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REGION 10 HANFORD PROJECT OFFICE
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CORRESPONDENCE CONTROL

May 13, 1993

Paul Pak
U.S. Department of Energy
P.O. Box 550, A5-19C
Richland, Washington 99352

Re: 200-BP-1 Remedial Investigation Report

Dear Mr. Pak:

Enclosed is a copy of the 200-BP-1 Remedial Investigation Report comments. The review was performed by the U.S. Environmental Protection Agency (EPA), its contractors and the Washington State Department of Ecology.

The EPA believes the Remedial Investigation report is very well written and appreciates the effort that went into its development.

If you have any questions or comments concerning the enclosed comments, please call me at (509) 376-8665.

Sincerely;

Paul R. Beaver
Unit Manager

Enclosures

cc: Nancy Uziemblo, WSDOE, w/Encl.
Mark Buckmaster, WHC, w/Encl.
Roger Freeberg/Julie Erickson, DOE, w/o Encl.
Becky Austin, WHC, w/o Encl.
Dave Jansen, WSDOE, w/o Encl.
Darci Teel, WSDOE, w/o Encl.
George Hofer, EPA, w/o Encl.
Audree DeAngeles, PRC, w/o Encl.
Ward Staubitz, USGS, w/o Encl.
Administrative Record, 200-BP-1 Operable Unit

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INTRODUCTION

The Environmental Protection Agency (EPA) along with EPA's contractors and the Washington State Department of Ecology has completed their review of the draft Phase I Remedial Investigation Report for 200-BP-1 Operable Unit, dated March 1993. The document was prepared for the Hanford site in Richland, Washington, by the United States Department of Energy (DOE). General comments are followed by specific comments and references.

GENERAL COMMENTS

Overall, the report is well organized, clearly written, and follows the EPA (1988a) guidance for conducting remedial investigation and feasibility studies (RI/FS) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). However, there are several areas of concern that need to be addressed.

The remedial investigation report uses upper tolerance limits (UTLs) when determining contaminants of concern. The UTLs are either from (1) the Hanford site soil background or groundwater background reports that were released as drafts in 1992, or (2) calculations based on background sampling. The site background reports generated many concerns and are not approved by the U.S. Environmental Protection Agency (EPA); the next draft reports will require full review by EPA. Comment disposition on September 16, 1992, for the soil background document, resulted in certain agreements among Westinghouse, EPA, and the Washington Department of Ecology (Ecology). Specifically, the parties agreed that the 95/95 upper tolerance limit rule would not be used, and that the Model Toxic Control Act 90th or 80th percentile (depending on distribution) rule would be used. This report does not, but should conform to that agreement. Certain contaminants may have been inappropriately eliminated during the contaminant identification process.

Air at the 200-BP-1 Operable Unit has been modeled. Two contaminant source areas and two depth ranges were defined; each model used one source

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area and one depth range. In addition, two different scenarios were assumed: (1) a future scenario in which the soil cover is lost through lack of maintenance and possible excavation; and (2) a scenario whose purpose is to model deposition of soil particles to estimate future soil contaminant concentrations. Results from scenarios 1 and 2 were combined to show particulate air concentrations and soil concentrations. The manner in which the scenario 1 results were combined with scenario 2 results to provide ambient air particulate concentrations is unclear, and should be explained in more detail.

Table 4-8 was randomly checked for completeness with respect to the contaminants and the risk-based screening process. It appeared to be in order.

Figures 5-5 through 5-8 show mixing factors for ground surface concentrations resulting from modeling of scenario 2. A brief explanation of how these mixing factors combine to give surface soil concentrations would be useful.

Indirect sources of information are used in the 200-BP-1 ecological risk assessment. As a result, the ecological risk assessment relies on theory and is less grounded in empirical data as illustrated by the following: (1) the stressors of potential concern are derived from human health screening criteria, (2) the bioavailable fraction of the soil was inferred from total chemical analyses, and (3) soil-to-plant and plant-to-animal transfer coefficients are taken from literature values, not from on-site studies. Future studies should be designed to obtain direct measurements of ecological effects.

The ecological risk assessment resembles a human risk assessment in that it involves a single stressor's effect on single organisms. Food chain effects are considered in only a limited way. The synergistic effect of stressors on individuals and populations is not considered, but should be.

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The concept of bioavailability, which is central to ecological risk assessment, is not sufficiently addressed. Data collected for assessing risk to humans cannot be readily transformed into data that are useful for ecological risk assessment. Bioavailability should be measured using chemical means (target extractant) and biological means (bioassay).

Segregation of the ecological risk assessment by exposure pathway may prevent an integrated ecological assessment of the 200-BP-1 area. Because this ecological risk assessment does not address the surface water pathway, the ecological risk assessment for the groundwater unit should address results from the surface water pathway and attempt to integrate them with results from the ecological impact from exposure to near-surface soils.

The Hanford site-specific background data do not distinguish between concentrations found in pedogenic and lithological soils. This discrepancy has led to an incomplete stressor-selection process in the ecological risk assessment.

SPECIFIC COMMENTS

1. Deficiency/Recommendation: Section 2.1, page 2-2 (first bullet)

The text states, "Collection of representative vadose zone samples for laboratory testing was to include . . . and potential bench-scale treatment tests." However, it is not stated in the report whether vadose zone samples were collected for bench-scale treatment tests. Also, it is not indicated whether the bench-scale tests (flushing with lixiviants and chemical stabilization) as proposed in the work plan (DOE-RL 1990) were conducted. These discrepancies should be addressed.

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2. Deficiency/Recommendation: Section 2.1.3, page 2-3

This section references Appendix B for the column leach testing data package, and Gillespie (1992) for analytical data associated with the leach testing. Analytical data associated with the leach testing should also be included in the data package to evaluate the test results.

3. Deficiency/Recommendation: Section 2.2, page 2-4

This section describes the goals of data gathering for the surface and near-surface investigation (Task 3). However, the following additional goal, which is included in the work plan (DOE-RL 1990) is not addressed and should be: subsurface soil survey using soil probes and scintillation detectors.

The sampling and analysis plan (SAP) (DOE-RL 1990) includes subsurface soil surveys using soil probes at locations identified by the land surface scintillation survey as having elevated levels of radionuclides, locations suspected to have unplanned releases, and locations containing underground distribution lines. However, the surveys were not performed. The reason for not surveying subsurface soils using soil probes should be explained.

4. Deficiency/Recommendation: Section 2.2.1, page 2-4

This section addresses the ground surface scintillation survey conducted on the entire 200-BP-1 operable unit. The types of alpha and beta/gamma detectors and the detection limits used in the field survey are not specified, but should be. Also, the type(s) of hand-held instruments (and their detection limits) used to survey the crib area are not described, but should be.

The text references WHC (1989) for the results of the scintillation survey. However, the work plan and SAP (DOE-RL 1990) was approved in March 1990. It is not clear whether the land surface was surveyed for radioactivity per Task 3 after approval of work plan or before approval. This discrepancy should be addressed.

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Further, the text indicates that Figure 2-3 shows the area of surface contamination. This figure simply identifies surface contamination, underground radioactive material, and interim stabilization zones, but does not show specific areas. The SAP (DOE-RL 1990) proposes to identify areas within 200-BP-1 having either alpha or beta/gamma radiation statistically greater (99 percent confidence of the mean) than the area background levels for more detailed inspections. However, the magnitude of surface contamination is not shown on the figure. Results of the radiation survey should be shown on an enlarged map to identify hot-spots and areas of radiation statistically greater than background levels. The results of the scintillation survey, including background radiation in the designated background zone in the 600 area, should also be included in an appendix.

The text in the last two sentences of this section states that most of the contamination may have been derived from wind-blown particulate matter. Possible sources are said to be unplanned releases from the operable unit and adjacent tank farms. This conclusion is not fully supported in the text. The majority of surface contamination is shown on Figure 2-3 to be on the northern side of tank farm. The strongest winds at the 200 East area Telemetry site are from the south-southwest (SSW), southwest (SW), west-southwest ([NSW] [SIC]), west (W), west-northwest (WNW), and northwest (NW) (Table 3T-3). Although dust may blow from any wind direction, it blows most frequently from the SSW, SW, NSW (SIC), W, WNW and NW. If surface contamination is derived from wind-blown particulate matter, areas down wind of the tank farms may have been more contaminated by wind-blown dust from the SSW, SW, NSW, (SIC) W, WNW, and NW rather than from others.

The results of the radiation survey and wind data should be discussed in detail to support the conclusion that unplanned releases and adjacent tank farms are possible contaminant sources.

In section 2.2, the text indicates that the locations of unplanned releases are uncertain. One of the goals of a surface investigation is to delineate surface contamination resulting from unplanned releases. It is not clear

whether the locations of unplanned releases are delineated from the results of the surface radiation survey. This discrepancy should be addressed.

5. Deficiency/Recommendation: Section 2.2.2, page 2-4

This section states that "near surface soil samples were collected at 26 locations throughout the 200-BP-1 operable unit. Samples were collected at areas of near surface contamination, approximate locations of unplanned releases, near the flush tank, and on the west side of the operable unit for background data." The rationale for selecting the locations and numbers of surface soil samples is not clearly explained. The approximate locations of unplanned releases, the flush tank, and the background area are not clearly shown on any map in the report. Surface soil sampling depths are not specified. The SAP proposes that two soil samples containing the highest radiation levels from each anomalous field screening location be sent to a qualified laboratory for analysis of parameters of interest (including additional compounds discovered during Task 2): one for the highest alpha reading, or one for the highest beta/gamma reading (section 2.3.4, page SAP/FSP-17, DOE-RL 1990), or one of each. The basis for collecting and selecting surface soil samples for on-site and off-site analysis is not discussed. These discrepancies should be addressed to ensure that adequate and representative surface soil samples are collected in accordance with the SAP. Any deviation from the work plan or SAP should be discussed.

6. Deficiency/Recommendation: Section 2.2.3, page 2-5

This section addresses pipeline integrity testing. However, the locations of the tested pipelines (two 4-inch and one 2-inch pipeline) are not shown on any map, but should be. Further, it is reported that the 2-inch line and the south 4-inch line were filled with liquid, but there is no indication of whether the liquid in the pipelines is a potential transport medium for contaminant migration to groundwater.

One of the activities for Task 3 (surface investigation) is to evaluate, test, and implement leak-detection technologies for underground effluent

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distribution lines in order to characterize uncontrolled discharges to subsurface soils. Initial helium tests indicate that there are no leaks from the empty pipeline. The pipeline that contained liquid was not tested, however. It is not clear how the goal of characterizing past or current uncontrolled discharges to subsurface soils will be met during Task 3.

The text states that "A final report of all field activities was not available at the time of this report." It should be clarified how and when additional information will be evaluated and incorporated into the remedial investigation report.

7. Deficiency/Recommendation: Section 2.3.1, page 2-6, second paragraph

The text states, " the shotgun shells proved to be inadequate for use in the survey . . . leading to inconclusive results." Use of kinepak two-component explosives is proposed in the SAP (DOE-RL 1990) for promulgating seismic waves. The use of shotgun shells in place of kinepak two-component explosives as proposed in the SAP is not explained. Further, no reason is given for not repeating the tests to obtain conclusive results. It is also not known whether the seismic survey will be repeated soon to meet the objectives of Task 5 (Seismic Refraction Survey). These discrepancies should be resolved.

8. Deficiency/Recommendation: Section 2.3.2.1, page 2-7

The text states, "Groundwater monitoring wells were located based on existing aquifer characteristics in the region." The text should describe the existing aquifer characteristics and how this information is used to select the monitoring well locations to ensure that they are representative. The SAP (DOE-RL 1990) proposes to review and evaluate data obtained during Task 5 (Seismic Refraction Survey) and Task 7 (Groundwater Analysis [evaluation of existing wells and results of first sampling period]), and to evaluate data obtained during Task 6 stage 1, and Task 7 (second sampling period) for monitoring well locations. Any deviation from the work plan and SAP should be explained in this section.

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9. **Deficiency/Recommendation: Section 2.3.2.2, page 2-7, third paragraph**

A gross-gamma tool is used for geophysical logging of 600 area wells whereas, a spectral-gamma tool is used for 200 area wells. The reason for using different logging tools should be explained.

10. **Deficiency/Recommendation: Section 2.3.3.1.2, page 2-8, first paragraph**

The listed wet chemistry constituents are not consistent with the constituents listed in Appendix E for groundwater wet chemistry analysis. For example, "nitrate, nitrate-nitrite, ammonia nitrogen, phosphate, sulfate, and sulfate not by ion chromatography (IC)" are included in the groundwater wet chemistry list in Appendix E, but are not listed in this section. Also, silicon oxide and aluminum are listed as wet chemistry constituents in this section, but are not found in Appendix E for groundwater wet chemistry. These inconsistencies should be explained and the text changed accordingly.

11. **Deficiency/Recommendation: Section 2.3.3.2, page 2-9**

This section states, "Slug tests were performed on all Task 6 monitoring wells." Task 6 lists 10 monitoring wells. However, 15 wells (12 existing and 3 proposed), for the unconfined aquifer and five wells (2 existing and 3 proposed) for the Rattlesnake Ridge aquifer are proposed for hydraulic testing in the SAP (DOE-RL 1990). Any deviation from the SAP should be explained.

Also, the basis for selection of wells 699-49-57B, 699-52-54, 699-52-57, and 699-53-55C for drawdown/recovery testing should be explained. The SAP proposed to perform drawdown/ recovery testing only on wells where groundwater can be discharged directly to the adjacent ground (outside the zone of influence of the test) for infiltration. Evaluation of the current groundwater quality prior to testing and determination of whether drawdown/recovery tests are appropriate for the well are also proposed. The text should explain whether these factors were taken into consideration in the selection of wells for drawdown/recovery tests.

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12. **Deficiency/Recommendation: Figure 2-3, page 2F-3**

The title of the figure, "Interim Stabilization Zones Within the UN-216-E-89 Unplanned Release" is not appropriate. The figure shows the entire operable unit before and after interim stabilization. The figure should be appropriately titled; for example "Surface Contamination Before and After Interim Stabilization."

A footnote or legend is not provided for the numbers 1 through 7 marked on the map showing conditions before interim stabilization, but should be.

Underground radioactive material is not defined in the text, but should be.

The boundary of the 200-BP-1 operable unit is not clearly demarcated on the maps, but should be.

13. **Deficiency/Recommendation: Figure 2-5, page 2F-5**

The symbols used for monitoring well locations do not allow clear differentiation between confined and unconfined aquifer wells. Distinct symbols should be used for confined and unconfined aquifer wells, or the two types of wells should be noted on the figure.

14. **Deficiency/Recommendation: Figure 2-5 and Table 2-3**

Figure 2-5 shows well 55-59 and Table 2-3 lists well 57-59. We believe that this is a single well. Which one of these is the correct well number?

15. **Deficiency/Recommendation: Figure 2-6, page 2F-6**

The legend used on this map identifies only confined and unconfined aquifer wells, but does not distinguish between existing and new wells. Existing and new confined and unconfined aquifer wells should be differentiated and clearly marked on the map with a legend provided for clarity.

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16. **Deficiency/Recommendation: Table 2-3, page 2T-3**

The total depth of well 699-55-55 is reported as 312 feet. However, the screen interval is shown between 148.4 and 169.3 feet. The chemical samples were collected from between 1 and 150 feet below ground surface (Appendix D). It is not clear whether the borehole for well 699-55-55 is drilled to 312 feet, or if there is a typographical error in presenting the total depth. This discrepancy should be corrected.

17. **Deficiency/Recommendation: Section 3.1.2.2, p. 3-3**

The discussion of specific retention is somewhat misleading. It is described here as representing "in practice...the volume of liquid which could be discharged to a pit without leakage to the ground water." It should be noted that the Hanford soils were once inundated during the Missoula floods and in the intervening years have drained from a fully saturated state. It is likely that in areas with little or no natural recharge, the volume of water in the soil prior to the liquid discharges equals the specific retention capacity of the soil--i.e. the amount of water that can be held against gravity drainage. Additional water added to the soil column therefore cannot be held completely against gravity drainage to ground water. Migration to ground water will be retarded, but most of the liquid applied to the soil surface will eventually drain to ground water. The faulty assumptions used in the past to describe "specific retention disposal" should not be continued in this or other present-day reports.

18. **Deficiency/Recommendation: Section 3.1.2.3, page 3-4**

The text does not address pipes leading to the cribs. Additional information is needed showing the locations and sizes of the inlet pipes including the presence or absence of the inlet pipe to crib 61.

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19. Deficiency/Recommendation: Section 3.1.2.3, page 3-4, fourth paragraph

The text refers to a 216-B crib flush tank. A reference indicating a figure showing the location of the 216-B crib flush tank is needed.

20. Deficiency/Recommendation: Section 3.1.2.3, page 3-4, fifth paragraph

The text refers to conditions at UN-200-E-89. There is no mention of the location of this until the top of page 3-5. The text needs to modified either to include UN-2-E-89 into figure 3-1 or reference figure 2-3 on page 3-4.

21. Deficiency/Recommendation: Section 3.3.1.2, page 3-11, first paragraph

The text states that West Lake may not be a "naturally occurring" water body. West Lake may not be a natural water body, but is likely to be a wetland or a jurisdictional wetland. The sentence should indicate that West Lake represents a natural or artificially derived surface water body or wetland.

22. Deficiency/Recommendation: Section 3.6.2.2.2, p. 3-33

A general statement is made that "little, if any natural recharge to the ground water occurs in the broad flat plain of the study area...". This may be true of the 600 Area surrounding the 200 Areas. However, it should be noted in the discussion of recharge that there are large areas within the boundary of the 200 East and West Areas that are devoid of vegetation, and that in these areas recharge to ground water may indeed be occurring.

23. Deficiency/Recommendation: Table 3-7

The units for Equivalent K described as cm/day are not correct. The units for the values shown should probably be cm/s.

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24. Deficiency/Recommendation: Section 4.0, page 4-1, last paragraph

According to MTCA, although fallout is from an anthropogenic source, it would be considered as a natural background. Therefore, such constituents as ^{90}Sr and ^{137}Cs would need to be evaluated as naturally occurring radionuclides. A number of other radionuclides would also qualify under this category.

25. Deficiency/Recommendation: Section 4.1.1, page 4-3

Presumably, a strong base was added to the waste mixture to neutralize the nitric acid supernatant. The text states that the supernatant was made alkaline, but does not indicate the final pH of the mixture. In any case, it would require a certain amount of care to react a strong acid and base in a heterogeneous mixture, such as that found with the tributyl phosphate process, so that the supernatant is precisely within a hydrogen ion activity range that would be ecologically safe (i.e, conservatively between $10^{-4.5}$ moles and $10^{-7.5}$ moles).

The influence of pH on chemical stressor bioavailability should be discussed as an indirect ecological effect and included in the contaminant selection process. For example, the text, in later sections, discusses the environmental chemistry and toxicology of nickel and cadmium. One underlying theme of these discussions concerns identification of the solid phases that control metal solubility. The hydronium ion concentration is a major factor in determining the extent of precipitation of metal oxyhydroxides. Natural organic polymers and colloidal "sesquioxides" (generally aluminum and iron oxyhydroxides) are variable-charged surfaces whose surface reactions are controlled by the potential-determining ions, which in this case include the hydronium ion and the hydroxide ion, and whose activity is reported in pH measurements.

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26. Deficiency/Recommendation: Section 4.2 and Table 4-3

It should be noted that the site-wide soil background documents referenced (DOE-RL, 1992b and 1992c) are presently draft, not final documents. The UTL's defined in these reports are based on the upper 95 percent confidence interval of the 95 percent quantile. In the resolution of comments on these draft background reports, it was agreed that the definition of background would follow the guidance provided in "Statistical Guidance for Ecology Site Managers" WDOE 92-54, i.e. using the 90th percentile.

The revised site-wide UTL's for soils are presently available and should be considered for use in the definition of 200-BP-1 background.

27. Deficiency/Recommendation: Section 4.2, page 4-6, third paragraph from top of page

Besides fallout, some organics could be considered natural background because of their association with vegetation, etc.

28. Deficiency/Recommendation: Section 4.2, page 4-6, fourth paragraph from top of page

The documents DOE-RL 1992b and DOE-RL 1992c referenced in this report are considered draft reports and have not been finalized or accepted by the regulators. These are the soil and groundwater background reports that were written to meet Milestone M-28, due April, 1992. As draft reports they are not acceptable to be used for referencing background values.

29. Deficiency/Recommendation: Section 4.2.1.2, Page 4-8, first paragraph from the top of page and Table 4-3

The background concentrations presented in Table 4-3 in the second to last column references the soil background document, only six constituents including aluminum, calcium, copper, iron, lead and sodium are evaluated in

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that document and given threshold values. The values that do appear in the background document are different than those values shown in Table 4-3 and referenced as coming from the background document. This document should not be referenced because it was never complete when submitted at the end of April 1992 to meet the M-28 milestone.

30. Deficiency/Recommendation: Section 4.2.1.2, page 4-8, fourth paragraph

The text states that "the calculated background UTLs and means are comparable to background soil concentrations presented in Hanford Site Soil Background." For several analytes, the operable unit specific background UTL is significantly different from the Hanford Site background UTL. For example, the operable unit specific background UTL for chromium is 10 mg/kg; the Hanford Site background UTL is 27.9 mg/kg. For chloride, the operable unit specific background UTL for chloride is 60 mg/kg; the Hanford Site background UTL is 763 mg/kg. The operable unit specific background UTL for nitrate is 4.2 mg/kg; the Hanford Site background UTL is 199 mg/kg.

The text should describe the method by which the operable unit specific background and the Hanford Site background are used for individual analytes in the contaminant selection process.

31. Deficiency/Recommendation: Section 4.2.2, page 4-9, first paragraph

An explanation is needed as to why sampling was conducted for TCL organic compounds for only the first quarter while sampling for TCL compounds was conducted for trip blanks <u>only</u>, during the four succeeding quarters.

32. Deficiency/Recommendation: Section 4.2.2.2, page 4-10, first paragraph at the top of the page and Table 4-3

All background values for groundwater are obtained from the Hanford Site Groundwater Background report (DOE-RL 1992c) and are apparently summarized in Table 4-3 of the RI report. The background document was never finalized or accepted by the regulators and was even more incomplete than the soil report.

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Like the soil report, radionuclides, organic, and trace metal constituents were never included. Additionally, certain areas of the Hanford Site were probably going to require different recharge areas as sources for background groundwater (i.e., the
Columbia River for parts of the 100 areas, the western part of the Hanford Site for much of the 200 plateau area, etc.). Tables, figures and appendices were missing, as was a complete data listing from which the included background values were derived. This is not adequate for a reference for a RI report.

33. Deficiency/Recommendation: Section 4.2.3, page 4-10, third paragraph

The text states that an assessment of the surface water pathway will be addressed in the 200 East groundwater aggregate area study. The ecological risk assessment requires an integrated assessment of all pathways. The separation of the surface water pathway makes for an incomplete ecological risk assessment.

A complete ecological risk assessment should be presented in either this report or the 200 East groundwater aggregate area study.

34. Deficiency/Recommendation: Section 4.2.3.3, Page 4-11

The risk assessment is weakened by the fact that no biota sampling was performed. The contaminant levels in biota were estimated.

35. Deficiency/Recommendation: Section 4.3.1.1, page 4-13, second paragraph

The text states that "the predominant forms of nickel found in the environment . . . are water insoluble and are generally not bioavailable for most plant and animal species". The bioavailability of nickel depends on the chemistry of the environment. There are instances in the natural environment in which the dominant nickel species is Ni^{2+}, complexed nickel, or weakly sorbed nickel; all of which may be bioavailable. Further, bioavailability is most

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often defined on a temporal scale such that adsorbed, labile species, which are defined by an extraction method, are defined as bioavailable. Weakly adsorbed or labile species are not soluble, but are bioavailable.

The phrase "In addition, the predominant forms of nickel" should be deleted and nickel should be evaluated as a contaminant of concern in the ecological risk assessment.

36. Deficiency/Recommendation: Section 4.3.1.1, page 4-13, third paragraph

There seem to be high levels of sodium, magnesium, calcium, potassium, and chloride in the soil; the ionic strengths of the soils are certainly above background. Excessive salinity and an elevated ionic strength can negatively affect plant growth.

Soil solution ionic strength should be evaluated as a physical stressor in the ecological risk assessment.

37. Deficiency/Recommendation: Section 4.3.1.1, page 4-13, second paragraph from bottom of page

Contaminants are eliminated on the basis of health risk. However, there needs to be some consideration for environmental or ecological risk, as well, Apparently, ecological risk is addressed in Section 6.0 of the RI report. The screening methodology should use some type of ecological risk evaluation to eliminate constituents of concern.

38. Deficiency/Recommendation: Section 4.3.1.2.2, page 4-18

This section discusses the derivation of the soil-to-air volatilization factors used to evaluate the inhalation-of-volatiles pathway. Volatilization factors used in the exposure assessment are not, but should be listed.

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39. **Deficiency/Recommendation: Section 4.4, page 4-24, first paragraph**

The text states, "A table of the 95 percent upper confidence limits (UCLs) of the mean soil concentrations is presented at the end of this section." The table number is not cited, but should be for quick reference.

40. **Deficiency/Recommendation: Section 4.4.1, page 4-25, second paragraph**

This paragraph indicates that boreholes were drilled to a depth of up to 236 feet within and through the cribs. Only three, not all, boreholes are drilled to a depth of up to 236 feet (Table 2-2). The text should clearly indicate that 25 boreholes were drilled to depths ranging from 29.5 feet to 50 feet. The remaining boreholes varied in depth from 226 feet to 233 feet.

41. **Deficiency/Recommendation: Section 4.4.1.1, page 4-25**

This discussion of the extent of contamination in near-surface soils, is not complete. The spatial distribution of contaminants of potential concern identified in section 4.3 is not addressed or shown on a map. The maximum contaminant concentrations for radionuclides are discussed, but not for inorganics and organics. These omissions should be corrected.

42. **Deficiency/Recommendation: Section 4.4.1.1, p. 4-25, last paragraph**

Line 2, typos, "exceeding their respective risk-based" should read "exceeding its risk-based", and in line 3 "and have half lives" should read "has half lives".

43. **Deficiency/Recommendation: Section 4.4.1.1, page 4-25, last paragraph of the page**

There is something missing from this paragraph, some other radionuclides with half-lives of 1 year, 300 days, and 40 days, that included manganese-54.

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44. **Deficiency/Recommendation: Section 4.4.2, p. 4-35**

In the first paragraph it is noted that contaminant levels in well E33-12 are generally low with respect to the other wells examined. This is not really true with respect to Tc-99 and Co-60, both of which have nearly 100 percent higher levels in E33-12 than in surrounding wells, such as E33-5 or E33-7. The levels of Tc-99 in well E33-12 range up to 1800 pCi/L, which is nearly twice the existing MCL. This should be noted in this section and evaluated in section 7.1.3 with respect to contamination of the confined aquifer.

45. **Deficiency/Recommendation: Section 4.4.1.1 and Table 4-19**

According to Table 4-19, chromium, chrysene, and PCB's were eliminated from the contaminants of concern for near surface soils, however the extent of contamination of these constituents is not described in Section 4.4.1.1. A brief paragraph describing the rational for deleting these constituents from the list of contaminants of concern would be appropriate to include in Section 4.4.1.1.

46. **Deficiency/Recommendation: Section 4.4.1.3, page 4-28, discussion on the bulleted items**

The discussion of uncertainty related to spectral gamma logging addresses a problem if you are trying to quantify radioactivity and not identify specific radionuclides. The most important plus for this system is its ability to identify specific gamma-emitting radionuclides and the movement and approximate location of these constituents.

47. **Deficiency/Recommendation: Section 4.4.2.1.1, page 4-36**

There are numerous inconsistencies between the text and the plume maps shown in Appendix K. For instance:

(a) Nitrate values are described to range between 1 to 493 mg/L, but nitrate values as high as 587 are shown in Figure K-3.

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(b) The discussion of the nitrate describes "The portion of the unconfined aquifer plume that extends into the study area from the west is likely from a 200 West Area source", but no such plume is shown on Figure K-3.

(c) The maximum gross alpha value is described in the text as being detected at well 699-49-55a. The maximum value shown in Figure K-5 appears to be in well 52-54. There also appears to be no distinction made in Figure K-5 between gross alpha measured in the confined and unconfined aquifers.

(d) The maximum gross beta value for the confined aquifer is noted in the text as being 952 pCi/L measured at well 699-E33-12, but 480 pCi/L appears in Figure K-4.

(e) The text notes, "Detected concentrations of potassium-40 ranged from 66 to 159 pCi/L.", but values in excess of 239 pCi/L are shown in Figure K-8.

(f) The concentration of total uranium north of the 200-BP-1 operable unit is noted in the text as 14 ug/L at well 699-E32-2, but this is not shown in Figure K-10.

(g) The highest tritium levels are noted in the text as 166,000 pCi/L at 699-E32-2 and 15,800 pCi/L at 699-E33-24. These values do not agree with those shown in Figure K-11.

48. Deficiency/Recommendation: Section 4.4.2.1, p. 4-35

Cs-137 is described in Chapter 5 and in Appendix F as sorbing strongly to sediment particles. In Table 5-9, Cs-137 is assigned a distribution coefficient of 10,000, and in Table 1 of Appendix F it is assigned retardation coefficients of 2,000-2,400. However Cs-137 is noted to have occurred in the

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ground water below the BY Cribs in wells 299-E33-7 and 299-E33-12 and at elevated levels in ground water over 1/2 mile north of the BY Cribs in well 699-50-53a. For a constituent that sorbs so strongly to the sediments, it is somewhat remarkable to detect it at such a distance from the source. Some explanation or discussion of this observation should be included in Section 4.4.2 or Section 5.2. Is Cs-137 transported by colloidal transport, chelation, or complexation with another constituent or are large amounts of Cs-137 sorbed to the aquifer matrix between 200-BP-1 and well 699-50-53a?

49. Deficiency/Recommendation: Section 4.4.2.1.2, page 4-38, Total Uranium

The text refers to well 699-E32-2 as being to the north of 200-BP-1. According to figure 2-6, the well is located to the west of 200-BP-1. This discrepancy needs to be addressed.

50. Deficiency/Recommendation: Table 4-1, page 4T-1

This table shows Ammonium Nitrate being disposed of to crib 50 and not to crib 57. The text should discuss this discrepancy in the appropriate section.

51. Deficiency/Recommendation: Table 4-3, page 4T-3b

Ammonia is listed as an anion. Ammonia, however, is a neutral molecule, although total soluble ammonia often includes the ammonium ion, which is a cation. Ammonia should be deleted from the table of anions.

52. Deficiency/Recommendation: Table 4-4, page 4T-4

The text differentiates between soils in the 0-to-15-foot layer and soils below 15 feet. However, the background data do not differentiate between surface soils exposed to pedogenesis, and lithological soils. This omission leads to several anomalous results that are found in Table 4-4. For example, the maximum concentration of mercury was found to be 0.4 mg/kg. The Hanford Site background UTL is presented as 1.25 mg/kg. Soil mercury concentrations, however, range from 0.01 to 0.3 mg/kg, with an average of 0.03 mg/kg (EPA

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1983). If mercury concentrations are compared with Hanford Site background mercury concentrations, the maximum mercury concentration found at the site falls well within "natural" or "anthropogenically derived" background concentrations found at Hanford. However, the maximum mercury concentration found at 200-BP-1 is 13 times the worldwide average, and is outside the common range found in surface soils.

There is indirect evidence that there is a source of bioavailable mercury in the vadose zone. Mercury was detected in 18 of 418 groundwater analyses with concentrations reaching 0.42 g/L. This suggests the presence of mobile and soluble mercury species in the soil solution, which in the surface soil would be bioavailable.

Potential contaminants such as mercury, which has different pedogenic and geologic background concentrations, should be reevaluated as stressors of potential concern in the ecological risk assessment.

53. Deficiency/Recommendation: Table 4-7, page 4T-7

Table 4-7 lists preliminary risk-based screening exposure factors. The particulate emission factor presented ($8x10^7$ m^3/kg) is incorrect. The correct value ($2x10^7$ m^3/kg), as stated in Section 4.3.1.2.2, should be listed in this table. In addition, Table 4-7 does not, but should include radionuclides exposure values used in the preliminary risk-based screening.

54. Deficiency/Recommendation: Table 4-19, page 4T-19

Table 4-19 shows contaminants that have been eliminated as contaminants of potential concern based on the extent of contamination. The table indicates that chromium was eliminated because it was detected only twice in subsurface soils. However, Table 4-8 indicates that chromium was detected in 80 of 82 samples of subsurface soils. This discrepancy should be corrected. Chromium should be retained as a contaminant of potential concern.

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55. Deficiency/Recommendation: Section 5

This report lacks the information how the radionuclides inventories were determined and the procedures followed. If this information is discussed in an other document, it should be referenced in this RI report.

56. Deficiency/Recommendation: Section 5.1, p. 5-1 - p. 5-8

The contaminant fate analyses is too generic to be useful for predicting the fate of contaminants at the 200-BP-1 operable unit. The discussion in this section generally describes the physics and chemical factors that influence the fate of specific contaminants in the environment but does not include in the discussion the specific physical and chemical environments of the 200-BP-1 operable unit. For instance, in the discussion of nickel on page 5-3, it is noted that "Important factors that control nickel mobility in soils are pH, type and amount of clay minerals, organic matter content, and the presence of iron and manganese oxides and hydroxides. Nickel sorbtion depends strongly on pH." The discussion should go on to indicate the pH of the 200-BP-1 soils, their organic matter content, and other operable-unit specific information that will allow the reader to assess the significance of contaminant fate and transport.

In the discussion of plutonium on page 5-5, it is noted that plutonium nitrate is readily soluble in water. It is known that large amounts of nitrate were discharged to the BY Cribs, however there is no mention of this or discussion of the influence of nitrate on the transport of plutonium at 200-BP-1. The distribution coefficient of 1,000 assigned to plutonium in Table 5-9 appears to assume no influence.

57. Deficiency/Recommendation: Section 5.1.1.1, page 5-1, third paragraph

The text discusses solubility, mobility, and leaching characteristics of PCB's depending on soil characteristics and the amount of chlorination of the PCB's. A discussion of the present conditions (i.e., amount of chlorination and soil characteristics at Hanford) is needed.

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This comment is also applicable to other similar sections also.

58. Deficiency/Recommendation: Section 5.1.2.1

Pandias, 1984, is cited but is not included in the list of references.

59. Deficiency/Recommendation: Section 5.1.3.1

A fate profile for antimony is noted to be included in Section 5.1.2.1, which is actually the profile for cadmium. We find no profile for antimony.

60. Deficiency/Recommendation: Section 5.2.1.3.3, page 5-13

The discussion on Soil Grain Size Distribution Data needs further explanation. The data seems to be too hypothetical. It is not explained in the text whether the two near-surface soil zone samples are taken from drill cuttings or grab samples. Further grain size analysis data could be obtained from samples taken from similar lithologies but from different areas.

61. Deficiency/Recommendation: Section 5.2.3.2, p. 5-16

In the second paragraph, DOE 1992b is cited as the reference supporting the selection of PORFLO-3 as an approved computer code. DOE 1992b in the list of references is actually the soil background report.

62. Deficiency/Recommendation: Section 5.2.3.2.1, page 5-17, (A)

In Scenario A, the units for the infiltration rate are missing. We assume the rate to be units of cm/yr. In Scenario B, the units should be in cm/yr, not cm/hr as shown. It is also noted that "symmetry necessitated modelling only one-quarter of the single crib." This should probably be one-half of the crib.

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63. **Deficiency/Recommendation: Section 5.2.3.2.8, page 5-26, Scenario B**

The text states "If instead...advection or dispersion...". Diffusion and advection are both forms of dispersion. Therefore, it may be more accurately written as "advection and mechanical dispersion".

64. **Deficiency/Recommendation: Section 5.1.3.1, page 5-3**

The paragraph discusses contaminant fate of antimony-125 and states that the fate profile for antimony described in Section 5.1.2.1 is also applicable to antimony-125. Section 5.1.2.1 does not include a discussion of antimony. A contaminant fate discussion of antimony-125 should be included in this section.

65. **Deficiency/Recommendation: Section 5.2.1.1, page 5-9**

This section discusses radioactive decay as a possible mechanism for airborne release of contaminants. A brief and conservative calculation should be included in the appendix to support the thesis that radioactive decay is not a mechanism of concern. If such a calculation for this site has been included in another document, that document should be referenced.

66. **Deficiency/Recommendation: Section 5.2.1.2, page 5-9**

This section discusses volatilization as a possible release mechanism to air. Again, a brief and conservative calculation should be included to support the thesis that volatilization is not a concern at this site.

67. **Deficiency/Recommendation: Section 5.2.1.3.3, page 5-13, third paragraph**

This section discusses the vegetative cover factor (V^1) component in the equations presented. The Superfund exposure assessment manual states that "For remedial investigation and feasibility study estimation purposes, one can

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use a zero pounds per acre vegetative cover value" (EPA 1988b). The term "zero pounds per acre" refers to crop residues; therefore, a scenario in which no vegetative cover is assumed to be present is suggested for use at this site.

68. Deficiency/Recommendation: Section 5.2.3.2.5, p. 5-20

The last paragraph on the page describes how the source terms for the contaminant transport modelling were calculated, yet the values themselves are not listed anywhere. The source terms have a very important influence on the modelling outcome and should be listed for comparison with the data presented in Figures 5-15 to 5-59 and in Table 5-10. An additional column with the appropriate source terms could be added to Table 5-9.

69. Deficiency/Recommendation: Section 5.2.3.2.5, p. 5-21

We do not agree with the assignment of 1 cm/yr as a "conservative" recharge rate nor the justification for selecting this rate. Much of the justification centers on the existence of an impermeable barrier to retard infiltration making water available for evapotranspiration. The depth of the barrier below land surface is not indicated, however we assume that it is located approximately at the tops of the cribs, which according to Table 2.2 are generally about 3.5 m below land surface. At this depth water in the soil is probably not available for loss due to evapotranspiration at an unvegetated site. In addition, the existing integrity of the barrier is unknown. We therefore question whether the "impermeable barrier" really does limit recharge to the cribs. We do agree that a fine-grained native soil surface cover could limit recharge and that 1 cm/yr is a reasonable recharge estimate, however we do not agree that it is a "conservative" estimate. We suggest rewording this section as noted above.

70. **Deficiency/Recommendation: Section 5.2.3.2.6, p. 5-22, top line**

Scenarios A and B are indicated as requiring initial contaminant concentrations. Scenario C also requires the initial contaminant concentrations.

71. **Deficiency/Recommendation: Section 5.2.3.2.7, p. 5-23**

(a) In the first paragraph, it is noted that properties for contaminant transport are not required for Scenario C. We believe that these properties are required for Scenario C. Is this a typo? Should Scenario D be noted? (b) The same comment applies to the discussion of anisotropy in the next paragraph. Was the anisotropy ratio adjusted for Scenario C as noted or Scenario D as we suspect? (c) In the last paragraph it is indicated that the same distribution coefficients were used in Scenarios A and B. We assume that the same distribution coefficients for uranium were used in Scenario C as well.

72. **Deficiency/Recommendation: Section 5.2.3.2.8, p. 5-25**

The statement is made that the "soil concentrations predicted in Scenarios A and B compared favorably to those recently measured (Table 5-10)." It should be noted that the Cs,ucl listed in Table 10 is measured from a whole soil sample which includes both contaminants sorbed to the soil matrix and those in the soil water.

73. **Deficiency/Recommendation: Figure 5-10**

The title to the figure indicates that this is the grid for Scenario C. This actually is the grid for Scenario D.

74. **Deficiency/Recommendation: Figure 5-24, p. 5F-24; Figure 5-47, p. 5F-47**

The title for these figures should indicate the scenarios (A, B, or C) which these figures represent.

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75. **Deficiency/Recommendation: Table 5-8**

In Section 5.2.3.2.7 on page 5-23, it is noted that specific storage was calculated by rounding the effective porosities up to the nearest tenth. In Table 5-8, the effective porosity for the sand layer is listed as .392 and the specific storage value is listed as 0.3. For the silt layer the effective porosity is 0.274 and the specific storage is 0.4. It appears that either the effective porosity or the specific storage values for the silt and sand layers have been transposed in the table.

The values of porosity and density listed in the table for each soil layer do not exactly match those used in the model. It appears that the parameter values have been entered in the wrong order either in the model or in the table. We suspect that the problem is with the table, and this should be checked and corrected.

76. **Deficiency/Recommendation: Table 5-10**

This table compares the results of present-day predicted versus measured concentrations of various constituents, but nowhere in the table is it indicated which modelling scenario was used to arrive at the predicted concentrations.

77. **Deficiency/Recommendation: Figure 5-32**

The moisture content of the soils as described in the figure showing the relative saturation appears to be much too high in this figure and in many of the other figures that show conditions several years after cessation of discharge. The moisture contents shown in these figures range from 60-70 percent of saturation, or about 18-24 percent moisture content by volume. The moisture contents actually measured in the soils underlying the cribs in 1990-1991 ranged from 3-8 percent by volume.

The predicted moisture contents are likely to be too high due to errors in developing the characteristic curves shown in Figures 5-11 to 5-14. The soil

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samples that were used to measure the moisture retention curves upon which these figures are based were sieved prior to the measurement and the size fractions greater than 2 mm were removed. However, the moisture retention curves that were measured were not then corrected to include the fraction of particles greater than the 2 mm size. This results in characteristic curves representing soils that are finer grained than those actually found in the field; soils that drain more slowly and have higher moisture contents at given matric potentials.

These higher moisture contents predicted in the soil and the erroneous characteristic curves may have a significant influence on the contaminant transport modelling results. The time of breakthrough of mobile contaminants to ground water and the drainage of the soil profile will be underpredicted. As noted in Section 5.2.3.2.8, the model predicted higher residual nitrate concentrations in the soil than were measured and indicates that most of the nitrate had migrated to ground water. This also indicates that uranium and plutonium may migrate to ground water more quickly that the model predicts. Predicted transport of the more strongly sorbed and shorter lived radionuclides such as Sr-90 and Cs-137 are not likely to be appreciably affected.

78. Deficiency/Recommendation: Section 6.2.1.2.1, p. 6-2, last line on page

Typo, "the current the current scenario" should read "the current scenario".

79. Deficiency/Recommendation: Section 6.2.1.3.1, page 6-5, third paragraph

An explanation is needed as to why surface soils have a higher particulate concentration than the infiltration soils would have if they were excavated.

80. Deficiency/Recommendation: Section 6.2.2.3, page 6-16, third paragraph

This paragraph discusses oral absorption factors used to adjust reference doses and slope factors for evaluation of the dermal exposure pathway. The

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last sentence states that the Health Effects Assessment Summary Tables (HEAST) (EPA 1992) recommend a gastrointestinal absorption factor for cadmium and nickel. This reference does not appear to be correct; the correct reference for gastrointestinal absorption factors should be provided.

81. Deficiency/Recommendation: Section 6.2.3.3, page 6-21, first paragraph

This paragraph discusses contaminants evaluated via exposure to dust deposition. The text states that because radium-226 is an alpha emitter it is expected to present its greatest risk via the inhalation pathway. Radium-226, however, in the industrial scenario, presents its greatest risk via the external exposure pathway. In addition, external exposure, and not inhalation, is evaluated for the fugitive dust deposition pathway. Radium 226 should be evaluated for the fugitive dust deposition pathway.

82. Deficiency/Recommendation: Section 6.3, page 6-29, second paragraph

The text states correctly that, in an ecological risk assessment, it is not possible to evaluate all potential effects on all potential receptors. However, the *Hanford Site Baseline Risk Assessment Methodology* (DOE 1993) and EPA documentation (1992) suggest that the correct method for reducing the uncertainty associated in ecological risk assessments is to use a suite of assessment and measurement endpoints at different organizational levels. In this ecological risk assessment, only one measurement endpoint and one assessment endpoint were used.

The ecological risk assessment should evaluate several measurement and assessment endpoints at different ecological organization levels.

83. Deficiency/Recommendation: Section 6.3.1.1, page 6-30

The selection of stressors is based solely on chemical and radiological properties of the contaminants. Synergistic and antagonistic effects of the

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contaminants on the environment are not considered, but may be very important in determining potential impact from the site on the local ecology.

The possible synergistic and antagonistic effects of the contaminants and the selected stressors should be discussed here.

84. Deficiency/Recommendation: Section 6.3.1.1, page 6-30

General chemistry analyses of near-surface soils did not meet data quality objectives for completeness. The incomplete data set for near-surface soils could affect the contaminant selection process.

The incomplete data set should be discussed in terms of its effect on the ecological risk assessment.

85. Deficiency/Recommendation: Section 6.3.1.2, page 6-30, second paragraph

The text states that ingestion and inhalation of soils have been neglected because of the lack of information available to quantify these pathways. There could be information from human toxicological studies about ingestion of soil materials and inhalation of organic vapors by mice that could be used in the analysis.

The ingestion and inhalation pathways should be quantified. If the data are not available, reasonable maximum exposure assumptions should be used.

86. Deficiency/Recommendation: Section 6.3.1.3, page 6-31, second paragraph

The citation, Ophel et al. 1976, is not listed in the reference section but should be.

87. Deficiency/Recommendation: Section 6.3.1.4, page 6-31, first paragraph

The text states that the measurement endpoint is individual mortality. However, there were no mortality studies conducted on indicator species.

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According to EPA (1992), "measurement endpoints are measurable responses to a stressor" and "when an assessment endpoint can be directly measured, the measurement and assessment endpoints are the same." The only endpoints used in the ecological risk assessment that were directly measured were the chemical analyses of the near-surface soils.

The text should be revised to clearly define the measured endpoint.

88. Deficiency/Recommendation: Section 6.3.2.4, page 6-33

There is no consideration for drinking water within the OU. Drinking water should be considered a source of exposure even if there are no large bodies of water, or no visible origin of drinking water.

89. Deficiency/Recommendation: Section 6.3.2.7, page 6-38, second paragraph

Evidence is presented that would lead to two different conclusions concerning the impact of the radiological dose to the pocket mouse. Considering the differences in experimental conclusions reported in the literature, it would seem that site-specific information is needed to evaluate the impacts of the chemical and radiological stressors. The Hanford Site background RAM states that if ecotoxicological data are not available or are insufficient, laboratory studies may be needed for an appropriate toxicological assessment.

Laboratory studies should be conducted to assess the site-specific impacts of chemical and radiological stressors on several indicator species. At a minimum, a soil bioassay should be performed.

90. Deficiency/Recommendation: Section 6.3.3.2.1, page 6-39

The text states correctly that uncertainty associated with the approach used in the ecological risk assessment is significant because data exist only for soil constituents. In addition, the soil analyses were total elemental analyses, which are not associated with the bioavailable fraction. Further,

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no bioassay of the soils were conducted, which would have shed light on the bioavailability of chemical stressors.

The text should emphasize that the ecological risk assessment was generally modeled; there were few measurements that connect soil contaminants to biota. However, techniques exist whereby the potential exposure to biota could be quantified. These techniques include chemical extraction that quantifies bioavailable fractions, bioassay, and plant uptake studies. Such studies would be useful in a Phase 2 investigation.

91. Deficiency/Recommendation: Table 6-3, page 6T-3

This table presents measured air concentrations of radionuclides. A footnote to the table states that the concentrations presented are average concentrations. The 95 percent upper confidence limit on the mean should be used to calculate inhalation intakes.

92. Deficiency/Recommendation: Table 6-21, page 6T-21

This table summarizes inhalation cancer risks associated with measured air concentrations of radionuclides. Footnote E states that the total uranium slope factor of 3.8E-08 $(pCi)^{-1}$ was obtained from the HEAST (EPA 1992). It appears that this reference is incorrect; the correct reference or correct slope factor should be cited.

93. Deficiency/Recommendation: Section 7.1.3, p.7-10 and Section 7.2.3, p.7-22

It is noted that residual Tc-99 is currently entering and impacting the ground water at concentrations of about 400-700 pCi/L. It should be noted that Tc-99 has been measured at concentrations up to 970-990 pCi/L in wells E33-5 and E33-7. These concentrations exceed the current MCL and should be so noted here and in the second paragraph on p.7-23 where it is noted that source control measures do not appear warranted for Tc-99 because it is below MCL standards.

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94. Deficiency/Recommendation: Section 7.2.4, p.7-23

Tc-99 is currently found in ground water below the operable unit in concentrations exceeding the current MCL. If no remedial action is taken to treat the TC-99 in the source or the ground water, then further monitoring of the ground water below the operable unit should be conducted to confirm the hypothesis that Tc-99 concentrations in the ground water will decrease in the future. This activity can be conducted as a part of the Phase 2 RI or incorporated into the 200-East aggregate area ground water investigation. Either way, the recommendation for further monitoring should be included in section 7.2.4 and should include Co-60 and uranium as well.

95. Deficiency/Recommendation: Appendix A and Appendix E

Tributylphosphate (TBP) is listed in Table 5-6 as a contaminant of potential concern. However, we could not find the results for TBP analyses in soil or ground water in Appendices A or E. We found TBP listed only occasionally as a tentatively identified compound (TIC). Where are the analytical results for TBP listed?

96. Deficiency/Recommendation: Appendix J, page J-5, second and third paragraphs

The text states that soil and water detection limits for several radionuclides exceed the work plan detection limits by several orders of magnitude, but does not explain this discrepancy.

The text should explain the discrepancy between the detection limits included in the work plan and those actually attained.

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