Appendix II-B

How Good the Impact Assessment Results Must Be

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The requirements in this appendix call for the assessment to be performed in accordance with the principles of fidelity, dominance, and management of uncertainty as specified in the Principles and General Requirements section. As used here, fidelity carries the same meaning that it does in high fidelity sound reproduction. It expresses the faithfulness of reproduction of the actual performance without adding distorting noise or bias which may obscure the more delicate but crucial sounds. To be useful for addressing public and regulator concerns, the assessment results must have acceptable fidelity, in other words, an acceptably low level of error, distortion, and bias. Idealized Hanford impact simulations must be shown to capture the essential factors of the actual situation. Fidelity also must encompass the lowest impact levels of concern to stakeholders and regulators.

Applying the principle of dominance requires the selection of the largest contributors to contaminant impact from among the demonstrably complete set of candidates specified in Appendix II-A. All potentially harmful Hanford-derived materials and contaminants must be included as candidates. This appendix specifies that the most dominant must be selected as contaminants of concern.

Consistent treatment of uncertainty throughout the assessment is indispensable to controlling quality or how good the impact assessment must be. For example, inattention to uncertainty of some field data collection effort may relegate all the assessment's data to unacceptably poor levels. Fidelity of assessment results could become so poor because of uncertainties in just one area of the assessment that actual impact to some receptors may be obscured.

An overview of the requirements in this appendix is:

(B0.0-1) Impact assessment fidelity shall be adequate for the assessment uses and users, either those directing the Hanford cleanup effort or those affected by its results. See "Uses and Users" in the Principles and General Requirements section.

(B0.0-2) The impact assessment shall provide the range of impact values which bracket uncertain impact with high probability. For example, it may be decided that the results must be able to show that, with 95 percent certainty, 99 percent of all impact has been identified.

(B0.0-3) An explicit, documented definition and validation of model structure and parameters shall be established and maintained current with model and parameter revisions.

(B0.0-4) Overall assessment uncertainty objectives shall be consistent with the applicable definition of the post-cleanup Hanford Site end state.

(B0.0-5) Projected assessment quality shall be acceptable to the Columbia River Comprehensive Impact Assessment (CRCIA) Board. See Appendix II-D.

1.0 Fidelity of Detecting Harmful Effects

The requirements in this section call for the assessment calculations to represent actual conditions. Decisions on the acceptability of generalizations or deviations from reality must be made with an understanding and a concern for the people potentially affected by Hanford derived contaminants. Their cultural perspective and values are the only moral measures of the acceptable fidelity. Fidelity must be treated as a serious factor which requires major investments of time to gather information about the ecosystems and population groups in the study area.

One fidelity concern is identification of the periods of highest exposure, which correspond to the periods when peak contaminant concentrations reach the Columbia River. The evaluation of the ability of models with to predict peak exposure levels is particularly important.

An overview of the requirements in this section is:

(B1.0-1) Assessment fidelity shall be sufficient to enable impact assessment at a level determined by the needs of affected ecosystems and cultural groups.

(B1.0-2) Exposures and, therefore, effects vary with time over very long periods. The time at which high exposures occur is less important than the peak concentrations encountered, except to the extent that simultaneously arriving contaminants combine in their effects on receptors.

(B1.0-3) Temporal peak width shall be accurate enough to support estimates of multi-generational exposure.

(B1.0-4) The effect of uncertainty in the relative timing of peaks shall be considered in evaluating the uncertainty of combined (total) peak exposures. The timing of contaminant concentration peaks and their period (temporal width) shall be accurate enough in relation to each other that they adequately approximate total dose to an unspecified maximally exposed receptor generation, including the effect of individual contaminant peaks overlapping in time. See Appendix II-C, Section 2.0.

(B1.0-5) Uncertainty in peak exposure level shall be quantified and managed to enable detection of impact relative to the criteria developed in response to the requirements specified in “CRCIA Standards” in the Principles and General Requirements section.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

2.0 Model Integration and Consistency

The requirements in this section call for the overall assessment to conform to established physical laws and sound practice. This will help maintain the required consistency among all the subtasks and models in the assessment; for example, across geographical subdivisions.

An overview of the requirements in this section is:

(B2.0-1) Consistency shall be maintained between boundary conditions of partitioned sub-region analyses, supporting valid and seamless integration into the overall assessment.

(B2.0-2) Consistency shall be maintained at interfaces between models used in the assessment. Before models are designed or selected, interfaces must be defined in terms of the output data characteristics required from one model to enable the receiving model to function with consistency, for example, in uncertainty, and fidelity.

(B2.0-3) Mass and momentum shall be conserved across the study area. This includes but is not limited to between calculations of partitioned sub-regions of the Hanford Site and river corridor downstream.

(B2.0-4) Integration of model equations for all exposure process and harmful effects steps shall be validated before committing resources to their use.

(B2.0-5) Consistency and seamless integration are especially important requirements which also apply to the use of data from other studies and analyses.

3.0 Selecting Factors for Assessment: The Study Set

The requirements in this section parallel the sections in Appendix II-A. The purpose of Appendix II-A is to ensure that no relevant factor is overlooked. This appendix requires that for any level of CRCIA effort, the assessment always considers the most important factors. These requirements call for the narrowing of the candidate factors specified in Appendix II-A to those which dominate potential impact to the receptors, that is from a demonstrably complete candidate set to the dominate study set.

An overview of the requirements in this section is:

(B3.0-1) The impact assessment shall be designed so that the dominant threats to humans, cultures, and the Columbia River ecosystem are assessed and so that assessment resources and time are focused on correctly assessing the most severe threats.

(B3.0-2) The dominant sources of harmful effects, both existing and projected, shall be evaluated.

(B3.0-3) The assessment shall provide estimates of peak concentrations and the duration of contaminant pulses at all Columbia River locations of importance to the Hanford ecosystem and human users.

3.1 Hanford Materials and Contaminants

The requirements in this section assure that all Hanford radioactive materials and chemicals that could have an unacceptable impact are assessed. A suggested way to do this is to estimate the likely impact of contaminants and inventories with successive, iteratively refined models of the contaminant-transport-exposure-impact process.

Three additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

3.2 Containment Failure and Release

The requirements in this section call for selection of the dominant containment failure scenarios from among the candidates defined in Appendix II-A, Section 2.0. Radioactive materials and hazardous chemicals are expected to be contained after disposal following cleanup operations. They also are expected to slowly leak into the surrounding ground, water, and air when the containments eventually fail. Selection of the containment failure scenarios will be based upon credible probability of occurrence and the extent of resulting impact. To preserve CRCIA relevancy to cleanup decisions, containment performance information should come from only one source, the U.S. Department of Energy's (DOE's) approved disposal engineering plans. Only if no such documentation exists will alternate sources of information be used. This could include DOE performance requirements, or generally accepted performance estimates for the selected disposal method.

Two additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

3.3 Transport Mechanism and Pathways to the Columbia River

The requirements in this section call for selection of the transport mechanisms and pathways to the Columbia River from among the candidates defined in Appendix II-A, Section 3.0. Physical transport mechanisms are involved in the movement of contaminants from an inventory in a contaminated region or breached containment to the Columbia River. Selection of the level of detail in modeling or in choosing from among alternative mechanisms and pathways will be done using the principles of dominance, fidelity, and management of uncertainty. Pathways accounting for 95 percent of the receptors' dose shall be included for each of the scenarios in Appendix II-A, Section 10. Uncertainties may be large. If so, it may be desirable to determine the cost effectiveness of research efforts to reduce uncertainty to a level comparable with other calculations and modeling in the assessment.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

3.4 Contaminant Entry into the Columbia River

The requirements in this section call for field data and the selection of the interface models which describe the manner and locations where contaminants enter the Columbia River. Candidates were identified in Appendix II-A, Section 4.0. While groundwater may be perceived to be the most probable pathway and entry mechanism, some scenarios may suggest other pathways to be more dominant and will require attention to other entry methods and locations. Applying the principles of dominance and fidelity to this selection process may depend on considerations such as habitat and drinking water uptake locations.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

3.5 Fate and Transport of Columbia River-Borne Contaminants

The requirements in this section call for selection of the dominant, most credible mechanisms of contaminant concentration upon initial entry into the Columbia River. The requirements also address the rate and pattern of mixing with bulk river water, reconcentration of diluted contaminants, and redistribution of contaminated sediments. Candidate mechanisms were developed in response to the requirements in

Appendix II-A, Section 5.0. Examples of situations these requirements examine include reconcentration of contaminants in soils through years of using weakly contaminated irrigation water, reconcentration of contaminants on hydroelectric equipment which is exposed for years to large volumes of water, and the redistribution of contaminated sediments by dredging or the eventual removal of dams. Rates and patterns of mixing with bulk river water also require insightful selection from among candidate scenarios such as patterns of dam operations and cyclical river flow rates.

An additional half page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.

3.6 Critical Habitat and Uptake Locations

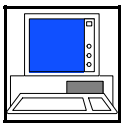
The requirements in this section call for selection of dominant uptake mechanisms and locations which result in the largest contributions to receptor dose. Candidate ecosystem habitat locations and requirements to identify candidate critical uptake locations such as drinking water uptake were addressed in Appendix II-A, Section 6.0. The selections specified in this section define the interface between distributed contaminants and the biotic exposure webs, such as food chains. Matching locations of concentrated contaminants with critical uptake is key to the assessment.

Two additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

3.7 Receptors and Exposure Pathways

The requirements in this section address selection of the receptors of concern (the receptor study set) from among the candidates identified in Appendix II-A, Section 7.0. Selections must also be made from among the candidate exposure pathways such that the chosen exposure models (the pathway study set), regardless of depth of detail, always represent the most important pathways to the potentially highest impacted receptors. In addition to the candidate receptors required to be considered for selection in Appendix II-A, Section 7.0, this section also requires selection of candidate receptors if they occupy crucial positions in food chains, cultural webs, economic networks, or any other receptor dependency web. If resource allocations to CRCIA are highly constrained, tradeoffs may have to be made between assessing more receptors or a broader spectrum of contaminants, for example. In any case, the most highly impacted receptors and the most dominant exposure pathways must be selected — a balance achievable only through interative executions of rough order-of-magnitude calculations prior to commitment of significant resources.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.



3.8 Dose Assessment

The requirements in this section address how well the dose characterization and quantification requirements in Appendix II-A, Section 8.0, must be implemented. Dose assessment provides the basis for assessing the impact because doses correlate with impact. Dose characterization approximates and simplifies dose. The dose as characterized must represent the actual or impeding dose to an acceptable degree of approximation. For example, dose is characterized in part by the selected Contaminants of Concern. Dominant contaminants are selected on the basis of their contributions to dose. Simplifying approximations must be applied similarly to other factors determining dose. Dose characterization must be statistical. Dose distribution across population groups must be assessed. Because of their disproportionate contribution to impact, the dose to the most highly exposed members of a population group is important. The tails of the distributions on the side of high dose are of particular importance to values, such as equity.

3.9 Receptor Impact and Tolerance Assessment

The requirements in this section call for selection of the dominant adverse effects from among the candidates required to be considered in Appendix II-A, Section 9.0. This section also requires the adverse effects selected for evaluation (the study set) be assessed with sufficient fidelity to reveal actual conditions. Project scope limitations will constrain these choices. Unexpected potential adverse effects discovered in the course of the assessment must be identified and either included for assessment or shown to be less than the least dominant impact previously selected.

3.10 Assessment Scenarios: River, Climate, Geological, and Political Changes

The requirements in this section call for selection of the dominant scenarios from among the candidates required to be considered in Appendix II-A, Section 10.0. Dominant scenarios are chosen based on both the severity of their effects on impact and the likelihood of their occurrence. Scenarios provide stakeholders and decision makers a measure of the effectiveness of cleanup solutions.

4.0 Assessment Software Requirements

The requirements in this section call for software characteristics that meet assessment needs. The requirements in this section are:

(B4.0-1) Software shall be designed, implemented, or procured on the basis of explicit requirements.

(B4.0-2) Model representation of dominant contaminants and pathways shall include all elements necessary to describe dominant elements of dose.

(B4.0-3) Verification and validation shall be performed on software.

(B4.0-4) A Quality Assurance Plan shall be established before any software is developed or procured.

(B4.0-5) A Software Test Plan shall be established during software requirements phase.

(B4.0-6) Software reviews (walk-throughs) shall be held for each software module. Reviews shall include verification of software interfaces.

(B4.0-7) Formal technical reviews shall be held at the end of the software requirements phase, the software design phase, and for analysis software integration prior to calculating assessment results.

(B4.0-8) Software design quality shall be evaluated and reviewed for acceptability by qualified independent reviewers approved by the CRCIA Board.

(B4.0-9) Software testing requirements shall be established during the software requirements phase.

5.0 Assurance of Assessment Quality

A concept and implementation approach to control the quality of the assessment during execution of the work shall be developed. This approach together with descriptions of the quality assurance work tasks to be done shall be published in a brief quality assurance plan. Required topics to be addressed in the plan follow and include confirmation that factors included in the assessment are the most dominant, confirmation of consistent treatment of uncertainty, and ensuring acceptable fidelity in the assessment results.

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