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DRAFT OUTLINE

METHODOLOGY FOR RISK-BASED EVALUATION OF REMEDIAL ALTERNATIVES AT THE HANFORD SITE

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide the methodology for conducting risked-based evaluations of remedial alternatives at the Hanford Site. Risk assessment is conducted as part of the feasibility study (FS) to support screening and detailed evaluation of remedial alternatives at sites evaluated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA). This methodology will be used to evaluate human health and ecological risk associated with alternatives for remediation of Hanford operable units during and following the feasibility study (FS). In contrast to the baseline risk assessment, risk assessment for remedial alternatives must address not only long-term risk but also short-term risks associated with implementation of the remedial alternatives.

1.2 CONTEXT

The methodology described in this document is partially based upon the "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives)" (EPA, 1991). The EPA guidance document does not address ecological risk assessment of remedial alternatives. The methodology provided in this document will include guidance for conducting ecological risk assessments of remedial alternatives. The methodology is also based on the "Hanford Site Baseline Risk Assessment Methodology, Revision 2" [(HSBRAM) DOE-RL 91-45 (DOE-RL 1993)] and the "Framework for Ecological Risk Assessment" (EPA 1992).

Risk assessment of remedial alternatives is used at several points in the CERCLA site remediation process:

- Risk is part of the effectiveness criteria used to screen alternatives (Phase II FS).
- Detailed consideration of risks is a key element in the full evaluation of alternatives (Phase III FS).
- Risks for the selected alternative (as well as risk trade-offs identified during the FS evaluation) are documented in the record of decision (ROD), and the risk assessment is updated to reflect any changes from the FS.
- The FS/ROD risk assessment is updated as needed to reflect changes or new information during final design and implementation of the

selected remedy.

- The risk assessment for the remedy must be updated every 5 years as part of the required periodic reassessment of the remedy's effectiveness.

  [Provide flowchart showing above]

Risk assessment of remedial alternatives is most important during the detailed evaluation of remedial alternatives. Three of the seven criteria for evaluation of remedial alternatives are directly related to risk (overall protection of human health and the environment, long- term effectiveness, and short-term effectiveness). ARARs are often based on risk considerations (e.g., MCLs). Reduction in toxicity, mobility or volume is also indirectly related to risk, as the basis for the criteria is that the reduction is presumed to reduce long-term risks. However, this document only addresses assessment of long-term and short-term risk; the interdependence of the criteria should be considered during the FS evaluation and alternative selection.

- The methodology provided in this document is an approach for using a variety of risk assessment tools. A "cookbook" approach is not appropriate.

- The overall framework of detailed evaluation of remedial alternatives determines the importance of each criteria and the appropriate level of effort. Therefore, the appropriate level of effort in risk assessment of remedial alternatives depends on 1) how critical the risk assessment is to the decision (generally always important), and 2) the uncertainties in the *relative* risk of alternatives.

- Often, relative risk between alternatives can be assessed qualitatively with greater certainty than assessment of the absolute risk of a single alternative. Examples will be provided to illustrate.

- Quantitative risk assessment is necessary when qualitative assessment is insufficient for remedy selection.

- Iterative risk assessment and alternative evaluation is needed.

  [Provide flowchart showing interactive risk assessment and evaluation.]

2.0 IDENTIFICATION OF RISKS AND EXPOSURE ASSESSMENT

- Long-term risks are those that remain following completion of remediation.

- Short-term risks are those that result (directly or indirectly) from performing remedial actions.

Much of the information to support risk assessment of remedial alternatives may be available from the baseline risk assessment, including:

- future land use
- contaminants of concern
- exposure pathways
- uptake considerations (rates, duration, etc.)
- toxicity information
- calculation of risk
- uncertainties

For example, many of the exposure pathways identified in the baseline risk assessment will be the same after implementation of remedial alternatives. However, other information may be necessary to assess risks that are not considered in the baseline risk assessment. The baseline risk assessment will be revised to account for effects of the remedial alternatives (e.g., institutional controls, excavation, treatment, containment).

2.1 HUMAN HEALTH RISK

2.1.1 Long-Term Human Health Risk

- direct exposure
- excavation of contaminated materials
- wind erosion and dispersion of contaminated materials
- biological intrusion (plant and animal)
- migration of contaminants to groundwater
- migration of contaminants to surface waters (e.g., river)
- migration of contaminants to the food-chain

2.1.2 Short-Term Human Health Risk

2.1.2.1 Risk to Public

- air releases (usually dust)
- increased infiltration and/or surface water runoff
- transportation releases (non-transportation risks can usually be minimized by proper design and planning)

2.1.2.2 Risk to Workers

- air releases (usually dust)
- direct exposure to workers
- excavation hazards
- general construction hazards
- chemical exposure and physical hazards associated with a treatment facility
- address effectiveness of worker protection measures

2.2 ECOLOGICAL RISK

2.2.1 Long-Term Ecological Risk

- direct exposure
- biological intrusion
- migration to the river
- long-term habitat destruction

2.2.2 Short-Term Ecological Risk

- habitat destruction
- wildlife disturbance

3.0 QUALITATIVE RISK ASSESSMENT

- Qualitative assessments of relative risks are used in screening alternatives. Where quantitative risk assessment would be needed to screen out an alternative, the alternative is carried into detailed development and evaluation. Qualitative risk assessment may be sufficient for detailed evaluation of alternatives.

- The alternative screening phase of the FS should only identify significant or exceptional risks associated with each remedial alternative.

- Qualitative risk assessments will rely upon common sense, professional judgement, comparison with the baseline risk assessment, comparisons with ARARs, information from analogous facilities and or operations.

- Examples will be provided to illustrate what type of risks are considered significant and the use of relative risks (risk comparison) in choosing between alternatives.

3.1 LONG TERM RISK

- The ability of the alternative to address the significant exposure pathways identified in the baseline risk assessment and achieve remediation goals.

- The potential for the alternative to increase risk associated with one or more pathways.

- The risk associated with any residual contamination

- The risk to both human and ecological receptors will be addressed.

3.2 SHORT TERM RISK

- Risks to workers and the public resulting from handling contaminated materials (i.e., excavation, treatment, transportation).

- The risks to workers and the public resulting from handling treatment wastes.

- The potential for significant disruption of habitat and/or natural resources.

4.0 QUANTITATIVE RISK ASSESSMENTS

4.1 GUIDELINES FOR DECIDING BETWEEN A QUANTITATIVE APPROACH AND A QUALITATIVE APPROACH

- Quantitative risk assessments are conducted as needed during detailed evaluation of remedial alternatives.

- A quantitative approach may be necessary when the alternatives appear to be closely ranked in terms of preference, and qualitative assessment of the relative short-term and long-term effectiveness has too much uncertainty for selection.

- A quantitative approach may be warranted to address perceptions of high risk (e.g., from public involvement). Factors that may result in elevated perceived risk include:

  - close proximity of population
  - presence of highly toxic chemicals
  - technologies with high release potential
  - high uncertainty regarding technology
  - multiple pathways or contaminants affecting same individual
  - multiple releases occurring simultaneously
  - multiple releases from nearby operable units
  - releases occurring over a long time
  - A quantitative risk assessment may not be warranted or may not be possible (within schedule constraints) if risk data are not readily available.

4.2 HUMAN HEALTH RISK

4.2.1 Long-Term Human Health Risk

- Human risk associated with contaminated materials remaining after remediation (including treatment wastes) will be assessed using the same methods as for the baseline risk assessment.

- Deterministic and/or probabilistic methods can be used to assess the impact of institutional control failure, containment degradation, and

treatment reversal.

4.2.2 Short-Term Human Health Risk

4.2.2.1 Public Risk

- Normal operational releases to air and water would be quantified, including rate and duration.
- Accidents (e.g., explosions, spills, equipment failure of pollution control devices) that result in releases to air and water will be quantified, including occurrence rate, and quantity released.
- The migration of the release to the point of exposure would be modeled.
- Toxicity and risk would be determined.
- Potential mitigating actions will be identified.
- Sources for necessary information will be provided.

4.2.2.2 Worker Risk

- Normal operational chemical and radiological exposure will be quantified.
- Accidents (e.g., explosions, spills, equipment failure of pollution control devices) that result in releases to air and water will be quantified, including occurrence rate, quantity released, and worker exposure.
- Toxicity and risk would be determined.
- Physical hazards will be quantified (rates of serious injury and death at construction sites).
- Potential mitigating actions will be identified.
- Sources for necessary information will be provided.

4.3 ECOLOGICAL RISK

4.3.1 Long-Term Ecological Risk

— Need to talk about ECO here just as in ECO

- direct exposure
- biological intrusion
- migration to the river
- long-term habitat destruction
- Long-term ecological damage may be difficult to quantify.

4.3.2 Short-Term Ecological Risk

Habitat and wildlife disturbance will be quantified in terms of area, duration, and degree (i.e., partial to total disturbance). For example, excavation or capping may completely destroy the habitat, while well drilling will only destroy 20 percent of the habitat.

5.0 RISK ASSESSMENT DURING AND AFTER DESIGN AND IMPLEMENTATION OF REMEDIAL ALTERNATIVES

- The proposed plan for remediation should summarize the risk assessment.
- The ROD should contain the results of the risk assessment for the preferred alternative.
- Any significant changes to the risk assessment during remedial design and implementation should be documented in a memorandum.
- Each five-year review should provide a revised risk assessment if it has changed.
- The methodology will focus on how to update the risk assessment within these contexts.

6.0 SUMMARY

7.0 REFERENCES