainties. A monitoring strategy to detect deviations is a critical part of each alternative.

4. DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives presented in this chapter consists of analysis and presentation of relevant information needed to allow decision makers to select a site remedy but does not include the decision-making process itself. The evaluation criteria will be described in Sect. 4.1, and each alternative will be assessed against those criteria in Sect. 4.2. The results of this assessment are then arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives is designed to provide decision makers with sufficient information to compare the alternatives adequately, select an appropriate remedy for the site, and demonstrate in the ROD that the remedy selection requirements of CERCLA have been satisfied.

4.1 CRITERIA FOR ANALYSIS

In this section, identify the regulatory criteria to be used for the detailed analysis of each alternative. Include the nine CERCLA criteria and NEPA considerations outlined below.

Alternatives will be evaluated with respect to NEPA values. Sufficient assessment of the various impacts that alternatives have on NEPA values need to be conducted so that an accurate evaluation can occur. As part of the alternative description, include information about how the alternative impacts the environment, local economy, and various resources. Then as part of the alternative evaluation, each alternative is assessed against its impact on these resources and other values. The evaluation against

NEPA values should be in a separate section, even if it duplicates information that can be found under CERCLA criteria.

Threshold Criteria

1. Overall protection of human health and the environment
2. Compliance with ARARs, unless a waiver condition is met

Primary Balancing Criteria

3. Long-term effectiveness and permanence, including

    - magnitude of residual risk
    - adequacy and reliability of controls
    - environmental impacts

4. Short-term effectiveness, including

    - protection of community during remedial actions
    - protection of workers during remedial actions
    - time until RAOs are achieved
    - environmental impacts, refer to NEPA criteria

5. Reduction of toxicity, mobility, or volume by treatment, including

    - treatment process used and materials tested
    - amount of hazardous materials destroyed or treated
    - degree of expected reduction in toxicity, mobility, or volume
    - degree to which treatment is irreversible
    - type and quantity of residuals remaining after treatment

6. Implementability, including

    - ability to modify the technology during implementation based on contingency monitoring
    - ability to construct and operate the technology
    - reliability of the technology
    - ease of undertaking any needed additional remedial actions
    - ability to monitor remedial effectiveness
    - ability to obtain approvals from other agencies
    - coordination with other agencies
    - availability of off-site treatment, storage, and disposal services and capacity
    - availability of necessary equipment and specialists
    - availability of prospective technologies

7. Cost, including

    - capital costs
    - operating and maintenance costs (annual costs)
    - long term institutional controls
    - periodic costs (5-year reviews, replacement costs)

- present worth cost
- non-discounted constant dollar comparison of alternatives for >30 years remediation

Modifying Criteria[1]

8. State acceptance

9. Community acceptance

NEPA Considerations

NEPA values that should be addressed in most alternative evaluations include:

- Socioeconomic impacts,
- Threatened and Endangered Species impacts,
- Natural Resources/Wetlands/Ecological impacts,
- Archaeological/Cultural impacts,
- Geological/Soils/Groundwater Resources impacts,
- Transportation,
- Climate/Meteorology/Air Resources impacts,
- Land Use,
- Cumulative Impacts,
- Surface Water/Water Quality,
- Environmental Justice,
- Unavoidable Adverse Impacts, and
- Irreversible/Irretrievable Commitment of Resources.

In some circumstances, other NEPA values may need to be evaluated. The regulations should be reviewed to determine applicability of other values.

4.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

Provide a detailed analysis of each alternative based on the criteria listed in Sect. 4.1. Present an explanation of the cleanup level expected to be achieved using each technology or alternative.

Perform a sensitivity analysis of the cost calculations to evaluate the effects of changing assumptions. Other types of contingencies that may be applicable in evaluating costs include an increase in the volume of soil or waste that must be handled or disposed; an increase in flow rate from recovery wells or volume of water required for treatment or the need for iron-removal or other additional treatment measures; and an increase in the number of recovery wells required to achieve containment and recovery of a groundwater plume. Each of these factors may have an enormous impact on the life cycle cost and the resulting cost-effectiveness of a given alternative. The sensitivity analysis evaluates the worst-case scenario for each approach and then estimates the resulting effect on capital, operations, maintenance costs, and implementability.

[1] These criteria will be addressed following receipt of a response to public comments and will be addressed in the ROD.

Organize this section by alternative and then by criteria. Present NEPA considerations as a separate criteria, clearly labeled.

Include a schedule for implementation, preliminary equipment specifications and material list, and a preliminary design of the component systems in the description of the recommended alternative. Ensure the description is detailed enough to allow an individual with no knowledge of the engineering evaluation/cost analysis to understand the workings and function of each of the components.

4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

Include a table listing of all the alternatives and the degree to which each alternative satisfies the criteria. Perform a comparison of the different alternatives. These comparisons become the rationale for selecting a preferred alternative and preparing the Proposed Plan.

5. REFERENCES

Include a list of references used to develop the FS in the format shown here. The following are general references for inclusion in an FS report.

40 *CFR* Pt. 300, National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

42 U.S.C. § 7401 et seq., Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986.

U.S. Department of Energy (DOE) 1993. *Remedial Investigation/Feasibility Study (RI/FS) Process, Elements, and Techniques Guidance*, DOE/EH-9400, December.

U.S. Environmental Protection Agency (EPA) 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (Interim Final), EPA/540/G89/004, Office of Emergency and Remedial Response, October.

U.S. Environmental Protection Agency (EPA) 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, EPA 540-R-00-002, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response and U.S. Corp of Engineers, Hazardous, Toxic, and Radioactive Waste Center of Expertise, July.