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March 12, 2002

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EDMC

Mr. James E. Rasmussen
United States Department of Energy
Office of River Protection
P.O. Box 450, MSIN: H6-60
Richland, Washington 99352

Dear Mr. Rasmussen:

Re: Comments on Functions and Requirements (F&R) Documents: C-104, RPP-7807, Rev 0, HFFCO Milestone M-45-03-T04 and S-112, RPP 7825, Rev 0, HFFCO Milestone M-45-03-T03

S6034

Please find enclosed final Ecology comments on the C-104 RCR following the draft submittal on March 8, 2002.

If you have any questions on this matter, please contact Dick Heggen at (509) 736-5716 or Suzanne Dahl at (509) 736-5705.

Sincerely,

Richard Heggen
for Suzanne Dahl
Tank Waste Disposal Project Manager
Nuclear Waste Program

Enclosure: C-104 RCR

cc: Joe Cruz, USDOE
Robert Lober, USDOE
Dennis Crass, CHG
Warren Thompson, CHG
J.H. Richards, CTUIR
Donna Powaukee, NPT
Russell Jim, YN
Todd Martin, HAB
Ken Niles, OOE
Administrative Record: M45-03

REVIEW COMMENT RECORD (RCR)	1. Date March 8, 2002	2. Review No.
	3. Project No.	4. Page 1 of 37

Document Number(s)/Title(s) **S-112 F&R**	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
RPP-7825, Rev 0, Single Shell Tank S-112 Full Scale Saltcake Waste Retrieval Technology Demonstration Functions and Requirements		D.Heggen, J. Caggiano S. Dahl, J.Yokel	Washington State Department of Ecology	1315 W. 4th Ave. Kennewick, WA (509) 736-5720

17. Comment Submittal Approval:

Organization Manager (Optional) _____ Date _____

10. Agreement with indicated comment disposition(s)

Reviewer/Point of Contact _____ Date _____

Author/Originator _____

11. CLOSED

Reviewer/Point of Contact _____ Date _____

Author/Originator _____

Item	Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted)	Status
1.	**Executive Summary, General.** Discuss why S-112 was selected for this retrieval demonstration. Also state that the risk based retrieval sequence approach was jointly developed by Ecology and USDOE during TPA Milestone M-45 negotiations. (SD)			
2.	**Executive Summary, Pg i, paragraph 2.** The S-112 is stated as being a "non-leaking saltcake tank"; however, it has not undergone tests to demonstrate its integrity. Modify the text to state that S-112 is "…an assumed non-leaking saltcake tank…" (JC) (DH)			
3.	**Executive Summary, Pg. i, paragraph 1, last sentence.** Add "and allows the addition of liquids in unfit for use tanks under specific parameters and controls" (SD)			
4.	**Executive Summary, Pg i, paragraph 3.** The retrieval requirement for C-104 is to leave no more than 360 cubic feet as stated in TPA Milestone M-45-00 (not 700 cubic feet). The 99% goal is applied to			

	the average volume for all SSTs which calculates to a maximum residual waste volume of 360 cubic feet for all large (200 series) SSTs. It is not intended to be applied on a tank by tank basis. Correct all text in the F&R and attachments to reflect the retrieval goal as stated in the M-45-00 TPA Milestone. (DH)			
5.	**Executive Summary, Pg i, paragraph 4.** Provide a brief description here of the general engineering design(s) under consideration for this saltcake dissolution demonstration. Provide additional details in appropriate sections of the main body of the F&R document. (SD)			
6.	**Executive Summary, Pg i, paragraph 6.** The executive summary does not identify that mixed waste may also remain in the event that the tank is not RCRA "empty". Include a statement to the effect that remaining waste is "mixed waste". (DH)			
7.	**Executive Summary Pg. ii, last paragraph.** The executive summary implies that EPA reference standards (methods) are the only basis for determining if any LDMM is acceptable to use for the S-112 retrieval effort. During the recent USDOE LDMM down-select workshop, EPA reference standards were not specifically called out as a key parameter for selection of LDMM. If USDOE intends to use other criteria in addition to EPA reference standards for selection of LDMM, revise the executive summary and state where in this report the related information will be included. Provide a list of criteria from the EPA reference standards that specifically apply to SST retrievals as well as an explanation as to why they are applicable. (DH)			
8.	**Pg. 1-1, paragraph 2.** Recent CT3 activities have indicated that these retrieval demonstrations will be aimed at individual tank closure. (SD)			
9.	**Pg. 1-1, bullet 2:** Revise the sentence to "… highest long-term risk first to minimize the impact…" (SD)			
10.	**Pg. 1-2, paragraph 1.** Describe the "numerous technologies" that have been identified for waste retrieval. Provide a table with a			

	citation, or reference to another part of this report. (JC)			
11.	**Pg. 1-2, paragraph 1.** Delete the word "detectable" from the following text: "...waste retrieval strategies and equipment must also integrate the means to detect, monitor, and mitigate detectable leaks." (DH)			
12.	**Pg. 1-2, paragraph 2.** The RPE genesis process is incomplete. Add additional text to include the memorandum of understanding (MOU) between Ecology and USDOE, M-45-08T (allowable leakage), and the M-45-03 TPA milestone series			
13.	**Pg. 1-2, paragraph 2.** The text describes the basis for establishing functions and requirements (F&R) as purely risk-based. Risk is a factor; however, it neglects to mention the lessons learned considerations (including LDMM) as stated in M-45-03-T03 that are also an important part of the basis for the F&R document. In addition, S farm risk already exceeds established limits for human health; therefore, the basis for establishing functions and requirements shifts from meeting risk levels established in the RPE to conducting the best technically achievable retrieval possible. (DH)			
14.	**Pg. 1-2, paragraph 2, last sentence.** Reference is made to "design, development, screening, and assessment of alternative technologies....for LDMM". Provide additional text detailing how and when ex-tank LDMM technology will be inserted into the design process. (JC)(DH)			
15.	**Pg. 1-3, section 1.1, last paragraph.** Delete the entire paragraph and revise it to reflect the direction provided to USDOE through the December 7, 2001 letter to James Rasmussen. The letter stated "Ecology anticipates that the Functions and Requirements (F&R) documents to be prepared before each retrieval will include sufficient information to allow Ecology to determine if additions of liquids for retrieval will be allowed. Ecology will transmit written approvals or disapprovals for the F&R documents that will include determinations on the addition of liquids." Revise the text. In addition, provide, in			

	appropriate portions of the text, design information as well as the nature of the liquid to be added to S-112 (i.e.: buffered or not). (DH) (SD)			
16.	**Pg. 1-3, section 1.2.** Add to the purpose of the F&R document the following: as statement to the effect that the F&R provides sufficient information regarding addition of liquids to allow Ecology to make an informed decision about the addition of liquid to the SST. (SD)			
17.	**Pg. 1-3. sections 1.2 and 1.3.** Indicate here and elsewhere (as appropriate) in this report how the design of the retrieval system will remove sufficient waste to allow individual tank closure. (SD)			
18.	**Pg. 1-4, section 1.4, paragraph 2.** If REDOX ceased operating in 1957, and this tank operated until 1973, there must have been other waste streams entering it. Please check and correct. Also add text describing all interim stabilization activities related to S-112 occurring after 1974 (JC) (SD)			
19.	**Pg. 1-4, section 1.4, paragraph 2.** The radionuclide CoCs appear to be missing some significant radionuclides such as 436,000 Ci of Cs-137 and 77,000 Ci of Sr-90. When all key scenarios and pathways are considered including a future failed cover scenario (RCRA cover estimate = 500 year duration) it is highly likely that these additional radionuclides will be an important aspect of future human health and environmental risk. In addition, non-radionuclide chemical CoCs are missing. Provide additional text discussing the above missing CoCs. (JC) (DH) (SD)			
20.	**Pg. 1-4. last paragraph.** The report mentions that S-112 contains saltcake and sludge waste. The retrieval is focused on removing saltcake; however, retrieval issues relating to the sludge remain unclear as follows: the volume of sludge remaining after saltcake retrieval, the toxic makeup of the sludge, location in the tank, and any plans to remove the sludge. Provide the above missing information including related information from the conceptual design. (DH)			

21.	**Pg. 1-5.** Chromium, Barium, Selenium, Molybdenum, were found in the borehole water leachates of the sediments from boreholes in the SX tank farms and other metals were included in the DQO workbook as contaminants of concern for the SX tank farm. These metals should be included in the contaminants of concern for the risk assessment. Re-calculate the risk with a complete contaminants of concern list. (JY)			
22.	**Pg. 1-6, paragraph 1.** States: "Drywell monitoring will occur prior to, during, and following 241-S-112 waste retrieval activity." Groundwater monitoring needs to be conducted on the same schedule. Provide additional text stating that that groundwater monitoring will be coordinated with drywell (and other) retrieval monitoring. (JC)			
23.	**Pg. 1-6.** Here and elsewhere in the document, provide specific details of drywell logging; i.e., the number, location and depth of dry wells to be logged, the frequency of logging, the logging rate and the tools to be used. Provide additional text detailing the missing information and include justification. Include a discussion of the use of gamma vs. neutron logging describing the advantages and/or disadvantages of each method. It is suggested that this detail be provided in one place and referenced in other places where logging is discussed. (JC)(DH)			
24.	**Pg. 1-6, figure 1-1.** Well W23-19 is a RCRA groundwater monitoring well that is sampled regularly because WMA S-SX is in groundwater quality assessment monitoring under RCRA regulations. Since the direction of groundwater flow has changed with time provide a date for this figure. Provide additional text to reflect the above information. (JC)			
25.	**Pg. 1-7, paragraph 1.** Sentence two indicates that dry well monitoring will be conducted as part of LDMM. See comment on Page 1-6 regarding missing drywell monitoring information. (JC)(DH)			

26.	**Pg. 2-5, Table 2-2.** The table of State and Federal regulations contains errors and is missing several key regulations. Revise the table as follows: Change WAC 173-303-640 to WAC 173-303. Change 40 CFR 265 to 40 CFR 260 through 268. Add 40 CFR 61, WAC 173-400, WAC 173-460, and WAC 246-247. Delete 40 CFR 280. In addition list applicable DOE orders. (JC)(DH)(BBK)(SD)			
27.	**Pg. 3-2, next to last bullet.** LDMM seems to be evolving on a separate, parallel path and NOT following the integration called for in this bullet. Since LDMM is not integrated as it should be, please indicate the schedule for inclusion of ex- and in-tank technology for LDMM. (JC)			
28.	**Pg. 3-2, last bullet.** What drives the "maximum" performance requirements? Also add that the TPA stated reason for a risk assessment approach (RPE) is to establish the risk associated with various activities. (SD)			
29.	**Pg. 3-2 through 3-3.** This portion of the F&R strategy focuses, in part, on the role of LDMM in support of retrieval operations; however, there is no discussion of the ability to adequately document the performance of the retrieval effort including leakage, if any, in order to evaluate the performance of the retrieval technology regardless of risk. Provide additional text discussing this aspect of SST retrieval. (DH)			
30.	**Pg. 3-4, through 3-5.** Missing are several risk scenarios/pathways including a future Failed Cover scenario with related human health inhalation and ingestion pathways, as well as Environmental/Ecological pathways. Provide additional text discussing these scenarios/pathways. (DH)			
31.	**Pg. 3-5, first paragraph (beneath bullet).** Expand on the statement that risk levels "…are high relative to …10-5…" Provide additional text listing actual risk levels at the S farm fenceline. (DH)			

32.	**Pg. 3-5, first paragraph (beneath bullet).** Explain how alternate risk levels are regulatory compliant and specify the specific alternate risk levels. In addition, moving the tank farm point of compliance to achieve regulatory risk levels is unacceptable. Delete the reference to alternate points of compliance. Perhaps the concept could be restated and a better description provided. (DH)			
33.	**Pg. 3-6, item 1 and first paragraph below item 3.** The statement that the RPE focuses on developing retrieval leak loss and residual waste criteria conflicts with the fact that risk based leak loss and residual goals specific to the S tank farm cannot meet regulatory risk based limits (as documented in this F&R). In addition, Page ii of the executive summary states: "Because the risk-based retrieval leakage threshold volumes are very small, the LDMM technologies selected for deployment will rely on the Best Available Technology…" The main focus of the S/SX tank farm RPE should be to establish a risk baseline against which future closure actions are compared. Since the risk numbers are so high, the RPE cannot be used to "develop retrieval leak loss and residual waste" criteria. At S farm, USDOE must utilize the best achievable technology to keep the leak loss and residual waste as low as possible. Revise the text to reflect the revised RPE strategy. (DH)			
34.	**Pg. 3-6, last sentence.** The report states "The risk assessment does not address risks to down-river future populations or the cumulative risks from other SSTs and waste sites outside the tank farm." Previous comments provided by Ecology to USDOE on the AX Farm RPE and the draft C-104 F&R on this subject were not incorporated here. In addition, other factors including, ancillary equipment waste inventory as well as certain air and direct contact/ingestion exposure pathways were also omitted. These omissions result in a highly questionable risk basis for making key decisions related to retrieval and closure. Decisions made according to the risk information presented in the F&R report based on the RPE would be incomplete. An uncertainty analysis was not included in the RPE. The above-			

	mentioned missing information needs to be included in future risk calculations prior to any closure decisions. (DH)			
35.	**Pg. 3-7, bullet 1.** The text indicates that groundwater impacts are evaluated at the tank farm boundary. This statement needs to be expanded to include the number/location of wells, type of sampling to be conducted, constituents to be analyzed, and frequency of sampling. Describe/justify how the above information along with location, spacing and screen length/placement of the wells is adequate to detect a release and why it is sufficient to allow assessment of groundwater quality impacts. Revise the text to include the missing details. (JC)			
36.	**Pg. 3-7, bullet 1.** What is the risk if all residual waste is removed? Provide additional information regarding this scenario. (SD)			
37.	**Pg. 3-7, bullet 1.** The statement that "...drinking water standards for TC99 are exceeded by the residual waste alone with no retrieval leakage..." is noted. In addition the last paragraph on page 3-9 basically states that, due to the significant exceedances in risk values from past leak inventory at S farm, deriving performance criteria for leak loss and mitigation at 10-5 ILCR is not justified. These statements emphasize the need to conduct the best technically achievable retrieval and LDMM techniques possible at S Farm. It also emphasizes the need for good detection and monitoring in order to accurately document the S-112 retrieval effort including implementation of the best technically achievable LDMM for future actions/decisions at S-112 and adjacent tanks. (DH)			
38.	**Pg. 3-7, last paragraph.** Provide a statement to the effect that an uncertainty analysis, although in progress, was not included with the S-112 F&R submittal. (DH)			
39.	**Pages 3-7 through 3-8.** Ecology does not approve of moving any established point of compliance (POC) farther out to meet cleanup and/or risk levels. The groundwater point of compliance is defined by			

	WAC 174-303-645(6)(a) as "a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down to the uppermost aquifer underlying the regulated units." In addition, the regulations state: "Alternatively, the point of compliance may be any closer points identified by the department at the time the permit is issued, considering the risks of the facility, the wastes and constituents managed there, the potential for waste constituents to have already migrated past the alternate compliance point and the potential threats to ground and surface waters." WAC 173-303-654(b) goes on to define waste management area (WMA). The WMA for the SSTs have been agreed to be the tank farm fencelines. Therefore, the POC is the vertical surface at the fenceline. (DH)			
40.	**Pg. 3-8, paragraph 1.** The process of developing assumptions based on engineering judgment where data were either unavailable or highly uncertain needs further explanation. Why are these assumptions valid input to the analysis? Provide additional text to address these concerns. (JC)			
41.	**Pg. 3-8, bullet 3.** The text states: "Impacts from the entire tank farm are not evaluated at the tank farm boundary because the contaminant concentrations from different tanks would not all combine at a single location along the tank farm boundary." This concept was not used in C farm F&R. Ecology is concerned that different logic is being employed at S-farm without any basis. The risk analysis associated with the F&R efforts needs to be relatively uniform in order to make consistent and informed decisions regarding retrieval and closure. Perhaps this statement indicates the need (as expressed in the AX and C farm RPE comments) for a comprehensive analysis of all related risk sources including those beyond the tank farm boundary. Provide additional text discussing the above concerns. (DH)			
42.	**Pg. 3-8, last paragraph, and Pg. 3-9, paragraph 1.** The description of risk is confusing. A statement is made that the long-term risks are			

	not sensitive to a retrieval leak from S-112; however, the same paragraph states: "...with no retrieval leakage...results in risk levels that are above 10 –5 at the 200 West fence..." In addition, the last paragraph on page 3-9 states that risks from past leaks in the S farm represent ILCR levels that are two to three orders of magnitude greater than the 10-5 risk standard. Where/how was this risk measurement calculated? These statements seem contradictory. Provide additional text explaining the above questions and apparent contradictions. Additionally, provide the risk numbers for the S farm fence line compared to the 200 West fence. (DH)			
43.	**Pg. 3-8, last bullet.** Evaluation of static and dynamic in-tank leak detection methods vs. risk limits conflicts with other statements in the S-112 F&R. Risk limits no longer govern the leak detection and (as indicated on page ii of the executive summary) since risk based retrieval leakage threshold volumes are small, "LDMM technologies selected for deployment will rely on the Best Available Technology..." Revise the text to incorporate the above concerns. (JC)(DH)			
44.	**Pg. 3-9, paragraph 3, sentence 1.** Provide additional text or refer to other areas of the report that states what specific techniques that will be used for waste retrieval that will minimize the amount of waste that could leak. (see comment executive summary, paragraph 4) (JC)			
45.	**Pg. 3-9, bullet 3.** A leak rate of 1.8 gallons is specified, but not the time of leakage. Is this 1.8 gal/min, 1.8 gal/hr, 1.8 gal/day? The assumption is that the time unit is an hour. Correct the text. (JC)			
46.	**Pg. 3-9.** Provide additional text detailing the indirect affect of liquid leaks as a mechanism to mobilize existing soil contamination. (SD)			
47.	**Pg. 3-9, last paragraph.** Correct the text stating "...for the Residential Worker." It should read "...for the Residential Farmer." (DH)			
48.	**Pg. 3-10, paragraph 2.** The report describes threshold leak volumes needing to be established for design of unspecified nature. If ex-tank			

	LDMM methods are targeting detection of leaks of 1,000 gals or less, what specifically does this statement mean? Provide additional text discussing relating the threshold leak volumes to LDMM capabilities, including those undergoing evaluation. Additionally define threshold leak volume and include information on how and when it will be used. (JC) (DH) (SD)			
49.	**Pg. 3-10.** Delete the text referring to the 200 UP-1 Interim Record of Decision and related performance measures. This extrapolation is out of context and has not been discussed with the Ecology review staff involved with the SST retrieval/closures processes. (DH)			
50.	**Pg. 3-11, figure 3-2.** This figure is not clear. Explain how the data were derived and the uncertainty in the input data so as to justify the significance and decisions based on it. Also provide a list of the input data. The use a dual logarithmic graph coupled with an attempt to compare risk between two very different exposure scenarios on one figure contributes to the confusion. Please revise and explain thoroughly and simply how this figure was derived and what it is supposed to describe (include examples). In addition, provide a larger/readable copy) (see comment Pg B-124) (JC) (DH)			
51.	**Pg. 3-11, paragraph 1, last sentence.** The assertion that "...waste removal activities have not cause any tank to leak..." needs to include specifics, or reference(s) where such information can be found. As stated, this statement cannot stand by itself without support. Most recently, there is evidence that indicates groundwater effects from the C-106 retrieval efforts. The report also implies that integrity data is available for S-112. It is difficult for the reader to gain perspective on this statement unless the similarities and differences between S-112 and these other, unspecified tanks are clearly spelled out. Revise the text and provide supporting information. (JC) (DH)			
52.	**Pg. 3-11 through 3-12, section 3.3.** Although this section generally states that lessons learned will be applied to the S-112 retrieval, the lessons learned Appendix A is lacking in LDMM technologies with			

	the exception of partitioning interwell tracer technologies. Provide additional text describing the recent LDMM demonstrations and down select process and include an estimated schedule for incorporation of the best technologies into the S-112 retrieval effort. (DH)			
53.	**Page 3-12, paragraph 1 and 2**. The statement: "The best available and deployable LDMM technology will be used…" is misleading in light of the missing lessons learned related to LDMM. Only partitioning interwell vapor LDMM was included in the lessons learned Appendix A. Missing are all other LDMM technologies currently under consideration by the USDOE through the LDMM down-select process. Revise the text to include the missing LDMM technologies under consideration. (JC) (DH).			
54.	**Pg. 4-1, section 4.0.** There are numerous functions and requirements stated here as objectives of the design. Add/revise the text to indicate the likelihood that these objectives can be achieved in a manner that satisfies these goals and the schedule for waste retrieval. (JC)			
55.	**Pgs. 4-1 – 4-7, section 4 general comment.** These F&Rs are lacking in detail. As these F&Rs are the presumed basis for this document, more detail is needed now, or at some later unspecified point. Provide more detail, or indicate when and where this level of detail will be available. In addition, the following functions and requirements are missing altogether: 1) F&R for the type of liquid to be added for retrieval, 2) F&R on low flow requirement, 3) F&R on the removal of the lower sludge layer, and 4) F&R on individual tank closure requirements. (JC) (SD)			
56.	**Pg. 4-1, section 4.2.** Hydrostatic forces are briefly mentioned. Provide additional text to support the limits stated in this section (do not simply reference a report). Cite key controlling regulations. (DH)			
57.	**Pg. 4-2, section 4.3.** The text states: "If active ventilation is required… during waste retrieval…" Provide additional text detailing			

	the requirements for vapor space pressure if active ventilation is not required. (DH)			
58.	**Pg. 4-2, section 4.4.** Related to this section and missing from the lessons learned (appendix A) is any information relating to non-radioactive gaseous discharges that affected site workers during the C-106 and SY-101 retrieval operations. Provide additional text detailing the requirements needed to prevent such events in the future. Provide key parameters and limits. (DH)			
59.	**Pg. 4-2, section 4.5.** Correct the statement that 99% retrieval is the goal. As stated in the comment on the Executive Summary, Pg i, paragraph 360 cubic feet is the goal stated in M-45-00. Also missing is a statement that even if the retrieval goal is met, retrieval should proceed, as technically feasible to remove as much tank waste as possible. In addition, explain how the 194 days was derived. (DH) (SD)			
60.	**Pg. 4-3, section 4.6.** The report states: "Provisions shall be made to sample waste during retrieval operations." Provide additional text detailing the method of sample collection, frequency of sampling, and list of constituents to be monitored/analyzed. Also include the rationale for the above. (DH)			
61.	**Pg. 4-3, section 4.6.1, bullet 1.** The goal stated here is to detect a cumulative leak loss during retrieval of 8,000 gallons. LDMM technologies are targeting a leak detection capability considerably smaller, on the order of 1,000 gallons or less. Experts at the recent USDOE LDMM down-select workshop agreed that, with minimal tank farm infrastructure disruption, a 4,000-gallon leak could be detected. The "Basis" states that the goal is 8,000 gallons based on BATEA. Provide details on the basis for the 8,000 gallons, and clarify what is the goal for LDMM and when will it be achieved. In addition, describe how fast a leak could be detected (provide some timelines). (JC) (DH) (SD)			

62.	**Pg. 4-3, section 4.6.1.** Based on other information presented in this report (i.e.: the fact that neither static nor dynamic leak detection methods would provide real-time leak detection), there is doubt that the in-tank leak detection methods on which this section is based would be able to detect a leak prior completion of retrieval. (DH)			
63.	**Pg. 4-3, sections 4.6.1, 4.6.2.** This is an excellent place to provide more detail of technology development and schedule for deployment of LDMM, either in the text or by reference to a location where this information is available. Provide additional text. (JC)			
64.	**Pg. 4-3, section 4.6.2.** After "Data shall be collected in event of a leak…" add the following statement "…to aid in leak mitigation and to aid in leak strategy decision points…" (SD)			
65.	**Pg. 4-3, section 4.6.2.** Based in information in this report, risk levels exceed health limits even if all the tank waste is removed and no leaks occur. Describe how future RPEs will be used to guide S-farm retrieval actions. It appears the remaining decisions will focus on the risk to workers to remove small residual waste volumes near the end of retrieval since the only retrieval drivers will be to get the most waste out with the smallest retrieval leak loss using the best achievable technology. S farm risk has already driven the performance measure to using the best achievable technology. Include a discussion on how RPEs will be used for individual tank closures. (DH) (SD)			
66.	**Pg. 4-4, section 4.9.** This section is inadequate. If a leak is detected, one would assume that the process would stop for an evaluation to determine if the detected leak is "real", and based on that decision, proceed forward to: stop retrieval and take action, continue retrieval, perhaps at a different rate, mitigate the leak, monitor the leak etc. Reliance on an RPE (risk) to evaluate a release in a tank farm that already exceeds allowable risk limits is not acceptable. Revise and correct this text. (see comments–on fig. 5-6) Please expand and clarify what will happen if and when a leak is detected. (JC) (DH)			

67.	**Pg. 4-5 through 4-6.** Missing is any discussion regarding waste compatibility for waste entering the DST system. Provide additional text detailing how the DST waste compatibility DQO and related waste compatibility issues will be satisfied. (DH)			
68.	**Pg. 4-7, section 4.1.3.** Provide the key parameters associated with dome loading, including examples of potential dome loading scenarios relative to the S-112 retrieval. (DH)			
69.	**Pg. 5-1. section 5.0, general.** Missing is a process description of what to do when a leak is observed. Ecology must be involved in the decision process. Provide additional narrative detailing the above concerns. (see comment Pg. 5-5, figure 5-6) (SD)			
70.	**Pg. 5-1, section 5.0.** Strike the text describing the possibility of not meeting some of the LDMM or retrieval requirements set forth in the F&R along with the statement regarding the TPA change control process. These statements impart a negative tone to the "LDMM and Retrieval Strategy" section and, although the possibilities exist, they need not be stated here. These statements do nothing to build confidence that USDOE will stand behind even the limited functions and requirements presented in this F&R document. (DH)			
71.	**Pg. 5-1, Sect. 5.1.1, first bullet.** Change wording to "Minimizes all waste releases to the environment" or similar language to reflect that minimizing hazardous and radioactive waste releases to the environment is the goal. Refer to the closure section of the TPA Action Plan Closure Section for direction. Please correct. (JC)(DH)			
72.	**Pg. 5-1, last sentence**. Revise the text to the following suggested language: "....then by definition there is no possibility of a leak unless the tank is overfilled." (JC)			
73.	**Pg. 5-1, section 5.1.1.** No mention is made in this section regarding the current USDOE LDMM demonstration/down-select process. Revise text to indicate the best achievable technology and the down-select process for LDMM will drive this portion of the F&R with a			

	leak detection capability of 4,000 gallons or lower. (JC)(DH)			
74.	**Pg. 5-1, section 5.1.1.** Add a fourth bullet for goals of an LDMM: Can detect leaks in a timely manner to allow suitable evaluation and response. Please add. (JC)			
75.	**Pg. 5-1, section 5.1.1, paragraph 2, sentence 2.** If the tank has not been tested for integrity using industry-accepted standards, then it is not fitting to assume that the tank does and will not leak. Provide the assurance of the non- leaking status, or correct this statement. (JC)			
76.	**Pg. 5-2, section 5.1.2.** Revise this section. Based on the USDOE mock tank tests and down-select process for LDMM it is highly likely that the "currently best available technology" does not require a free liquid surface. Provide additional text describing the available technologies and plans to down-select and incorporate new LDMM technologies. Also state that the panel members at the recent down-select workshop all agreed that at least some of the technologies available would be able to detect leak of 4,000 gallons or less. (DH)(JC)			
77.	**Pg. 5-2, section 5.1.2.** Missing is a table (similar to that found in the C-104 F&R – Table 5-1) estimating leak loss over time. Provide the missing table. (DH)			
78.	**Pg. 5-4, section 5.1.2.1, sentence 3.** This sounds like mass balance, which was performed during the C-106 waste retrieval. This methodology has been evaluated. Revise and correct the text. (JC)			
79.	**Pg. 5-3, section 5.1.2.1. .** The technique discussed is too unresponsive to provide primary LDMM capability. The technique might be used in conjunction with other more effective methods to confirm a result. Discuss this concept. This section also concludes with a statement that the accuracy of dynamic leak detection may be significantly affected by operational influences. Provide additional text specifying the accuracy of dynamic leak detection for the S-112 retrieval. Include all potential influences as well as a range of			

	detection capabilities for dynamic leak detection. In addition provide a description of the exact methods under consideration. (JC) (DH)			
80.	**Pg. 5-3, section 5.1.2.2.** Although this section mentions some static liquid level measurement devices for use on a free liquid surface, it fails to describe how this method could be applied to S-112 considering specific in-tank conditions during retrieval. Furthermore, the section concludes with the following statement: "The ability of these methods of leak detection to accurately determine the presence of a sufficiently small leak…has not been determined in tanks without a free liquid surface." This seems to imply these methods are not suitable for the intended use at S-112. Provide additional text detailing the application of these methods considering the specific in-tank conditions expected during retrieval. (DH)			
81.	**Pg. 5-4, sections 5.1.3 and 5.1.4.** Provide additional text explaining how the mission would be accomplished, including the timeliness of any leak monitoring and mitigation system. (JC)			
82.	**Pg. 5-4, section 5.2.** The timeliness of leak detection is critical so that a leak can be detected quickly to allow an appropriate response in a timely fashion. Detection of a leak after the completion of retrieval is not acceptable. It only offers the opportunity to confirm a leak detected by other means. Please clarify. (JC)			
83.	**Pg. 5-4, fourth bullet.** Provide additional text detailing the uncertainty related to S-112 characterization data and waste chemistry. (DH)			
84.	**Pg. 5-5, section 5.3, paragraph 1.** If the 1.8 gal/hr "average" leak rate includes leaks at A-105, BX-102 and T-106, please provide the basis for this information and the standard deviation from the mean for this number. How were the leak rates established for the three tanks mentioned above? Provide additional text with details. (JC)			
85.	**Pg. 5-5, section 5.3, paragraph 2.** If the dry well external leak detection system developed in the 1960s was predicated on detecting a			

	leak of ~5,000 gallons at a leak rate of 1.8 gph, explain how a 10,000 gallon leak would go undetected. Clarify, explain and provide details. (JC)			
86.	**Pg. 5-6, figure 5-2.** Provide units of time for the horizontal scale on this figure. (JC)			
87.	**Pg. 5-7, paragraph 2.** A visual would be helpful to understand how the liquid level can be maintained below the interstitial liquid level. What is the basis for the statement that S-112 is not leaking? Provide a reference or cite evidence of this "integrity". (JC)			
88.	**Pg. 5-8, last 2 bullets of Section 5.4.1.** Does it really matter as to the source of the detection? If a change is detected, then this should trigger an evaluation and one of the criteria would be evidence of a leak in S-112, an adjoining tank, or mobilization of waste in the vadose zone. How quickly such a detection is achieved is a function of the frequency of logging, the type of tool used and the logging rate. Provide additional text to clarify. (JC)			
89.	**Pg. 5-8, bullets.** See earlier comment (Pg. 1-6) regarding logging and either provide detail or reference. (JC)			
90.	**Pg. 5-8, last 2 paragraphs of section 5.4.1.** Revise this paragraph to either reflect the information requested in the comment for Pg. 1-6 or reference the location in this report. (DH)			
91.	**Pg. 5-10, figure 5-3 (and fig. 5-4, pg. 5-11).** Provide additional text stating that all transfer piping system will be double contained. (JC)			
92.	**Pg. 5-10, section 5.2.2, paragraph 1, last sentence.** (see comment Pg. 1-6) Either provide additional text here or reference an acceptable description elsewhere in the text. In addition, provide the turnaround time to make the data/results available. (JC) (DH)			
93.	**Pg. 5-12, paragraph 2.** Provide additional text detailing how fast a leak could be detected using the transfer flow technique. (DH)			
94.	**Pg. 5-12, paragraph 3.** Specify the details of the leak detection			

	system in the DSTs; i.e., the minimum leak that can be detected, the expected lag time between a leak and detection of the leak, and the general specifications of the leak detection system. In addition, please include or provide a reference to where such detail can be found. (JC) (DH)			
95.	**Pg. 5-12, bullet 1.** Please clarify what type of gamma logging (gross, spectral etc.) is to be used and whether any logging with a neutron is planned? If not, state why. Ecology believes that gamma logging is incapable of detecting the typical radiation associated with the mobile groundwater constituents that are the main risk drivers for S-112. (JC) (DH)			
96.	**Pg. 5-13, bullet 2.** What is the objective of the stated review? Please clarify. (JC)			
97.	**Pg. 5-13, last bullet**. What if S-112 is detected to be a leaker or the uncertainty of the test is too high to give a definitive result? What contingencies are planned? Provide details. (JC)			
98.	**Pg. 5-13, last paragraph.** How long will validation of a leak take? An F&R is needed to prescribe a time limit. Also isn't the first step to stop retrieving? (see comment Pg. 5-15 figure 5-6) (SD)			
99.	**Pg. 5-14, paragraph 1.** How soon will Ecology be notified? Ecology should review and approve the process control plan. Ecology must have concurrence rights in implementation of the process control plan. Provide additional text describing the above concerns. (SD)			
100.	**Pg. 5-14, Section 5.6.2.1.** Missing from the dynamic leak detection section is information on the accuracy of the system related to density change. Provide additional text discussing the accuracy of this method. Include a table/diagram showing the change in calculated/estimated volume flow vs. change in density. (DH)			

101.	**Pg. 5-14, Section 5.6.2.1, paragraph 1.** Dynamic leak detection is described as using liquid waste level measurements. Describe any potential pitfalls in application of this method to the S-112 retrieval. (DH)			
102.	**Pg. 5-14, paragraph 2.** LDMM data are stated to lag behind retrieval by 48-96 hours. Are these two to four calendar days, or two to four work days? Is retrieval going to be on a 24 hr/day, 7 day a week basis? Please clarify. (JC)			
103.	**Pg. 5-15, figure 5-6.** This diagram is missing a key leak detection step. USDOE has been provided with a draft suggested revised diagram that includes a leak detection decision point between the upper two boxes on the diagram along with some related additional decisional flow paths. Revise the diagram to include a leak detection decision box with associated decisional flow pathways. (DH)			
104.	**Pg. 5-16, last paragraph.** Speaks of transfer lines. Provide additional text describing these lines and with an explanation that the lines will be double contained. (JC)			
105.	**Pg. 5-16, last paragraph.** The following statement is made: "This assumes that no leak is detected in the transfer line(s) or the DST." Describe the leak detection to be used in the lines, tanks, and ancillary equipment. (JC)			
106.	**Pg. 5-17, section 5.6.2.2 paragraph 2.** States that "The frequency and duration of the static test will be determined during design of the retrieval system." This is not acceptable. The frequency and duration should be part of the functions and requirements that drive design. Revise the text to correct this statement. (JC) (DH)			
107.	**Pg. 5-18, section 5.6.2.3.** This section needs considerable expansion to indicate the type of logging that will be conducted. (see comment page 1-6) In addition, the statement "The frequency of drywell monitoring, types of monitors to be used and the potential response actions to a leak will be established during the design phase of the			

	project." is not acceptable. These parameters are essential functions and requirements that will dictate design. Revise the text to correct this oversight. (JC) (DH)			
108.	**Pg. 5-19 to 5-19, section 5.7.** Provide additional text that includes target objectives for ex-tank LDMM techniques, such as minimize size of leak that one can expect to detect, time lag between leak and detection, the ability to monitor the growth of the leak volume and processing/turnaround time. In addition, include a schedule of testing and selection that leads to a decision on both in- and ex-tank LDMM technologies to be used and a date for the timely insertion of these technologies into retrieval design and operations. (JC)			
109.	**Pg. 7-1 section 7.0.** Add any new references used in providing additional information based on Ecology comments. (DH)			
	Appendix A Lessons Learned			
110.	**Appendix A – general, table A-1, third column, Titled: "Relevancy to 241-C-104 and 241-S-112 Retrieval".** The same generic statement is essentially made for every item; namely, "May adversely impact schedule, operating costs and leak risk." This generalization provides little substance to be applied to the S-112 retrieval. It focuses on engineering design and process changes in the tanks. If any of this is to be relevant to S-112, it must address specific issues in a specific manner. State specifically how schedule, cost and/or leak detection could be affected for S-112. Revise this table. (JC)			
111.	**Pg. A-2.** Missing are the following lessons learned from the C-106 past practice sluicing retrieval: 1) Do not flush tank at the end of retrieval with supernate, 2) Use at least two spray nozzles for better coverage, 3) Position the pump on the bottom, 4) The retrieval system outperformed the original C-106 retrieval goal. Expand on this information in the Lessons Learned Appendix A. (SD)			

112.	**Pg. A-2, paragraph 4.** C-106 used mass balance for leak detection. Revise the text to reflect this fact. (JC) (DH)			
113.	**Pg. A-3, paragraph 2.** Refers to logging of "drywells" surrounding the GAAT tanks that were used to measure and monitor conductivity in the groundwater as a means of leak detection during waste retrieval. As used locally, "drywells" end in the vadose and do not extend to groundwater. Please explain how this was done. (JC)			
114.	**Pg. A-4.** Missing lessons learned from other Hanford retrievals. Provide additional text in Appendix A discussing previous Hanford retrievals. (SD)			
115.	**Pg. A-4, paragraph 2.** Discusses the SRS double-shell tanks. Without a comparison of the two leak detection systems, this discussion is not relevant. Tabularize the specifications for the SRS and Hanford DST leak detection systems. (JC)			
116.	**Pg. A-4, section A.2.5.** There are no references to ex-tank leak detection (LDMM) technologies other than partitioning interwell tracer technology. Provide text and related references to all of the technologies currently under consideration for use as LDMM by USDOE. (DH)			
117.	**Pg. A-4, section A.2.5.** This section is too limited. Provide additional lessons learned from other federal programs and private industry. (SD)			
118.	**Pg. A-6, Table A-1.** Missing are lessons learned from interim stabilization, including pump operations/maintenance, chemistry requirements to control line plugging, etc. Add all missing lessons learned relating to the above. (SD)			
119.	**Table A-3.** This Table essentially discusses only in-tank leak detection to the exclusion of ex-tank LDMM. What ex-tank leak detection methods were used elsewhere, what lessons were learned, and what is the relevance of these lessons to C-104? Revise the Table to include these missing details and provide text explaining the			

	relevancy to C-104. (JC) (DH)			
120.	**Pg. A-34, A.3.2.2.** "Waste mobilization predictions based on core-sampling information have been determined to be invalid." This statement greatly concerns Ecology. Missing is a discussion under the "Relevancy…" column. Discuss this statement and provide text with the missing information. (DH)			
121.	**Pg. A-38, A.3.3.1.** The text describes a potential leak detection system for pipelines between C-104 and receiver tank. Describe these lines, including construction and the current and proposed leak detection for the lines. (DH)			
122.	**Pg. A-39.** A number of references are made to other lessons learned that are "…applicable to Leak Detection." However, there is no meaningful description of the relevancy to the S-112 retrieval. Provide text describing specifically how the referenced lessons are applicable to S-112. (DH)			
123.	**Pg. A-42.** A number of references are made to other lessons learned that are "…applicable to Leak Monitoring." However, there is no meaningful description of the relevancy to the C-104 retrieval. Provide text describing specifically how the referenced lessons are applicable to S-112. (DH)			
	Appendix B (RPE)			
124.	**Appendix B-general comment.** Ecological risk has not been evaluated. The HFFACO milestone identifies that the scoping level RPE will provide an environmental risk evaluation. Include an evaluation of ecological risk in this RPE. (JY)			
125.	**Appendix B-General comment:** The S-112 RPE is incomplete as submitted for reasons including the following: 1) Missing significant risk pathways/scenarios that would likely increase calculated risk			

	(without which, a true picture of the risk cannot be realized), 2) missing estimate and inclusion of waste remaining in ancillary equipment, IMUSTs, etc. 3) Lack of an uncertainty analysis. 5) Missing cumulative total risk evaluation considering the additional impact of other non-tank sources of contamination. (DH)			
126.	**Appendix B-General Comment:** Provide a hard copy of the final responses/disposition of the USDOE S-112 RPE working group RCR comments. (DH)			
127.	**Appendix B-General comment.** Missing from this RPE are tables listing routine radiological risk as found in the C-104 RPE on pages B-57 to B-59, tables B.5.2 and B.5.3? The question relating to this information would be as follows: Why do radiological risks present population (and MEI) risks, while chemical risks present only MEI risks? Either provide the missing tables with a response to the associated question or explain why these tables are not included. (DD) (DH)			
128.	**Appendix B-General comment.** Missing from this RPE is a table similar to Table B.5.5 as found in the C-104 RPE listing maximum contaminant concentrations in groundwater. Either provide a similar table in the appropriate section of the S-112 RPE or explain why it is not needed. (DH)			
129.	**Appendix B-General comment.** The long term human health risk and the intruder risk and NRC intruder scenarios fail to deal with cover designs or failed cover. The future failed cover scenario and associated air and direct contact/ingestion human health and environmental pathways could have a significant impact on this RPE. It is possible that constraining performance measures would change if the future failed cover scenario and related exposure pathways were considered. Not incorporating this scenario also adds to existing uncertainties with this RPE. Provide additional text either describing why this scenario and related pathways were not considered or describe the affect on this RPE when they are incorporated. Include			

	all supporting data. (JY) (DH)			
130.	**Pg. B-1, paragraph 2.** This document and approach performs an analysis (RPE) that identifies a maximum allowable leak based on risk; i.e., risk-based performance. Since S tank farm will continue to exceed regulatory risk levels, regardless of retrieval actions, an analysis is needed to determine the risk of the best achievable retrieval performance, especially since the target leak detection limits that are being identified in LDMM technology development are well below allowable leak limits based on risk. An accurate and complete risk assessment is essential for each SST tank farm (or group of farms) in order to establish baseline conditions at each farm prior to the beginning of the first retrieval operation. Additional full risk assessments (RPEs) are not necessary (until prior to closure) in specific tank farms where risk is so high that the only course of action is to retrieve as much as is safely achievable with minimal or no leakage. This concept needs to be addressed before continuing this approach. (JC) (DH)			
131.	**Pg. B-1, section B1.0.** The text correctly states that the HFFACO Milestone requires that environmental risk be evaluated as well as human health risk. The RPE is missing an analysis of environmental (ecological) risk (i.e., non-human biota). It is necessary to assess ecological risk, since results of human risk assessment are not limiting in all cases. Provide an environmental/ecological risk assessment for this RPE. (DD) (DH)			
132.	**Page B-2, paragraph 1.** The report states that "Tank farm retrieval decisions are also interrelated with remediation and closure decisions of other non-tank sources in the Hanford Site 200 East and 200 West Areas." Ecology agrees; however, this information was not included in this RPE. Cumulative impacts from other waste sites affect the risk calculations for C-112 and/or S Farm. Explain the statement as worded in the text and provide examples. Provide the missing cumulative risk information and incorporate into this RPE. (DH) (JC)			

133.	**Pg. B-2, paragraph 2.** Establishing "risk vs. volume" relationships appears to focus on waste volume. Risk ultimately needs to be linked to COC (contaminant of concern) dose (not simply waste volumes) to a receptor. Provide additional text that clearly states and incorporates the above concern. (DH) (DD)			
134.	**Pg. B-3.** If the goal is to ultimately meet applicable cleanup standards, then (even an incomplete risk assessment) the risk based calculations presented for S Farm indicate that long-term human health risk will exceed regulatory limits even if no leakage occurs and no residual waste remains in the tanks. Therefore, what functions or requirements can be directly influenced by the full RPE risk assessment at this point in time? It is clear that the functions and requirements for all retrievals in S farm should now be focused on limiting additional contaminant contribution to the remaining structures/soil/groundwater using the best achievable technology with a full evaluation of risk to site workers to achieve the retrieval goal. Revise the text and include a discussion of the above concepts. Include references to other applicable portions of the RPE. (DH)			
135.	**Pg. B-4 paragraph 1.** Based on previous RCR comments from Ecology, the final AX RPE failed to include cumulative risk from non-tank farm sources. In addition, the uncertainties associated with the AX RPE risk conclusions were significant. USDOE failed to carry forward these comments to this RPE. Provide additional information in the RPE addressing past unresolved AX Farm RPE comments including the above concerns. (DH)			
136.	**Pg. B-4 paragraph 2.** 99% retrieval is not the specific goal for S-112 (see earlier RCR comment regarding waste retrieval goals). M-45-00 established the goal at 360 cubic feet of residual waste (approx. 2,700 gallons). (DH)			

137.	**Pg. B-4, figure B.2.1.** The copy quality of this figure renders a portion of the figure unreadable. Provide a clean copy of this figure. (DH)			
138.	**Pg. B-8, section 2.2.1, paragraph 1.** Provide an estimate of the total linear feet of all transfer lines that remain in S-Farm. In addition, provide details of how many catch tanks, IMUSTs, etc. remain in or near S-Farm. Describe any that could still contain waste and provide a volume/constituent estimate of waste remaining in these tanks. (DH)			
139.	**Pg. B-9, paragraph 1.** Provide a detailed history of the various wastes that were introduced in S-112 that are likely to be present in S-112 at this time. (DH) (DD)			
140.	**Pg. B-10.** The report states that because of insufficient data, inventory associated with ancillary equipment was omitted from this RPE. This is not acceptable. Specify how and when these data will be developed and when they will be incorporated into this analysis. In addition incorporate the fact that ancillary equipment has not been included in an uncertainty analysis. (JC) (DH) (DD)			
141.	**Pg. B-13, section B.3.1.1.** See comment Pg. B-10 regarding the omission of ancillary equipment and provide the information or reference where it is provided in the report. (JC)			
142.	**Pg. B-13, section B.3.1.1.** In addition to groundwater pathways, it is possible that long-term human health risks may occur via soil-based exposure pathways (e.g., human soil ingestion, livestock soil ingestion with COC transfer to milk/beef, crop root uptake of soil COCs with subsequent food chain transfers, re-suspension of soil with subsequent inhalation, external exposure to soil radionuclides) and air-based exposure pathways (e.g., inhalation, external exposure to radionuclides in air). Describe the uncertainty associated with considering the above long-term human health risks over a 10000 y period. (DD) (DH)			

143.	**Pg. B-13, bullets.** No mention is made of preferential pathways such as unsealed boreholes and wells and clastic dikes, all of which are present in S Tank Farm. Provide additional text to address this omission. (JC)			
144.	**Pg. B-15 (and elsewhere).** When models are discussed, there is a need to identify the type of model, the specific code(s), the input parameters used in the code(s), and the values chosen for these input parameters, including uncertainty. This can be addressed once and then referenced elsewhere in the document where mentioned. Revise all related text to include the above information. (JC)			
145.	**Pg. B-15, section B.3.1.3.** State rationale for continued maintenance of the closure surface barrier over the time span considered in this RPE along with the rationale for assuming there will be no air or direct contact/ingestion pathways. As part of the above requested information, discuss a failed cover scenario and the resulting risk pathways. (DD) (DH)			
146.	**Pg. B-15, section B.3.1.3.** In addition to residential farmer and industrial worker scenarios, other exposure scenarios may apply in order to more comprehensively evaluate long-term human health risk. For example, HSRAM lists residential, agricultural, and recreational scenarios. Also, a Native American subsistence resident scenario and a subsistence fisher scenario (at the Columbia River) should be evaluated. Provide additional text detailing the above-described scenarios. (DD) (DH)			
147.	**Pg. B-16. Figure B.3.2.** Good Figure. In the box entitled "Past Leaks/Retrieval Losses", please specify whether past leaks includes leaks from ancillary equipment (pipes, vaults, valve pits, diversion boxes etc.) and the reason for exclusion if that is the case. Please clarify. (JC)			
148.	**Pg. B-16, figure B.3.2.** Missing from this figure are a several significant scenarios including: failed cover scenarios leading to air,			

	direct contact/ingestion pathways, bioaccumulation pathways, subsistence/hunter-gatherer, etc., and environmental/ecological pathways. Provide a revised figure that includes the missing scenarios/pathways (see previous comment) (DH)			
149.	**Pg. B-17, section B.3.2.** Elsewhere, it states that this RPE is for S Farm, but here there is indication that a separate RPE for S-102 will be performed. Explain this inconsistency and indicate why another RPE is needed for S-102. (JC)			
150.	**B-18, paragraph 1.** The report states that all cases assume that a RCRA cover will be constructed; however, the text does not provide any assumption about the longevity of the cover. Provide additional text describing the assumptions used regarding the cover life. Discuss cover failure scenarios and future environmental and human health pathways that could be affected as a result of cover failure. This information could be incorporated and referenced with previous similar comments. (DH)			
151.	**Pg. B-18, paragraph 4, last sentence.** The text states: "No retrieval leakage is expected from a sound tank." Unless this tank has undergone integrity testing using industrially acceptable standards, this assertion has no basis. Furthermore, C-106 (also considered a sound tank) leaked several thousand gallons as indicated by both mass balance analysis and also by significant dilution of groundwater constituent concentrations during retrieval compared with pre-and post retrieval concentration data. Delete this sentence and this assumption. (JC)			
152.	**Pg. B-18.** There are a number of release events that have resulted in contaminant releases to the vadose. These include 1) collection and routing of cooling water and tank condensate to the cribs 2) mechanical failure of tanks and leakage into the underlying soil column 3) failure of ancillary equipment used to transfer liquids between tanks 4) inadvertent overfilling of tanks. It is not clear from			

	the text if these events were adequately covered. Explain how the three source terms, 1) past leaks; 2) retrieval leakage; 3) residual waste have adequately calculated the risk from these release events. (JY)			
153.	**Pg. B-21, section B.3.3.4.** The assumption that ancillary equipment risk inventory is small and; therefore, excluded from this RPE is not acceptable and lacks foundation. The RPE did not include even a rough estimate of ancillary equipment inventory as a basis for excluding it from the RPE. Provide additional supporting text estimating the amount of ancillary waste inventory as well as a detailed discussion of how that affects the risk calculations and uncertainties for this RPE. (DH) (JC)			
154.	**Pg. B-21, section B.3.4.** In addition to LCFs and if data are available, consider adding non-fatal cancers and non-cancer radiological effects (e.g., acute radiation syndrome, dermal erythema, opacification of the eye, temporary impairment of fertility, etc.), especially for "short-term" risks. Morbidity risk coefficients (i.e., fatal plus non-fatal cancer risk) are higher (more conservative) than mortality risk coefficients (i.e., fatal cancer risk) for radionuclides. Provide additional text detailing the above information. (DH) (DD)			
155.	**Pg. B-21.** Short term Human Health risk seems to be a combination of accident scenarios and standard EPA residential exposure scenarios. These need to be separated for clarity. Separate accident from standard EPA short- term human health risks. (JY)			
156.	**Pg. B-22, paragraph 1**. Because short-term human health risk (i.e., accident and non-accident) is evaluated for the 10 retrieval cases, it is not clear what has been excluded from analysis. Provide additional text either including this information in the analysis or explaining why is was omitted. If it is included, adjust the risk calculations. If not, provide a discussion of how exclusion affects uncertainty and adjust the uncertainty analysis accordingly. (DD)(DH)			

157.	**Pg. B-22, paragraph 1.** It may be possible that subsurface leaks at the base of the tank result in an atmospheric release for volatile COCs (even in the "short-term"). Provide additional text discussing this potential scenario. (DD) (DH)			
158.	**Pg. B-23, Step 6.** State that radiological dose is determined for the "involved worker" too, presuming this is the case. (DD) (DH)			
159.	**Pg. B-25, section B.3.5.** Need specific details related to modeling. (see modeling comment Pg B-15) (JC)			
160.	**Pg. B-26, section B.3.5.1, last paragraph.** Please identify the input parameters for flow and transport (e.g., dispersivity, gradient) used in the models and specify the location at which the model results applies; i.e., at the nearest point on the fenceline, the nearest location along the fenceline on the groundwater flow path, etc. Explain why the modeled thickness of the aquifer was chosen as 5 m, when groundwater monitoring wells extend up to 16 m into the aquifer of a 200+ ft. thick aquifer. (JC)			
161.	**Pg. B-27, section B.1.2.1.1.** Which ERPGs are used (-1, 2, or 3)? Provide additional clarifying text. (DD) (DH)			
162.	**Pg. B-24 and B-25, section B.3.4.3.** Note that this section has some inconsistencies with Figure B.3.2 (i.e., text says noninvolved workers are exposed via inhalation and external exposure, while Figure B.3.2 indicates only inhalation; text says public exposed via inhalation, external exposure, and food, while Figure B.3.2 indicates inhalation and food only). Provide an explanation and corrections as needed to the RPE. (DD) (DH)			
163.	**Pg. B-25, section B.3.4.4.** The text states that a hazard index (HI)<1.0 is acceptable but is silent on acceptable cancer risk here. Provide additional text with an explanation of the acceptable cancer risk noted above. (DD) (DH)			

164.	**Pg. B-26, section B.3.5.1.** Regarding predictions out to 10000 years, although radiological profiles can be predicted via decay constants, unknown climatic and tectonic events (which influence fate/transport processes) may override the utility of these predictions over this time scale. Provide additional text detailing the above scenarios. (DD) (DH)			
165.	**Pg. B-29, Table B.3.4.** This list of COCs (radionuclides and non-radionuclides) appears short, given the complex and uncertain disposal history. Detail the justification for this approach (including the assertion that these COCs contribute 95% of the groundwater pathway long-term risk) and acknowledge the associated uncertainty. For example, if a more comprehensive array of pathways were evaluated, would additional COCs be added (DD) (DH)			
166.	**Pg. B-30, paragraph 1.** The report states the assumption that the RCRA Subtitle C barrier would degrade after 500 years from date of installation. This could lead to the failed cover scenario discussed in previous Ecology comments for the C-104 F&R and RPE as well as the S-112 F&R and RPE . Incorporate this assumption into previous comments relating to the failed cover scenario and related air and direct exposure environmental and human health pathways. Indicate where this was incorporated. (DH)			
167.	**Pg. B-30, paragraph 2.** What is the basis for the simulated leak losses, what is the standard deviation associated with each, and the uncertainty of these values? Provide an explanation. (JC)			
168.	**Pg. B-32, paragraph 1, last sentence**. Provide a basis for the assumptions of uniform aquifer thickness and contaminant distribution. (JC)			
169.	**Pg. B-33, section B.3.6.3.** Note that DOE/EIS-0189 (TWRS/EIS) evaluates Native American and recreational shoreline/land user exposure scenarios, in addition to residential farmer and industrial			

	scenarios. Provide an evaluation of these scenarios for the S tank farm. (see earlier comment on these scenarios. The additional information could be combined as one response referencing the applicable comments) (DD) (DH)			
170.	**Pg. B-34, paragraph 2.** It is stated that the industrial worker scenario represents "non-remediation workers." Explain why long-term risk was not evaluated for "remediation workers" as well. (DD) (DH)			
171.	**Pg. B-34, section B.3.6.4.** Describe URF methodology in more detail. For example, state whether or not URF methods use toxicity factors (e.g., cancer slope factors, reference doses) from EPA's IRIS/HEAST. In addition explain the use of URF methodology in PNNL's Multimedia Environmental Pollutant Assessment System (MEPAS) software. Evaluation of LCFs (fatal cancers) for short-term human health risks vs. ILCRs (fatal and non-fatal cancers) for long-term risks is somewhat inconsistent. Provide additional text to clarify the inconsistencies. (DD)			
172.	**Pg. B-34 through B-36, section B.3.6.4 including Table B.3.7.** Equation 1 makes no distinction among non-carcinogens, non-radionuclide carcinogens, and radionuclides. All three types of COCs should be summed and presented separately due to differences in derivation methods (i.e., hazard index for non-carcinogens, ICLR for non-radionuclide carcinogens, and ICLR for radionuclides). Revise the text to correct the above concerns. The text refers to "Equation B.1." This referral should be to "Equation B.2." Correct the text. (DD) (DH)			
173.	**Pg. B-36, section B 3.6.5**. This risk allocation is useful for cancer risk but does not address non-cancer hazards. Provide a separate "hazard index budget" for non-carcinogens with an HI threshold of 1.0. (DD)			

	(DH)			
174.	**Pg. B-37, paragraph 1.** Provide rationale/citations for the 100 mrem/y chronic and 500 mrem acute dose standards in the USDOE intruder scenario. (DD) (DH)			
175.	**Pg. B-38, table B.3.3.** Why do the radionuclides in this table not include all of those listed in previous related Tables in the RPE? Also should units for "unit dose factor" be expressed per time (i.e., mrem/Ci-y)? Provide explanations regarding the above concerns. (DD) (DH)			
176.	**Pg. B-38, paragraphs 1 and 2.** The USDOE intruder scenario considers radionuclides only. Explain how are non-radionuclides evaluated for this scenario. (DD) (DH)			
177.	**Pg. B-38, paragraph 2.** Revise text to state that dose (mrem/y) from each radionuclide is summed to calculate dose to a particular receptor. (DD) (DH)			
178.	**Pg. B-38, section B.3.7.2.** Explain the logic behind the change in classification for HLW remaining in the tank after retrieval to the classification of LLW. It's the same waste, so how does it acquire a new identify/classification by virtue of its residual status in a tank. Is this an appropriate use of NRC "incidental waste"? Provide and explanation. (JC)			
179.	**Pg. B-39, paragraph 1.** Because the NRC scenario assumes intrusion 500 y after waste disposal and the USDOE assumes intrusion 100 y post-tank closure, the two scenarios are not strictly comparable. Explain the discrepancy and include the NRC scenario. (DD) (DH)			
180.	**Pg. B-39, table B.3.9.** How does one assure that these Class C limits will not be exceeded? Provide and explanation. (JC)			
181.	**Pg. B-42, next to last paragraph.** It appears this citation should be			

	40 CFR 193. Please check and correct as necessary. (JC) (DH)			
182.	**Pg B-50, paragraph 2.** It is stated that example retrieval cases are not intended to provide a means to "relax" regulatory requirements. Furthermore, the strategy should be designed to minimize retrieval leaks and residual volume in the tanks. As such, determining a risk-based threshold for "allowable" leak volume is only one part of the strategy. The other critical part is to minimize leaks and volumes (consistent with the ALARA principle in radionuclide regulation). In this regard, however, ALARA should not only consider long-term human health risk but also short-term risks to workers during the retrieval process. Provide additional text reflecting the above concerns. (DD) (DH)			
183.	**Pg. B-55, bullet 1 in section B.4.2.** There is no agreement from Ecology that vadose zone contamination from past leaks is not to be remediated. This is a modeling assumption only. Provide additional text for clarification. (JC) (DH)			
184.	**Pg. B-58, paragraph 3.** Re subsurface leaks; revise text to include a short-term atmospheric scenario. (see related earlier comment) (DD) (DH)			
185.	**Pg. B-60, paragraph 1.** Re LCFs; (see earlier related comments) (DD) (DH)			
186.	**Pg. B-61, section B.5.1.1.3.** If the non-radioactive chemical concentrations in the residual tank waste are the same for all cases, why is ICLR not the same for all cases (similar to the situation for hazard index)? Provide additional clarifying text. (DD) (DH)			
187.	**Pg. B-63.** Does bullet 1 assume that no interim barrier is deployed before closure? Provide explanation. (JC)			
188.	**Pg. B-63, bullet 2 etc.** See comment on Pg. B-26, Section B.3.5.1 and address. (JC)			

189.	**Pg. B-64, Fig. B.5.1 (and others).** Do the data plotted here assume that the contaminant/activity is uniform over the entire modeled 5 m thick aquifer? Provide an explanation for this and other similar figures. (JC)			
190.	**Pg. B-124, figure B.6.2.** Provide details on how this figure was constructed. It is not particularly transparent and the conclusions hinge on its accuracy. This analysis considers ILCR (due to non-radionuclide and radionuclide carcinogens), as a function of retrieval leak loss volume and residual tank waste volume. Hazard index (non-carcinogens) should also be evaluated for Tank S-112 and S Tank Farm (as a whole). (DH) (DD)			
191.	**Pg. B-129 through B-134, section B.6.3.** The conclusions presented in this section need to be modified to incorporate the Ecology concerns presented in the preceding Ecology comments. Revise this section to incorporate the preceding comments. (DH)			
192.	**Pg. B-133, section B.6.4.1**. Ecology agrees that delaying S-112 retrieval progress is not in the best interest of the public. This statement is made in consideration of the fact that USDOE is currently working on an uncertainty analysis for this RPE. This statement is also conditional on adequate resolution of key comments provided in this comment submittal. Ecology does not agree that the results of the AX farm uncertainty analysis are generally applicable to S farm, especially when the missing scenarios and related pathways are considered. Provide the missing uncertainty analysis that incorporates adequate resolution to Ecology comments by June 30, 2002. (DH)			

	XXXXXXX **Attachment B1** XXXXXX			
193.	**Pg. B1-3, section B1.2.0.** What is meant by the term "past leak data"? Does it include waste leaked from various tanks in S Farm? As S-112 is listed as "sound", what would be used? Does this term include other wastes that could have leaked from ancillary equipment at any time during operation of tanks in C Farm? Provide additional text to answer the above questions. (JC)			

REVIEW COMMENT RECORD (RCR)	1. Date 3/12/02	2. Review No.
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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
RPP-7807, Rev. 0 Single Shell Tank C-104 Full Scale Sludge/Hard Heel, Confined Sluicing and Robotics Technologies Waste Retrieval Demonstration Functions and Requirements		J. Caggiano, S.Dahl, D.Delistraty, D.Heggen, A.Huckaby	Ecology	1315 W. 4th Ave. Kennewick, WA (509) 736-5720

17. Comment Submittal Approval:

Organization Manager (Optional) _____ Date _____

10. Agreement with indicated comment disposition(s)

Reviewer/Point of Contact _____

Author/Originator _____

11. CLOSED

Reviewer/Point of Contact _____ Date _____

Author/Originator _____

Item	Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted)	Status
1.	**Executive Summary, paragraph 2.** The first sentence states: "This document establishes for the life of the project....". During the review of the draft C-104 Functions and Requirements (F&R) document, Ecology provided comment which recommended the establishment of "placeholders" for insertion of LDMM technologies, groundwater monitoring plan descriptions, contaminated groundwater characterization data, vadose zone monitoring plan descriptions, vadose zone characterization data insertions, etc. The phrase "for the life of the project" appears to indicate that the C-104 F&R document will neither include "placeholders" nor will be			

	modified to include descriptions, plans, data, etc. Again, it is recommended that the document allow for insertion of LDMM technologies, groundwater monitoring details, vadose zone monitoring details, vadose zone data, groundwater characterization data, etc. (AH)			
2.	**Executive Summary, Pg i, paragraph 4.** The retrieval requirement for C-104 is to leave no more than 360 cubic feet as stated in M-45-00. The 99% goal is applied to the average volume for all SSTs which calculates to a maximum residual waste volume of 360 cubic feet for all large (200 series) SSTs. It is not intended to be applied on a tank by tank basis. Correct all text in the F&R and attachments to reflect this concept. (DH)			
3.	**Executive Summary, paragraph 5.** The paragraph does not identify that mixed waste may also remain in the event that the tank is not RCRA "empty". Include a sentence or reference about remaining waste being "mixed waste". (AH)			
4.	**Executive Summary, paragraph 7.** The last sentence states: "...and developed to a level that adds confidence and increased capability to the EPA reference methods..." The portion of the sentence quoted implies that there is some process by which it will be determined whether or not the "alternate technologies" have been developed to some qualitative level that increases "capability to the EPA reference methods". The document should include a description of the process to be followed. As the "alternate technologies" may be new in relation to "EPA reference methods", it is important to understand the criteria by which the "alternate technologies" will be deemed worthy of implementation and/or incorporation. At a minimum, include an identification in the Executive Summary that the C-104 F&R document includes a description of the process by			

	which the "alternate technologies" will be evaluated and compared to "EPA reference methods". (AH)			
5.	**Pg. 1-1, section 1.0.** The second and third sentences of the second paragraph state: "SST waste retrieval activities will be conducted, to the extent required, to meet requirements that allow ultimate closure of the tank and the tank farm. DOE, the State of Washington Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) have adopted a risk-based approach to SST retrieval." Although removal standards are established by retrieval-related TPA milestones and the risk-based retrieval approach is described by retrieval-related TPA milestones, closure requirements have not been established. Therefore, add a sentence to this paragraph which indicates that retrieval activities will be conducted in such a manner that does not preclude future retrieval and/or closure actions in the event that closure requirements are established which require additional retrieval and/or closure action(s). (AH)			
6.	**Pg. 1-1, section 1.0.** The Hanford CT3 process has recently moved toward individual closure of single shell tanks. Provide additional information in this and other F&R documents sufficient to support individual tank closures. (SD)			
7.	**Pg. 1-1, section 1.1.** The last sentence of the first paragraph correctly identifies the concern associated with liquid usage during past practice sluicing. A broader view indicates that high-volume liquid usage in the aging SST systems is the primary concern. In the case of tank C-106, the cooling water added to the tank prior to retrieval may have leaked from water lines and may have served as a hydraulic driving force. Therefore, it is recommended that the text identify that any high-volume liquid usage in the SST systems is a primary concern. (AH)			

8.	**Pg. 1-1, section 1.1, paragraph 2.** Describe the "numerous technologies" that have been identified for waste retrieval. In other words, an adequate conceptual description of the planned system is needed. Provide a description including tables. This information could be included elsewhere in the report. (JC) (SD)			
9.	**Pg. 1-2, section 1.1.** The next to last sentence in the paragraph from the preceding page states: "…detect, monitor, and mitigate detectable leaks". The word "detectable" in this context could be interpreted to mean that only those leaks which exceed the risk-calculated "allowable leakage amount" will be mitigated. Recommended wording is: "…detect, monitor, and mitigate leaks". (AH)			
10.	**Pg. 1-2, section 1.1, paragraph 1, last sentence.** Reference is made to "design, development, screening, and assessment of alternative technologies….for LDMM". The schedule presented in the January 2002 project W-523 notes shows a proposed technology insertion point (TIP) of May 2002 for LDMM into the design phase. Provide adequate detail and schedule indicating how and when ex-tank LDMM technology will be inserted into the design process. This information shall be of sufficient quality so that Ecology can asses the adequacy of the system. (JC)(DH)			
11.	**Pg. 1-2, section 1.1**. The first bullet which describes the tank C-104 retrieval demonstration goals does not follow the direction of the goals as established by milestone M-45-03F or M-45-00. To avoid misunderstanding or misinterpretation, re-write the goals borrowing key non-conflicting portions of milestone language. Recommended wording is: "Establish the technological-based retrieval volumes of a confined sluicing robotics system designed to meet the *Hanford Federal Agreement and Consent Order* Milestone M-45-03F. The			

	demonstration will include the installation and implementation of full scale leak detection, monitoring, and mitigation (LDMM) technologies. The demonstration goals also include retrieval of approximately 89 kilograms of plutonium with tank residues not to exceed 360 cubic feet." (AH)(DH)			
12.	**Pg. 1-2, section 1.1.** The second bullet ends with the following stated goal: "...and detect leakage within a risk-based performance envelope." The applicable wording of Milestone M-45-03-T04 is: "The functions and requirements document and its associated RPE shall provide environmental and human health risk evaluation data/information associated with estimated waste volumes to be retrieved, the maximum volume which could leak during retrieval, and risk from residual waste." The main purpose of the F&R and associated RPE is to provide sufficient information on the proposed retrieval actions in order to understand associated risk whether it is from residual waste or leaked waste. It was not Ecology's intention that these documents be used to establish residual or allowable leakage volumes without adequate consideration for technology-based performance. It is recommended that the following wording be used instead: "...and detect leakage within a technology-based performance envelope." (AH) (SD)			
13.	**Pg. 1-2, section 1-1, bottom of page.** The results of the RPE are said to "establish performance requirements that are protective of human health and the environment." The main purpose of the F&R and associated RPE is to provide sufficient information on the proposed retrieval actions in order to understand associated risk whether it is from residual waste or leaked waste. It was not Ecology's intention that these documents be used to establish residual or allowable leakage volumes without adequate			

	consideration for technology-based performance. Allowing up to 36,000 gallons to leak during retrieval from a single tank that DOE considers "sound" seems contrary to the stated goal. If all twelve 100-series tanks in C Farm were allowed to leak 36,000 gallons and add in a few thousand more gallons leakage for the 200-series tanks, that would be essentially the equivalent of leaking an entire tank to the soil during waste retrieval. Considering that LDMM technologies under consideration by USDOE have potential to detect leaks less than 1,000 gallons, these statements seem at odds with one another. The Retrieval Performance Evaluation (RPE) is lacking in substance and detail (see comments on Appendix B) as well as an uncertainty analysis and; therefore, cannot be relied upon as a basis for calculating such a high leak loss volume. (JC) (DH) (SD)			
14.	**Pg. 1-2, section 1.1.** The last paragraph on the page indicates that "in absence of these requirements, the results of the RPE are used to determine the risk posed by residual waste..." The requirements as stipulated by HFFACO Milestone M-45-03F are to retrieve the waste to the DST system to the limits of the technology (or technologies) selected. The Milestone M-45-03F requirements do not appear to require a risk assessment to be performed to "establish performance requirements that are protective of human health and the environment." Furthermore, the word "risk" does not appear in the HFFACO Milestone M-45-03F. As such, include an identification that the risk assessment wording required by milestone M-45-03-T04 states: "The functions and requirements document and its associated RPE shall provide environmental and human health risk evaluation data/information associated with estimated waste volumes to be retrieved, the maximum volume which could leak during retrieval, and risk from residual waste." It appears that USDOE has interpreted the wording to mean that the use the RPE approach is to establish			

	"allowable leakage" numbers. In addition, include an identification that the RPE used for C-104 does not allow an understanding of the risks associated with C-104 retrieval actions due to a scaling approach, missing key scenarios/pathways, and the lack of tank/tank farm-specific inventory and contamination characterization data/information. (see previous comment)(response may be combined with response for previous comment) (AH)			
15.	**Pg. 1-3, section 1.1.** The first two sentences on the page reference the risk results of the RPE. Due to the scaling approach used and the inability to estimate/evaluate risk associated with tank C-104, the credibility of the RPE risk assessment is at issue. Therefore, either include an identification that USDOE's RPE risk assessment approach achieves establishment of "allowable leakage" numbers or delete the statements. Similarly, either include an identification that USDOE's RPE risk assessment approach does not achieve a credible environmental and health risk evaluation due to the use of a scaling-approach and the lack of tank-specific and/or tank farm-specific contamination characterization and/or loss inventory information (i.e., it does not meet the stated objective of Milestone M-45-03-T04) or delete the statements. (AH)			
16.	**Pg. 1-3, section 1.1.** The TPA milestones state that the F&R and RPE should establish the risk of actions including resulting leaks and residual waste. The milestones do not state this will be the only criteria used to establish limits. Limits should be established by a combination of technology limits and risk limits. (SD)			
17.	**Page 1-3, paragraph 3.** Delete the entire paragraph and revise it to reflect the direction provided to USDOE through the December 7, 2001letter to James Rasmussen. The letter stated: "Ecology anticipates that the Functions and Requirements (F&R) documents to			

	be prepared before retrieval of each SST will include sufficient information to allow Ecology to determine if additions of liquids for retrieval will be allowed. Ecology will transmit written approvals or disapprovals for the F&R documents that will include determinations on the addition of liquids. Revise the text as directed above. (DH)(AH)			
18.	**Pg. 1-3, section 1.2.** As HFFACO Milestones M-45-03F and M-45-03-T04 are applicable to the C-104 F&R, Milestone M-45-03F should be referenced in relation to item number one (establishment of F&Rs). Recommended wording is: "...(1) establish the F&Rs to meet the requirements specified in *Hanford Federal Facility Agreement and Consent Order* Milestone M-45-03F....". (AH)			
19.	**Pg. 1-3, section 1.2.** HFFACO Milestone M-45-03F states: "This demonstration shall also include the installation and implementation of full scale leak detection, monitoring, and mitigation (LDMM) technologies." As such, item number two of the paragraph does not accurately depict LDMM objectives as described by HFFACO Milestone M-45-03F. Recommended wording is: "...(2) establish demonstration system specifications (including LDMM system specifications) and include a scoping level RPE". (AH)			
20.	**Pg. 1-3, section 1.2.** The third sentence indicates that USDOE Order 413.3 will be used/followed for defining "design start" and initiating final design. In other places of the C-104 F&R document, it is indicated that LDMM strategy is under development and that the strategy will be submitted "prior to initiation of design". It is this reviewer's understanding that LDMM is currently on a multi-year schedule to consider LDMM technologies and options. As such, the concern arises that the LDMM selection schedule may not allow inclusion/deployment to support C-104 retrieval activities. In other			

	words, there is a concern that the "design start" process associated with this retrieval action may constrain or even preclude LDMM options. Include a description of how LDMM will be deployed to support C-104 retrieval. Also, include a process description which does not constrain LDMM selection and deployment. In other words, include a process description which does not preclude deployment of ex-tank LDMM technologies to support C-104 retrieval. In addition, briefly describe USDOE Order 413.3. (AH)(DH)			
21.	**Pg. 1-3, section 1.3.** The first and second sentences of the first paragraph states: "This document provides the F&Rs necessary to support the design of the demonstration waste retrieval system for 241-C-104. This document also provides the strategy used to define the functions and F&Rs for retrieval and leak detection….". HFFACO Milestone M-45-03-T04 states: "This document will establish demonstration system specifications (including LDMM system specifications)…". In addition, the same milestone states: "DOE will submit its C-104 LDMM strategy as part of the functions and requirements document, prior to initiation of design." However, as stated in Section 1.2, the purpose of the F&R document is to "establish the LDMM…strategy". It may be concluded that the F&R document does not achieve the requirement as established by HFFACO Milestone M-45-03-T04. Include an identification of this issue and a description of the process that will be followed to achieve the milestone requirement/objective so that the critical path is not affected. (AH)			
22.	**Pg. 1-3, section 1.3.** The first bullet states: "Establishing the demonstration system requirements including the LDMM requirements". HFFACO Milestone M-45-03-T04 states: "This document will establish demonstration system specifications			

	(including LDMM system specifications)…". System "requirements" and "specifications" are two different things. Add an additional bullet which achieves establishment of LDMM system specifications (referencing process to be followed) without affecting project critical path. (AH)			
23.	**Pg. 1-3, section 1.3.** The last paragraph on the page describes how the functions and requirements in the document provide the foundation for the design criteria and design requirements documented in "Level 2 design specifications". As functions and requirements for LDMM are not provided in this document, include a description of how those functions and requirements will be "inserted" into this document. In other words, either identify "hold points" for insertion of LDMM functions and requirements or describe the process by which LDMM requirements and specifications will be established. In addition, whatever process is chosen to insert or establish LDMM functions, requirements, and specifications, the process should not affect project critical path. (AH)			
24.	**Pg. 1-4, section 1.3.** The second sentence of the first complete paragraph indicates that groundwater monitoring activities will be consistent with the most current C Farm groundwater monitoring plan. Via various means, numerous deficiencies associated with the existing C Farm groundwater monitoring network have been acknowledged (i.e., TPA Milestone M-24-00 annual negotiations, by the resulting "RCRA Well Needs Table" attached to last year's M-24-00M change control package, Ecology's update of the "RCRA Well Needs Table", etc.). In particular, it has been concluded that the current groundwater monitoring network has inadequate number and configuration (i.e., placement) of wells to ensure detection of			

	contamination emanating from C Farm. Therefore, it is expected that the groundwater monitoring network will change prior to initiation of the C-104 retrieval actions. It is appropriate to commit to monitoring groundwater in a consistent manner that will be employed at the time of retrieval. In addition, it is appropriate to acknowledge Ecology's concern associated with the current groundwater monitoring network's ability to detect contamination emanating from the C Farm. Recommended language to insert is: "Deficiencies associated with the existing groundwater monitoring network (i.e., adequacy of number and location of wells to detect contamination) have been identified by Ecology and thus, the groundwater monitoring network is anticipated to be modified to address those deficiencies prior to implementation of retrieval actions." (AH)			
25.	**Pg. 1-4, section 1.3.** The second sentence of the first complete paragraph indicates that groundwater monitoring activities will be consistent with the most current C Farm groundwater monitoring plan. While it is appropriate to commit to monitoring groundwater in a consistent manner (i.e., manner of sample collection) that will be employed at the time of retrieval, it is also appropriate to customize the groundwater monitoring to monitor before, during, and following the C-104 retrieval action. Groundwater monitoring conducted before, during, and following the C-106 retrieval clearly showed an effect of C-106 tank farm activities/operations on groundwater quality (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). Due to the expected changes to the C farm groundwater monitoring network and the unknowns associated with LDMM capabilities, include a commitment to monitor groundwater via an Ecology-approved monitoring plan which is designed to monitor the effects of C-104			

	retrieval activities on groundwater. (AH)			
26.	**Pg. 1-4, section 1.3.** The third sentence of the first complete paragraph indicates that drywell monitoring will occur prior to, during, and following waste retrieval activities. Due to the unknowns associated with LDMM capabilities, include a commitment to monitor drywells via an Ecology-approved monitoring plan. Recommended wording is: "Drywell monitoring will occur prior to, during, and following 241-C-104 waste retrieval activity via an Ecology-approved monitoring plan." (AH)			
27.	**Pg. 1-4, paragraph 1** states: "Drywell monitoring will occur prior to, during, and following 241-C-104 waste retrieval activity." Groundwater monitoring needs to be conducted on the same schedule. Groundwater monitoring before, during, and following the C-106 retrieval clearly showed an effect of waste retrieval from a "sound tank" and demonstrates the need for monitoring the groundwater as well as the dry wells. Provide additional text stating that that groundwater monitoring will be coordinated with drywell (and other) retrieval monitoring. (JC)			
28.	**Pg. 1-5, section 1.4.** The section does not identify the status of raw water lines. Groundwater monitoring conducted before, during, and following the C-106 retrieval clearly showed an effect of C-106 tank farm activities/operations on groundwater quality (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). Include an identification that interim measures taken in 200 West Area are currently scheduled to also occur in 200 East Area. Specifically, include identification that capping/cutting of leaking and/or unneeded raw water lines will occur with pressure testing of remaining lines is scheduled to occur this calendar year. (AH)			

29.	**Pg. 1-5, section 1.4.** The section does not include a description of existing or planned run-on controls. Include an identification that interim measures were taken in 200 West Area to provide run-on controls associated with 200 West Area tank farms. (AH)			
30.	**Pg. 1-5, section 1.4.** The section does not include a description of the current understanding of contaminant "inventory" outside of tank C-104. Spectral gamma logging provides ex-tank contamination characterization information (GJO-98-TAR, GJO-HAN-18). Include a description of ex-tank contamination characterization information available for near/around tank C-104. (AH)			
31.	**Pg. 1-5, section 1.4, paragraph 1.** Hanlon lists both C-104 and C-106 as "sound" tanks. Groundwater monitoring data before, during and following the C-106 retrieval suggests otherwise. Spectral gamma logging suggests releases between C-104 and C-105 (GJO-98-TAR, GJO-HAN-18). While the release may not have come from a loss of integrity from C-104, there is an inventory of waste in the vadose zone from a release from this cascade line series. Therefore, the assumption of C-104 as a sound tank and not including any soil inventory for analysis is flawed and needs to be corrected. Revise the F&R and RPE to include the above information and any other related soil waste release inventory data. Adjust the risk assumptions accordingly. (JC)(DH)(AH)			
32.	**Pg. 1-5, section 1.4, paragraph 3.** Sentence two indicates that dry well monitoring will be conducted as part of LDMM. Missing are the following details: 1) The type of logging to be conducted 2) the tools to be used 3) logging rates 4) logging schedule/frequency Provide additional text detailing the missing information and include justification. Include a discussion of the use of gamma vs. neutron logging. (JC) (DH)			

33.	**Pg. 1-5, section 1.4.** The second paragraph does not include a long list of "primary contaminants of concern". Tank 241-C-104 contains many additional contaminants. In addition, the tank contains contaminants that are considered important as groundwater "indicators" in association with Hanford SSTs (i.e., technetium-99, chromium, nitrate, etc.). It is noted that the RPE risk model of Appendix B can be described to be "driven" by technetium-99 as it represents a mobile contaminant in the environment. Yet, technetium-99 is not included as a "primary contaminant of concern". Therefore, include an explanation of basis or definition of "primary contaminants of concern" in this section. Describe why technetium-99 was not included. (AH)			
34.	**Pg. 1-5, section 1.4.** The second paragraph discusses "primary" contaminants of concern. The reader is referred to the RPE for provision of additional information on tank waste constituents. The RPE (page B-31) identifies radionuclide and chemical "contaminants of concern". The texts of the F&R document and the RPE should be consistent. Although the RPE identifies how contaminants of concern were selected ("based on a screening analysis that indicated these constituents would be highly mobile in the vadose zone and groundwater and would contribute approximately 95% of the total groundwater pathway long-term human health risk"), the two texts should, at a minimum, discuss the same list of contaminants of concern. Therefore, identify in the F&R text that the RPE identifies nitrite, nitrate, chromium, and total uranium as "chemical" contaminants of concern. (AH)			
35.	**Pg. 1-5, section 1.4.** The second paragraph does not include any non-radionuclides as "primary contaminants of concern". However, the best basis inventory for tank C-104 lists many contaminants			

	which are of concern to Ecology. For example, the TWINS database indicates the following best basis inventories for the following contaminants: 1,460 kilograms chromium, 34,600 kilograms fluoride, 837 kilograms lead, 67.3 kilograms mercury, 2,630 kilograms nickel, etc. Therefore, include an explanation of basis or definition of "primary contaminants of concern" in relation to non-radionuclides in this section. In other words, include an identification of how non-radionuclides were evaluated in context of "contaminants of concern" which could potentially enter the environment. (AH)			
36.	**Pg. 1-5, section 1.4.** The last sentence of the second paragraph states: "The RPE provides additional information on tank waste constituents." While this is accurate, the RPE does not appear to provide complete information on additional tank waste constituents. The F&R document, as a fundamental, should include a complete listing of inventory. The TWINS data base provides a "best basis inventory" for all Hanford Site SSTs. Therefore, include a complete listing of tank C-104 best basis inventories from TWINS somewhere in the F&R document. Currently, without this listing, the F&R document is incomplete as it does not even provide a complete identification of best basis inventories. As such, the document does not "provide environmental and human health risk evaluation data/information associated with estimated waste volumes to be retrieved". (AH)			
37.	**Pg. 1-5, section 1.4.** The second sentence of the third paragraph indicates that drywell monitoring will occur for leak detection and monitoring. Due to the unknowns associated with LDMM capabilities, include a commitment to monitor drywells via an Ecology-approved monitoring plan. (AH)			

38.	**Pg. 1-5, section 1.4.** The third paragraph does not identify that groundwater monitoring will occur for leak detection and monitoring. Due to the unknowns associated with LDMM capabilities, include a commitment to monitor groundwater via an Ecology-approved groundwater monitoring plan. This commitment should either be included in the third paragraph or a fourth paragraph should be written which describes the groundwater network as a 241-C-104 "condition". (AH)			
39.	**Pg. 1-7, section 1.5.** The last bullet refers to the scoping-level RPE as "draft". Page "B-i" does not indicate the RPE is draft. Either delete the word "draft" or include an explanation of the "draft" designation. If the designation is correct, the RPE should also indicate it is draft. (AH)			
40.	**Pg. 2-1, section 2.0.** Due to the unknowns associated with the LDMM, add clarifying language which will insure support of LDMM selection, design, and deployment. Recommended language for the last sentence of the section is: "The following subsections identify the retrieval requirements framework as well as the LDMM selection, design, and deployment approach that will govern operation of the 241-C-104 waste retrieval system." (AH)			
41.	**Pg. 2-1, section 2.1.** The last sentence on the page states: "This document meets the submittal requirements identified by Milestone M-45-03-T04 of the *Hanford Federal Facility Agreement and Consent Order*." The F&R document does not include LDMM system specifications as required by Milestone M-45-03-T04. To date, the LDMM system has not been selected, designed, or deployed. Therefore, add a statement to the document that identifies that the LDMM selection, design, and deployment will not affect the project critical path. Also, include a statement that the project critical			

	path will not preclude LDMM selection, design, and deployment options. (AH)			
42.	**Pg. 3-1, section 3.1.** The first bullet of the section indicates the retrieval schedule is "driven by" DST space availability. A more accurate way to describe the situation is that the retrieval schedule is "reliant upon" DST space availability. (AH)			
43.	**Pg. 3-1, section 3.1.** As the F&R document includes "lessons learned", the retrieval of tank C-104 is considered a "demonstration", and TPA agreements are modified as needed, change the last bullet to include provision for modification of existing TPA milestones as needed. Recommended language is: "...vadose zone, retrieval performance, and establishing new or modifying existing milestones." (AH)			
44.	**Pg. 3-2, section 3.1.** Editorial observation. The second bullet contains an unnecessary "of" between the words "establish" and "LDMM". (AH)			
45.	**Pg. 3-2.** This portion of the F&R strategy focuses, in part, on the role of LDMM in support of retrieval operations; however, there is no discussion of the ability to adequately document the volume of potential leakage in order to evaluate the performance of the retrieval technology regardless of risk. Provide additional text discussing this aspect of SST retrieval. (DH)			
46.	**Pg. 3-4, section 3.1.** The various risk assessment performance measures (i.e., long-term risk, intruder risk, and worker risk) do not appear to identify or address "impacting releases". Impacting releases occur when contamination mobility is enhanced by unit-specific conditions. For example, during tank waste operations associated with C-106, groundwater impacts were observed (see			

	figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). While the cause for the contamination mobilization may be inconclusive (i.e., leaking fire suppression lines, leaking cooling water lines, etc.), groundwater has been negatively impacted. As such, it is appropriate for risk assessments to include "impacting releases" in the appropriate risk scenarios. If the risk assessment scenarios will not include evaluation of "impacting releases", include an explanation/justification in the F&R document. (AH)			
47.	**Section 3.1, General Comment.** The section includes a description and discussion of the RPE. What the discussion does not include is an identification that the "scoping-level" RPE generates a "leak loss limit" that is both numerically high (36,000 gallons) and non-inclusive of C-Farm-specific characterization data/information. The stated purpose in the associated TPA milestone(s) is to evaluate the risk of certain actions and not to develop a leak loss limit based strictly on risk lacking consideration of reasonable technological limits. During several document development meetings, Ecology representatives communicated that the previous generated leak loss number of 29,000 gallons was unacceptably high. Also during the document development meetings, Ecology repeatedly requested the use of "hold points" until such time that LDMM leak detection limits could be generated/identified rather than forcing the agreed-to approach to specify an unacceptably high "leak loss limit". The approach appears to result in the generation of a "scoping-level" RPE at the expense of provision/generation of a "leak loss limit" that provides adequate evaluation confidence or acceptability. In other words, as the RPE does not use C-Farm-specific characterization information/data (due to unavailability and scaling approach), lacks some key failed cover scenarios/pathways, and lacks			

	environmental/ecological pathways, the confidence associated with the "leak loss limit" is lessened. In other words, the RPE approach taken appears to trade adequate confidence associated with the "leak loss limit" for a "scoping-level" evaluation that will allow the retrieval demonstration to advance. The "trade-offs" that are inherent to this approach should be clearly described in the F&R. In addition, due to the unacceptably high leak loss limit number, an identification of Ecology's concerns with the process/approach should also be included in the discussion. Clearly, this issue has not been resolved by this text and certainly not by the leak loss limit increasing from 29,000 to 36,000 gallons. (see comment Pg 1-2, Section 1.1) (AH)(DH) (SD)			
48.	**Pg. 3-5, figure 3-2.** This figure is not readable. Explain how the data were derived and the uncertainty in the input data so as to justify the significance and decisions based on it. Also provide a list of the input data. The use a dual logarithmic graph coupled with an attempt to compare risk between two very different exposure scenarios on one figure contributes to the confusion. Please revise and explain thoroughly and simply how this figure was derived. (JC) (DH)			
49.	**Pg. 3-6, bullet #1.** The exclusion of waste and contaminants in the ancillary equipment and the soil is unacceptable. Either revise the report to demonstrate that this doesn't change the data/conclusions or revise the analysis. (JC)			
50.	**Pg. 3-6, section 3.2.** General Comment. The RPE approach appears to only evaluate risk to human health (i.e., long-term, intruder, and worker risk scenarios). TPA milestone M-45-03-T04 states: "The functions and requirements document and its associated RPE shall provide environmental and human health risk evaluation data/information…". Include an explanation of how this risk			

	assessment approach provides an environmental risk assessment. In particular, include an explanation of how the approach addresses evaluation of environmental risk to meet Milestone M-45-03-T04 requirements. (AH)			
51.	**Pg. 3-6, section 3.2.** Administratively, procedurally, and chronologically, post-retrieval occurs before closure which occurs before post-closure. In bullet number 3, change the word "post-closure" to "post-retrieval". (AH)			
52.	**Pg. 3-6, section 3.2.** Typographical error noted in bullet number 3. Insert an "as" between the words "data" and "well". (AH)			
53.	**Pg. 3-7, paragraph 1.** The report states "The risk assessment does not address risks to down-river future populations or the cumulative risks from other SSTs and waste sites outside the tank farm." Previous comments provided by Ecology to USDOE on the AX Farm RPE and the draft C-104 F&R on this subject seem to have been ignored. In addition other factors including, ancillary equipment and past C-Farm-specific non-tank leak/spill soil inventory as well as certain air and direct contact/ingestion exposure pathways were also omitted. These omissions result in a highly questionable risk basis for making key decisions related to retrieval and closure. Decisions made according to the risk information presented in the F&R report would be incomplete and out of context. An uncertainty analysis was not performed. Ecology has little confidence in the risk based conclusions presented in this report. (DH)			
54.	**Pg. 3-7, bullet 1.** The text indicates that groundwater impacts are evaluated at the tank farm boundary. This statement needs to be expanded to include the number/location of wells, type of sampling to be conducted, constituents to be analyzed, and frequency of			

	sampling. Describe/justify how the above information along with location, spacing and screen length/placement of the wells is adequate to detect a release and why it is sufficient to allow assessment of groundwater quality impacts. Please revise the text. (JC)			
55.	**Pg. 3-7, section 3.2.** Screening performance measures by which impact analysis is evaluated are listed in bullet form. Groundwater quality at the tank farm boundary is identified as a measure. Include an identification that currently, Ecology has expressed concern that the groundwater monitoring network is incapable of ensuring contamination detection. This issue has been well established during TPA Milestone M-24-00 annual negotiations and is documented by "RCRA Well Needs" tables (calendar year 2000 and updated calendar year 2001). To date, there is no schedule for well installation to occur at C Tank Farm's groundwater point of compliance. Therefore, until such time as a compliant groundwater monitoring network exists (i.e., one that ensures contamination detection at the point of compliance) at C Tank Farm's groundwater point of compliance, this performance measure does not provide assurance that impact can be evaluated in relation to groundwater quality. (see previous comment)(AH)			
56.	**Pg. 3-7, middle of page.** The process of developing assumptions based on engineering judgment where data were either unavailable or highly uncertain needs further explanation. Why are these assumptions valid input to the analysis? Please address and revise text. (JC)			
57.	**Pg. 3-7, section 3.2.** The text explains that where data were unavailable or highly uncertain, assumptions were developed to complete the analysis. Identify in this section if groundwater quality			

	was assumed to have already been impacted by C Tank Farm releases (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). Also, if this assumption has not been made, include an explanation and/or justification. (AH)			
58.	**Pg. 3-7, section 3.2.** Screening performance measures by which impact analysis is evaluated are listed in bullet form. Compliance assessment is identified with an indication that "open issues" have been identified. Include an identification somewhere in the F&R document that Ecology has expressed concern that the groundwater flow direction is not adequately understood at C Tank Farm. Understanding groundwater flow direction is a regulatory requirement which is currently an "open issue" at C Tank Farm. Therefore, until such time as a compliant groundwater monitoring network exists (i.e., one that ensures contamination detection at the point of compliance) at the C Tank Farm, this performance measure does not provide assurance that impact can be evaluated in relation to groundwater quality. (AH)			
59.	**Pg. 3-7, bullet 4.** Explain and justify why the conceptual model for this tank farm excludes ancillary equipment and the inventory of contaminants leaked to the vadose zone. (JC)			
60.	**Pg. 3-7, last two bullets.** These two statements of LDMM are too vague. Please provide details, or state when this detail would be available before waste retrieval occurs so as to be meaningful. (JC)(DH)			
61.	**Pg. 3-7, second to last bullet.** The text implies there was an evaluation of static measurements for C-104; however, the type of retrieval planned for C-104 will not accommodate static in-tank			

	methods. Please correct the text. (DH)			
62.	**Pg. 3-8.** The inadequacy of LDMM and this proposal for waste retrieval is best captured in the following: "The upper leak detection limit for the farmer scenario….is approximately 36,000 gallons. The target performance criterion for the leak detection system shall be 36,000 gallons or less. The best deployable leak detection technology currently available may not be able to reliably detect a leak of this size in a timely manner." Provide a detailed explanation of the uncertainty associated with this leak loss volume. (JC)			
63.	**Pg. 3-8, section 3.2.** The last sentence of the third paragraph identifies a RPE variable. As groundwater and compliance requirements are defined as RPE performance measures to assess impact, the scenario to relocate the point of compliance boundary is not a variable that will likely be changed for purposes of this RPE. The last sentence of the third paragraph does not appear to be needed and it is recommended that it be deleted. (AH)			
64.	**Pg. 3-9, paragraph 1.** The lessons learned found in section A did not include any information or reports following the summer 2002 ex-tank LDDM demonstrations. In fact the only ex-tank leak detection technology mentioned was a soil vapor method. (DH)			
65.	**Pg. 3-9, paragraph 1, last sentence.** This is an assertion that needs to cite specifics, or reference(s) where such information can be found. As stated, this statement can not stand by itself without support. Please revise. (JC)			
66.	**Pg. 3-9, paragraph 3.** Add a sentence to the end of the third paragraph which refers the reader to Section 5 for a description of the LDMM strategy. Recommended wording is: See Section 5 for a description of the process by which ex-tank LDMM will be selected,			

	designed, and deployed. (AH)			
67.	**Pg. 3-9, section 3.3.** Typographical error noted in first sentence which should read: "Lessons learned have already provided…". (AH)			
68.	**Pg. 3-9, section 3.3.** As the subject matter is radiological mixed waste, the term "critical" may have additional meaning that is not meant in this context. Re-word the 2nd bullet from the bottom of the page to re-state when retrieval will stop. (AH)			
69.	**Pg. 3-9, section 3.3.** Add an additional bullet at the bottom of the section which states: "Increase environmental monitoring (i.e., drywell and groundwater) before, during, and after retrieval activities." (AH)			
70.	**Pg. 3-9, paragraph 3, last sentence** reads, "The best available and deployable LDMM technology will be used for 241-C-104 retrieval." (see comment #2) The statement, as written, is unacceptable. Please revise. (JC)			
71.	**Pg. 3-9, paragraph 3.** Revise the second sentence as follows: "…incorporate these lessons learned in this F&R and during the design…" (DH)			
72.	**Section 4, General Comment.** The basis of functions and requirements have been provided in each sub-section. In the event that requirements change, include a provision that, if necessary, new requirements will be evaluated for incorporation. For example, if SST and DST dome loading requirements become more stringent, the C-104 retrieval F&R should include a provision to address the imposed change(s). (AH)			
73.	**Pg. 4-1, section 4.0.** There are numerous functions and requirements stated here as objectives of the design. Add/revise the text to indicate			

	the likelihood that these objectives can be achieved in a manner that satisfies these goals and the schedule for waste retrieval. (JC)			
74.	**Pg. 4-1, section 4.0.** If the best basis inventory (BBI) of a certain date is cited and associated with retrieval goals/objectives, then the F&R document should include a complete BBI dated 8/1/00. The BBI should list all contaminants included in the BBI as of the date selected. Also, to clarify, identify if the 8/1/00 BBI represents pre-interim stabilized or post-interim stabilized inventory. (AH)			
75.	**Pg. 4-1, section 4.2.** Hydrostatic forces are briefly mentioned. Provide additional text to support the limits stated in this section (do not simply reference a report). Cite key controlling regulations. (DH)			
76.	**Pg. 4-1, section 4.2.** Either add a new sub-section or modify this sub-section to indicate that all liquid additions and subtractions will be measured/metered. (AH)			
77.	**Pg. 4-2, section 4.3.** The text states: "If active ventilation is required… during waste retrieval…" Provide additional text detailing the requirements for vapor space pressure if active ventilation is not required. (DH)			
78.	**Pg. 4-2, section 4.4.** Related to this section and missing from the lessons learned (appendix A) is any information relating to non-radioactive gaseous discharges that affected site workers during the C-106 and SY-101 retrieval operations. Provide additional text detailing the requirements needed to prevent such events in the future. (DH)			
79.	**Pg. 4-2, section 4.5.** Correct the statement that 99% retrieval is the goal. As stated in the first comment, 360 cubic feet is the goal stated in M-45-00. Also missing is a statement that even if the retrieval			

	goal is met, retrieval should proceed, as technically feasible to remove as much tank waste as possible. (DH)			
80.	**Pg. 4-2, section 4.5.** The TWINS Website 2000 is referenced for the 8/01/2000 best basis inventory. Again, as the cited reference could be subject to change and the F&R should represent a "stand-alone" document, include the complete 8/01/2000 BBI in the F&R. (see comment Pg. 1-5, section 1.4) (AH)			
81.	**Pg. 4-2, section 4.5.** Include a description of how recovery limits will be measured and documented. (AH)			
82.	**Pg. 4-2, section 4.6.** The report states: "Provisions shall be made to sample waste during retrieval operations." Provide additional text detailing the method of sample collection, frequency of sampling, and list of constituents to be monitored/analyzed. Also include the rationale for the above. (DH)			
83.	**Pg. 4-3, section 4.6.1, bullet 1.** The goal stated here is the detect a cumulative leak loss during retrieval of 19,000 gallons, but the goal state on pg 3-8 is 36,000 gallons. LDMM technologies seem to be targeting a leak detection capability considerably smaller, on the order of 1,000 gallons or less. The "Basis" states that the goal is 19,000 gallons based on BATEA. Justify the 19,000 gallons, make these statements consistent, and clarify what is the goal for LDMM and when will it be achieved. (JC)			
84.	**Pg. 4-3, section 4.6.1, bullet 2.** On page 3-8, the statement is made that DOE is not certain it can detect a leak of 36,000 gallons (no uncertainty of this estimate provided). This statement says that a 19,000 gallon leak can be detected with a 95% certainty and a 5% probability of false alarm. These statements are incompatible. Please revise and clarify with details. (JC)			

85.	**Pg. 4-3, section 4.6.1.** Based on other information presented in this report, and considering that the real risk numbers will drive the leak loss volume lower, there is some doubt that the in-tank leak detection methods on which this section is based would be able to detect a leak prior completion of retrieval. (DH)			
86.	**Pg. 4-3, section 4.6.1.** The term "best available technology economically achievable" (BATEA) is used rather than "best available technology" (BAT). Using wording such as "economically achievable" renders the requirement very subjective and completely dependent upon a supporting budget. As such, include a rough order estimate of budget that is necessary to support achievability of ex-tank LDMM. Obviously, Ecology is concerned that LDMM be dependent upon unspecified budget (during a time of shrinking budgets) when LDMM specifications have not been provided (i.e., LDMM has not been selected, designed, or deployed). (AH)			
87.	**Pg. 4-3, section 4.6.2.** The second sentence specifies "to support a post-retrieval RPE, which will be used to address retrieval of the next C-Farm tank. " Due to the concerns previously identified regarding the RPE approach (i.e., scaling, lack of unit specific characterization, lack of uncertainty analysis, missing scenarios/pathways, etc.) and as this section is dedicated to functions and requirements for this retrieval activity, delete the quoted words. (AH)			
88.	**Pg. 4-3, section 4.6.3.** The sub-section does not clearly indicate if liquid added or waste removed will be measured/metered. The sub-section could be interpreted to indicate that the system components will be "monitored and controlled". Include a function to measure/meter liquid added and waste removed. (AH)			
89.	**Pg. 4-4, section 4.8.** The use of supernatant for retrieval liquid needs to be explained. Describe the advantages and disadvantages of use of			

	recycled supernatant. Include a description of: 1) the type of liquid, 2) the estimated volume of each type of liquid, 3) the type of buffering to be used. Include the additional sample cost and effort associated with sampling the DST waste per the "Retrieval DQO" sampling requirements for characterization of Retrieval waste. Describe how quickly the system will be able to detect leaks. In addition, discuss the benefits of switching to just water as the retrieval liquid as the retrieval effort nears completion so that additional waste is not being added to the residuals. (the response to this comment could satisfy other parts of the report, including Section5.2.1 and Section 5.3.2.1, where supernatant is mentioned as a retrieval liquid) (DH) (SD)			
90.	**Pg. 4-4, section 4.8.** The sub-section indicates tank C-106 will be used for "drain-back of flush water during and after sluicing." The issue of adding contaminated liquids is unacceptable because the Hanford SSTs do not meet RCRA standards for a RCRA tank system; therefore, they cannot be used to receive RCRA wastes for storage as a TSDF. They are not awaiting issue of a TSDF permit; they are awaiting closure. Reuse/new use for holding contaminated liquids absent a permit and upgrade to RCRA standards is not compatible with state/federal hazardous waste regulations. C-106 lacks leak detection and monitoring sufficient for a leak to be detected. C-106 is an unfit for use tank and any additions of liquid must be approved by Ecology. At this time, Ecology does not approve this action. (AH)(DH)(JC)(MB)(SD)			
91.	**Pg. 4-4, section 4.9.** This section is inadequate. If a leak is detected, one would assume that the process would stop for an evaluation to determine if the detected leak is "real", and based on that decision, proceed forward to: stop retrieval and take action, continue retrieval,			

	perhaps at a different rate, mitigate the leak, monitor the leak etc. Reliance on an incomplete/insufficient RPE to evaluate a release is not acceptable. Please expand and clarify what will happen if and when a leak is detected. (JC)			
92.	**Pg. 4-4, section 4.9.** Include an indication that the liquids added during retrieval activities will be measured/metered. (see comment Pg. 4-1, section 4.2) (AH)			
93.	**Section 5.0, general comment.** Somewhere in Section 5 provide a process description of leak detection response actions. Indicate how and where Ecology is involved in the decision process. Include a statement that Ecology must approve a process control plan and that Ecology shall concur with the process control plan prior to implementation. (see comment for Pg. 5-15, figure 5-6) (SD)(DH)			
94.	**Section 5, general comment.** In an earlier comment (page 3-8, Section 3.2) regarding statements made about LDMM technology deployment, it was recommended that the following sentences also be included in Section 5: "However, different LDMM technologies are being tested by the Tank Focus Area Program, and eventually a new LDMM technology may be found that can deliver enhanced performance compared to currently deployable technologies. If a new technology is available and deployable within the context of the 241-C-104 retrieval demonstration design and construction schedule then it will be implemented." Section 5 should clearly describe the Tank Focus Area Program as well as the current USDOE LDMM technology down-select process. In addition, Section 5 should also include "hold points" where LDMM technologies may be inserted after they have been selected by the Tank Focus Area Program. (AH)			

95.	**Pg. 5-1, section 5.0.** Strike the text describing the possibility of not meeting some of the LDMM or retrieval requirements set forth in the F&R along with the statement regarding the TPA change control process. This is adds a negative tone to beginning of the "LDMM and Retrieval Strategy" section and, although the possibilities exist, it need not be stated here. Delete the above mentioned statements. (DH)			
96.	**Pg. 5-1, section 5.0.** The term "best available technology economically achievable" (BATEA) is used in the first paragraph. The same acronym was used in Section 4. Use of the term renders the requirement (in Section 4) very subjective and completely dependent upon a supporting budget. It is recommended that the term "best available technology" be used. (AH)			
97.	**Pg. 5-1, section 5.1, first bullet.** Change wording to "Minimizes all waste releases to the environment" or similar language to reflect that minimizing hazardous and radioactive waste releases to the environment is the goal. Refer to the closure section of the TPA Action Plan Closure Section for direction. Please correct. (JC)(DH)			
98.	**Pg. 5-2, sentence 2.** Revise the text as follows: "....then by definition there is no possibility of a leak unless the tank is overfilled." (JC)			
99.	**Pg. 5-2, paragraph 2.** Due to the fact that the risk assessment (RPE) used to support retrieval/LDMM decisions is inadequate in it's present form, and since corrections to the RPE will likely not occur in a timely manor, and furthermore since USDOE is basing design progress on Ecology approval of the functions and requirements presented in this document, Ecology will not hold up progress by holding approval of the F&R pending corrections to the RPE.			

	Ecology will not rely on risk-based decisions to move forward with design of the C-104 retrieval system. Revise text to indicate "Best Available Technology (BAT) and the down-select process for LDMM will drive this portion of the F&R with a minimum leak detection capability of 4,000 gallons. (JC)(DH)			
100.	**Pg. 5-2, paragraph 2.** Risk was never intended to be the only factor for making retrieval and leak detection decisions. The RPE was meant to provide relative risk information, which could be used in combination with BAT for guiding design. (SD)			
101.	**Pg. 5-2, paragraph 3.** Based on the USDOE mock tank tests and down-select process for LDMM it is highly likely that the "currently best available technology" does not require a free liquid surface. Provide additional text describing the available technologies and plans to down-select and incorporate new LDMM technologies. Also state that the panel members at the recent down-select workshop all agreed that at least some of the technologies available would be able to detect leak of 4,000 gallons or less. (see previous comment) (DH)(JC)			
102.	**Pg. 5-3, bullets 2 and 3.** Are really engineering controls for prevention of a leak. They are not a leak detection strategy. Please correct. (JC)			
103.	**Pgs. 5-3 through 5-8, section 5.1.1.** Revise this section. Provide information related to applicable and available leak detection technologies, including those under evaluation in the USDOE down-select process. (DH)			
104.	**Pgs. 5-3 – 5-8, section 5.1.1.** The text describes/discusses the RPE results and in particular, the "leak loss limit". Include an identification in Section 5.1.1 that the RPE provides a human health			

	risk assessment but does not provide an environmental risk assessment. (AH)			
105.	**Pg. 5-4, paragraph 1, sentence 4.** This sounds like mass balance, which was performed during the C-106 waste retrieval. This methodology has been evaluated. Please correct. (JC)			
106.	**Pg. 5-5, section 5.1.1.** Leak loss limit. (Refer to comment - Section 3.1, general) (AH)(DH)(JC)			
107.	**Pg. 5-5, paragraph 4.** Justify the first sentence regarding the target for leak detection of a free liquid surface vs. a non-liquid surface. Correct and provide additional text. (JC)			
108.	**Pg. 5-5, paragraph 4.** The text indicates the free liquid surface case is a full order of magnitude less than 19,000 gallons (=1,900 gallons). Compare that statement to the 8,000 gallon leak detection limit previously presented for the free liquid retrieval case for C-106. (DH)			
109.	**Pg. 5-5, bullet 4.** Provide additional text detailing the uncertainty related to tank C-104 characterization data and waste chemistry (DH)			
110.	**Pg. 5-6, paragraph 2, last sentence.** Revise text regarding current best available technology to include technologies under consideration in the USDOE down-select process. (DH)			
111.	**Pg. 5-6, sentence 2 below table 5-1.** What is the basis for the non-catastrophic leak loss of 1.8 gal/hr? Isn't this based on conditions in the tank that no longer prevail, e.g., use of FIC etc? Provide additional text explaining the rationale for the 1.8 gal/hr. and if this leak loss rate changes, and revise all text in the F&R to reflect the change. (JC) (DH)			
112.	**Pg. 5-6, paragraph 3, last sentence.** Justify the statement that			

	"...there is no evidence to indicate a catastrophic failure in 241-C-104 is likely." If specific evidence exists, state what it is, or delete this statement. Conversely, state that there is no evidence to say that a catastrophic failure is not likely. Please correct the text. (JC) (DH)			
113.	**Pg. 5-7, last paragraph see comment pg. 4-4, section 8.** Revise text to reflect actual C-106 groundwater data. (DH)			
114.	**Pg. 5-7, section 5.1.1.** The next to last sentence on the page states: "Lessons learned (Appendix A) show no evidence of retrieval causing a tank leak, and the 95% probability leak rate for a non-catastrophic leak in an SST (1.8 gal/hr) would be undetectable." The lessons learned included in Appendix A does not include or acknowledge groundwater observations at various tank farms regarding leaking lines mobilizing contamination (i.e., S-SX, B-BX-BY, C, etc.). To explain, during tank C-106 retrieval activities, groundwater impacts were observed (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). However, no conclusions were reached regarding whether the contamination was mobilized by raw water line leaks (i.e., due to line testing in preparation for C-106 retrieval or due to C-106 cooling water additions) or waste management operations (i.e., movement of waste within C Farm via leaking lines). Due to the groundwater observations, Ecology issued a letter dated October 11, 2000 which acknowledges the groundwater contamination observations and requests USDOE to conduct quarterly monitoring until such time that it is decided which groundwater monitoring program is applicable to C Tank Farm. The lessons learned in Appendix A should acknowledge such observances. Also, if contamination is mobilized during the course of routine tank farm operations, it would not be			

	unreasonable to conclude that contamination could also be mobilized during the course of retrieval operations. Therefore, either re-write the sentence to identify conclusions associated with contamination groundwater observations or add additional text which identifies/acknowledges that Ecology has concluded that contamination has been mobilized during the course of routine tank farm operations. In addition, identify that, in the past and currently, there are no leak detection capabilities that can monitor/detect a leak rate of 1.8 gal/hr with 95% probability. (AH)			
115.	**Pg. 5-8, 2 bullets.** Does it really matter as to the source of the detection? If a change is detected, then this should trigger an evaluation and one of the criteria would be evidence of a leak in C-104, an adjoining tank, or mobilization of waste in the vadose zone. How quickly such a detection is achieved is a function of the frequency of logging, the type of tool used and the logging rate. Provide additional text to clarify. (JC)			
116.	**Pg. 5-8, section 5.1.1.** The note at the bottom of the page identifies that the groundwater monitoring system is "not designed for real time (i.e., instantaneous) leak detection and response…" Via various means, numerous deficiencies associated with the existing C Farm groundwater monitoring network have been acknowledged (i.e., TPA Milestone M-24-00 annual negotiations, by the resulting "RCRA Well Needs Table" attached to last year's M-24-00M change control package, Ecology's update of the "RCRA Well Needs Table", etc.). In particular, it has been concluded that the current groundwater monitoring network has inadequate number and configuration (i.e., placement) of wells to ensure detection of contamination emanating from C Farm. Therefore, it is expected that the groundwater monitoring network will change prior to initiation of the C-104			

	retrieval actions. Include an identification in the note that deficiencies associated with the existing groundwater monitoring network's ability to detect groundwater contamination (i.e., adequacy of number and location of wells) have been identified by Ecology. Although the groundwater monitoring network is anticipated to be modified to address those deficiencies prior to implementation of retrieval actions, changes to the groundwater monitoring network have not been scheduled to date. (AH)			
117.	**Pg. 5-9, Section 5.2.1.** Provide additional text explaining the advantages and disadvantages of the use of supernatant as retrieval liquid. Include a discussion about the advantage of using only water near the end of a retrieval effort. (see comment Pg 4-4, section 4.8) (DH) (SD)			
118.	**Pg. 5-10, figure 5-3 (and fig. 5-4, pg. 5-11).** Provide additional text stating that all transfer piping system will be double contained. (JC)			
119.	**Pg. 5-10, section 5.2.2, paragraph 1, last sentence.** Either provide additional text here, or reference an acceptable description elsewhere in the text. In addition, state the turnaround time to make the data/results available to Ecology. (see comments for Pg. 1-4, section 1.3, Pg. 1-4. paragraph 1, and Pg 1-5, section 1.4, paragraph 3.) (JC) (DH)			
120.	**Pg. 5-11.** Provide additional text detailing how fast a leak could be detected using the transfer flow technique. (DH)			
121.	**Pg. 5-12, paragraph 1.** Specify the details of the leak detection system in the DSTs; i.e., the minimum leak that can be detected, the expected lag time between a leak and detection of the leak, and the general specifications of the leak detection system. In addition, please include or provide a reference to where such detail can be			

	found. (JC) (DH)			
122.	**Pg. 5-12. second paragraph.** Specify whether or not transfer line "volumetric/mass balancing" will be used. Also indicate the accuracy of such a system. (DH)			
123.	**Pg. 5-13, first bullet.** Please clarify what type of gamma logging (gross, spectral etc.) is to be used and whether any logging with a neutron is planned? If not, state why. Ecology believes that gamma logging is incapable of detecting the typical radiation associated with the mobile groundwater constituents that are the main risk drivers for S-112. (JC) (DH)			
124.	**Pg. 5-13, sixth bullet.** What is the objective of the stated review? Please clarify. (JC)			
125.	**Pg. 5-13, last bullet.** What if C-104 is detected to be a leaker, or the uncertainty of the test is too high to give a definitive result? What contingencies are planned? Provide details. (JC)			
126.	**Pg. 5-15, figure 5-6.** This diagram is missing a key leak detection step. USDOE has been provided with a draft suggested revised diagram that includes a leak detection decision point between the upper two boxes on the diagram along with some related additional decisional flow paths. Revise the diagram to include a leak detection decision box. In addition, indicate where Ecology approves of the process control plan as well as implementation of the plan. (DH)(SD)			
127.	**Pg. 5-16, paragraph 1.** Dynamic leak detection is described as using liquid waste level measurements. How can this provide any leak detection capability with a relatively dry retrieval method that provides no liquid surface during the retrieval? Please explain. (DH)			

128.	**Pg. 5-16, paragraph 1, last sentence.** LDMM data are stated to lag behind retrieval by 48-96 hours. Are these two to four calendar days, or two to four work days? Is retrieval going to be on a 24 hr./day, 7 day a week basis? This document needs to provide the following limitations: 1) Time limit to detect leaks. 2) Time limit to validate a leak. 3) Time limit to notify Ecology. Provide additional text clarifying the above. (JC) (SD)			
129.	**Pg. 5-16, last line speaks of transfer lines.** Will these be double contained? Please clarify. (JC)			
130.	**Pg. 5-17, paragraph 1,** Next to last sentence states: "This assumes that no leak is detected in the transfer line(s) or the DST." Will there be systems in place to detect any such leaks? Provide additional text to clarify. (JC)			
131.	**Pg. 5-17, paragraph 2, first three sentences.** It is not clear that the first response to a detected leak is to stop retrieval and then proceed to check instrumentation to determine whether the "detected leak" is valid or a false alarm. Explain the process for response to a detected leak. (JC)			
132.	**Pg. 5-17, section 5.3.2.3, paragraph 1, sentence 1.** Approximate the period of operational suspension time that may be required to conduct a static leak test. Is it hours, days? Is it even possible? (see comment # 5-16 para.1) Provide details. (JC) (DH)			
133.	**Pg. 5-17, last paragraph.** States that "The frequency and duration of the static test will be determined during the design of the retrieval system." This is not acceptable. The frequency and duration should be part of the functions and requirements that drive design. Revise the text to correct this statement. (JC) (SD)			

134.	**Pg. 5-18, section 5.3.2.4.** This section needs considerable expansion to indicate the type of logging that will be conducted (see comments Pg. 1-4, section 1.3, Pg. 1-4, paragraph 1, and Pg. 1-5, section 1.4, paragraph 3) (JC) (DH)			
135.	**Pg. 5-19, section 5.3.3, bullets.** Clarify the questions from the previous comment, or refer to the section that provides such information. Add a third bullet; namely, "Calculate a revised vadose zone inventory if a leak or change is noted." (JC)			
136.	**Pg. 5-19, Section 5.3.3.** The last paragraph of the section does not include a scenario of "inconclusiveness" regarding leak detection. During tank C-106 retrieval activities, groundwater impacts were observed (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). However, no conclusions were reached regarding whether the contamination was mobilized by raw water line leaks (i.e., due to line testing in preparation for C-106 retrieval or due to C-106 cooling water additions) or waste management operations (i.e., movement of waste within C Farm via leaking lines). Due to the groundwater observations, Ecology issued a letter dated October 11, 2000 which acknowledges the groundwater contamination observations and requests USDOE to conduct quarterly monitoring until such time that it is decided which groundwater monitoring program is applicable to C Tank Farm. (AH)			
137.	**Pg. 5-19, section 5.3.4.** Provide additional text that includes target objectives for ex-tank LDMM techniques, such as minimize size of leak that one can expect to detect, time lag between leak and detection, the ability to monitor the growth of the leak volume and processing/turnaround time. In addition, a schedule of testing and selection should be included that leads to a decision on both in- and			

	ex-tank LDMM technologies to be used and a date for the timely insertion of these technologies into retrieval design and operations. (JC)			
138.	**Pg. 5-19, section 5.3.4.** The section does not include a description of the LDMM selection process or schedule. The LDMM selection process represents a significant investment in LDMM technology evaluation and selection. The following language is recommended to be inserted in Section 5.3.4: "Improved methods for external tank leak detection are being developed and demonstrated in support of single-shell tank (SST) waste retrieval operations. Primary improvements involve the ability to interrogate the entire volume of soil proximal to a tank rather than the point-source measurement methods currently employed. The objectives of the testing efforts include gaining an understanding of the performance of each of six external tank leak detection technologies (listed below) in terms of a 95% minimum probability of leak detection and a 5% maximum probability of false alarms; with an objective of getting the false alarm probability as low as possible. Additional objectives include determining the sensitivity of each of the external tank leak detection methods with respect to minimum detectable leak volumes and rates, and rough order of magnitude costs for installation, maintenance, and operations. The FY 2001 testing is designed to support a "down-selection" to the top two external tank leak detection technologies. The down-selected external tank leak detection technologies are planned for more rigorous testing in FY 2002 to acquire the performance data required to qualify the external tank leak detection technologies for deployment in support of SST waste retrieval operations. External			

	tank leak detection technology testing will be performed at the 105-A Mock Tank Leak Site (MTLS) in 200 East Area (1/8-mile East of B-Plant along 7th Avenue). The MTLS is a two-thirds scale SST with the bottom third of the tank buried beneath grade. The MTLS is roughly 50-feet in diameter and is open to the atmosphere. A PVC piping network permits simulation of tank leaks at various locations across the tank bottom and side-walls. A center leak was chosen for initial testing purposes since it represents one of the most difficult leaks to detect. A total of six external tank leak detection technologies will be demonstrated at the MTLS. These include one tracer technique (partitioning interwell tracer tests), three electrical techniques (electrical resistivity tomography, high resolution resistivity, and electromagnetic imaging), a cross-borehole seismic technique, and a cross-borehole radar technique. The six external tank leak detection technologies were down-selected from several dozen methods evaluated during an Advanced Characterization Workshop conducted at Hanford during January of 2000. The six external tank leak detection technologies are leveraged from other DOE Office of Science and Technology efforts being conducted through the Environmental Management Science Program and Characterization, Monitoring, and Sensor Technology Program. The external tank leak detection technology demonstrations involve collaboration with other DOE Sites, National Laboratories, Universities, and Private Industry partners. (AH)			
139.	**Pg. 6-1, section 6.0.** Due to the uncertainties associated with the ex-tank LDMM, Ecology is requesting that a "hold point" be "built" into the F&R document for future insertion of ex-tank LDMM			

	information. As ex-tank LDMM technologies are currently under review, ex-tank LDMM specifications have not been provided in the C-104 F&R, ex-tank LDMM technology has not been selected, designed, or deployed, a "hold point" is appropriate to address this important omission. As currently written, this section does not provide for an ex-tank LDMM insertion process. (AH)			
140.	**Pg. 6-1, section 6.0.** Ex-tank LDMM selection, design, and deployment is not considered a "minor field change". Identify that the C-104 functions and requirements will be modified to include ex-tank LDMM after selection and design have occurred. (AH)(DH)			
141.	**Pg. 7-1 section 7.0.** Add any new references used in providing additional information based on Ecology comments. (DH)			
	Appendix A Lessons Learned			
142.	**Appendix A – general.** The entire Appendix is generic and is not made relevant to C-104 and anticipated problems. It focuses on engineering design and process changes in the tanks. If any of this is to be relevant to C-104, it must address specific issues in a specific manner. Provide additional text to correct these deficiencies and make it specifically relevant to C-104. (JC)			
143.	**Appendix A – general.** The same generic statement is essentially made for every item; namely, "May adversely impact schedule, operating costs and leak risk." This generalization provides little substance to be applied to the C-104 retrieval. It focuses on engineering design and process changes in the tanks. If any of this is to be relevant to C-104, it must address specific issues in a specific			

	manner. State specifically how schedule, cost and/or leak detection could be affected for C-104. Revise this table. (JC) (SD)			
144.	**Appendix A – general, table A-1, third column,** Titled: "Relevancy to 241-C-104 Retrieval". The same generic statement is made for every item; namely, "May adversely impact schedule, operating costs and leak risk." This generalization provides little substance to be applied to the C-104 retrieval. If these items are relevant to C-104, state specifically how schedule, cost and/or leak detection could be affected for C-104. Revise this table. (JC)			
145.	**Pg. A-2, section A.2.1.** Include an identification that groundwater monitoring occurred before, during, and after C-106 retrieval activities and contaminant observations indicated an impact (see figures 2.9-33 and 2.9-34 of *Hanford Site Groundwater Monitoring for Fiscal Year 2000* [PNNL-13404]). (AH)			
146.	**Pg. A-2, section A.2.1.** Revise this section to include the following lessons regarding C-106: 1) Do not use supernate as a flush liquid at the end of retrieval. 2) Use at least two spray nozzles for better coverage. 3) Place pump as low as possible (on bottom). 4) The system retrieval performance exceeded the design goal expectations. (SD)			
147.	**Pg. A-2, last sentence.** C-106 used mass balance for leak detection. Revise the text to reflect this fact. (JC) (DH)			
148.	**Pg. A-3, section A.2.2.** This section refers to logging of "drywells" surrounding the GAAT tanks that were used to measure and monitor conductivity in the groundwater as a means of leak detection during waste retrieval. As used at Hanford, "drywells" terminate in the vadose zone and do not extend to groundwater. Please explain how this was done. (JC)			

149.	**Pg. A-4, section A.2.5.** There are no references to ex-tank leak detection (LDMM) technologies other than partitioning inter-well tracer technology. Provide text and related references to all of the technologies currently under consideration for use as LDMM by USDOE. (DH)			
150.	**Pg. A-4.** Missing are lessons learned from other Hanford retrievals prior to C-106. Provide additional text detailing the history and lessons learned from previous Hanford retrievals. (SD)			
151.	**Pg. A-4, paragraph 2.** Discusses the SRS double-shell tanks. Without a comparison of the two leak detection systems, this discussion is not relevant. Tabularize the specifications for the SRS and Hanford DST leak detection systems. (JC)			
152.	**Pg. A-4, section A.2.5.** This section is too brief. Provide more information on lessons learned from other federal programs and private industry demonstrations. (SD)			
153.	**Table A-1.** Missing are lessons learned from Hanford interim stabilization (i.e.: pump operations and maintenance, chemistry to control plugged lines, etc.). Provide lessons learned related to interim stabilization. (SD)			
154.	**Table A-3.** This Table essentially discusses only in-tank leak detection to the exclusion of ex-tank LDMM. What ex-tank leak detection methods were used elsewhere, what lessons were learned, and what is the relevance of these lessons to C-104? Revise the Table to include these missing details and provide text explaining the relevancy to C-104. (JC) (DH)			
155.	**Pg. A-31, A.3.2.2.** "Waste mobilization predictions based on core-sampling information have been determined to be invalid." This statement greatly concerns Ecology. Missing is a discussion under			

	the "Relevancy..." column. Provide the missing information. (DH)			
156.	**Pg. A-34, A.3.3.1.** The text describes a potential leak detection system for pipe lines between C-104 and receiver tank. Describe these lines, including construction and the current and proposed leak detection for the lines. (DH)			
157.	**Pg. A-35.** A number of references are made to other lessons learned that are "...applicable to Leak Detection." However, there is no meaningful description of the relevancy to the C-104 retrieval. Provide the missing text. (DH)			
158.	**Pg. A-36.** Missing is a meaningful discussion of the relevancy of the lessons learned to C-104. Provide the missing information. (DH)			
159.	**Pg. A-37, A3.4.2.** Missing is a discussion of the relevancy of the lessons learned to C-104. Provide the missing information. (DH)			
160.	**Pg. A-38.** A number of references are made to other lessons learned that are "...applicable to Leak Monitoring." However, there is no meaningful description of the relevancy to the C-104 retrieval. Provide the missing text. (DH)			
161.	**Pg. A-40**. There appears to be a typographical error; the section should be A3.5.3. A number of references are made to other lessons learned that are "...applicable to Leak Mitigation." However, there is no meaningful description of the relevancy to the C-104 retrieval. Provide the missing text. (DH)			
162.	**Appendix A, tables A-4 and A-5.** The tables do not appear to include Ecology's letter regarding groundwater monitoring at C Tank Farm which concludes impact to groundwater associated with C Tank Farm operations. Include reference of the letter in the tables as well as identification of the letter in the bibliography. (AH)			

	Appendix B (RPE)			
163.	**General comment:** The C-104 RPE is unacceptable as submitted for reasons including the following: 1) Missing significant risk pathways/scenarios that would likely increase calculated risk (without which, a true picture of the risk cannot be realized), 2) Missing C-Farm soil inventory not directly related to past tank leakage (i.e.: line leaks and waste remaining in ancillary equipment, IMUSTs, etc.) 3) Lack of an uncertainty analysis, 4) The statement found on Page B-90 that, had the S-Farm modeling approach been used the risk the result would have been higher groundwater concentrations and higher long-term risks, 5) Missing cumulative total risk evaluation considering the additional impact of other non-tank sources of contamination. (DH)			
164.	**General comment:** Provide a hard copy of the final resolution/disposition for all C-104 RPE USDOE work group RCR form comments. (JC) (DH)			
165.	**Pg. B-1, section B1.0.** The text correctly states that the HFFACO Milestone requires that environmental risk be evaluated as well as human health risk. The RPE is missing an analysis of environmental (ecological) risk (i.e., non-human biota). It is necessary to assess ecological risk, since results of human risk assessment are not limiting in all cases. Provide an environmental/ecological risk assessment for this RPE. (DD)			
166.	**Page B-2, paragraph 1.** The report states that "Eventually the impacts from all waste sites will need to be considered together." As			

	stated in previous comments, cumulative impacts from other waste sites could affect the risk calculations for C-104 and/or C Farm. Provide the missing cumulative risk information and incorporate into this RPE. (DH)			
167.	**Pg. B-2, paragraph 2.** Establishing "risk vs. volume" relationships appears to focus on waste volume. Risk ultimately needs to be linked to COC (contaminant of concern) dose (not simply waste volumes) to a receptor. Provide additional text that clearly states and incorporates the above concern. (DD)			
168.	**Pg. B-4, paragraph 2.** (See comment Pg 1-3, Section 1.1)			
169.	**Pg. B-5 paragraph 1.** Based on previous RCR comments by Ecology, the final AX RPE failed to include cumulative risk from non-tank farm sources. In addition, the uncertainties associated with the AX RPE risk conclusions were significant. USDOE failed to carry forward these comments to this RPE. (DH)			
170.	**Pg. B-5, paragraph 2**. The HFFACO Milestones describes the retrieval goal as a maximum residual of 360 cubic feet while retrieving at least 89 kg Pu. Revise the text to describe the above goal. (DD) (SD)			
171.	**Pg B-5, section B.2.1.** Although the text acknowledges that waste has leaked to the soil from tanks or associated piping, one related issue remains unclear in both the F&R and the RPE as follows: was knowledge/history of past waste transfers used to develop an estimate of waste in the soil at C-Farm that correlates to the type of waste that leaked for each time period (not what is currently stored at C-Farm)? Provide additional text describing if this type of soil waste inventory			

	was incorporated in the C-104 RPE. If not, provide a detailed discussion of exactly how the soil inventory was determined. (DH)			
172.	**Pg. B-8, section 2.2.1, paragraph 1.** Provide an estimate of the total linear feet of all transfer lines that remain in C-Farm. In addition, provide details of how many catch tanks, IMUSTs, etc. remain in or near C-Farm. Describe any that could still contain waste and provide a volume/constituent estimate of waste remaining in these tanks. (DH)			
173.	**Pg. B-11, paragraph 1.** Provide a detailed history of the various wastes that were introduced in C-104 after the tank was emptied (post-1955 sometime) (DD)			
174.	**Pg. B-11, paragraph 3.** Insufficient data on wastes associated with ancillary equipment should be considered in an uncertainty analysis of the source term. Provide an uncertainty analysis incorporating this lack of data. (DD)			
175.	**Pg. B-12, section B.3.0.** (see comment Pg B-1, Sect B.1.0) (DH)			
176.	**Pg. B-12, paragraph 4, bullet 2.** Because scaling cannot account for all differences between C and AX tank farms, this extrapolation should also be included in an uncertainty analysis as well as the uncertainty associated with considering groundwater impacts over a 10,000 yr period. Describe the uncertainty associated with both issues. (DD)			
177.	**Pg. B-13, bullet 1.** In addition to groundwater pathways, it is possible that long-term human health risks may occur via soil-based exposure pathways (e.g., human soil ingestion, livestock soil ingestion with COC transfer to milk/beef, crop root uptake of soil			

	COCs with subsequent food chain transfers, re-suspension of soil with subsequent inhalation, external exposure to soil radionuclides) and air-based exposure pathways (e.g., inhalation, external exposure to radionuclides in air). Describe the uncertainty associated with considering the above long-term human health risks over a 10000 y period. (DD) (DH)			
178.	**Pg. B-13, bullet 2.** State rationale for assuming a loss of institutional control after 100 yrs. Also state the rationale for listing specific COCs as generally immobile in the environment. If plutonium is immobile in the environment, then why does plutonium register 100 times background in the Hanford 200 Area annual average area air monitoring results? In addition, the recent Hanford fire indicated plutonium was distributed to the air pathway at levels significantly over 100 times background in the Tri-Cities area. As part of the above requested information, discuss a failed cover scenario and the resulting pathway scenarios. (DD) (DH)			
179.	**Pg. B-14, paragraph 2, last bullet.** In addition to residential farmer and industrial worker scenarios, other exposure scenarios may apply in order to more comprehensively evaluate long-term human health risk. For example, HSRAM lists residential, agricultural, and recreational scenarios. Also, a Native American subsistence resident scenario and a subsistence fisher scenario (at the Columbia River) should be evaluated. Provide additional text detailing the above-described scenarios. (DD) (DH)			
180.	**Pg. B-17, figure B.3.2.** Missing from this figure are a several significant scenarios including: failed cover scenarios leading to air, direct contact/ingestion pathways, bioaccumulation pathways,			

	subsistence/hunter-gatherer, etc., and environmental/ecological pathways. (see previous comment) (DH)			
181.	**Pg. B-18, paragraph 4.** (see comment on 360 cu ft, Pg. B-5, paragraph 2)			
182.	**Pg. B-19, table 3.1.** Most of the cases assume a retrieval leak loss of 8,000 gallons. Since the F&R document states that the best leak detection capability is 19,000 gallons, explain how USDOE will verify that no more than 8,000 gallons leaked to the soil. (DH)			
183.	**Pages. B-19 – B-21, section B.3.3.** This section is vague. It appears that the source term used for the RPE is based only on known tank leak inventory. If that is the case, then other past leak sources are missing from this evaluation. Provide a clear, detailed, historical description of all C-Farm past leak sources. Include the type of waste that leaked and state whether or not it was included in the source term inventory estimate. (DH)			
184.	**Pg. B-21, paragraph 3.** The large discrepancy between radionuclide activity estimates from the soil inventory model vs. the gamma scan (e.g., 128000 Ci vs. 42 Ci for Cs-137, respectively) highlight the uncertainty in the source term inventory estimate. In addition, it calls into question the use of gamma detection in the drywells for monitoring potential leaks from non-gamma emitting radionuclides that comprise a significant portion of the in-tank waste inventory. (see previous comments on gamma logging) (DD)(DH)			
185.	**Pg. B-22, paragraph 4.** Although use of DST supernate to retrieve waste from SSTs minimizes generation of new waste volume, it increases risk associated with SST leaks, since additional COCs			

	(from DSTs) have been introduced in the retrieval process. Also, the use of supernate inside the tank towards the end of retrieval (as potential avenues of waste escape are exposed) may add additional risk. Describe these potential additional risk scenarios. (DD)(DH)			
186.	**Pg. B-24, section B.3.3.4.** The assumption that ancillary equipment risk inventory is small and; therefore, excluded from this RPE is not acceptable and lacks foundation. The RPE did not include even a rough estimate of ancillary equipment inventory as a basis for excluding it from the RPE. Provide additional supporting text estimating the amount of ancillary waste inventory as well as a detailed discussion of how that affects the risk calculations and uncertainties for this RPE. (DH)			
187.	**Pg. B-24, paragraph 2.** In addition to LCFs and if data are available, consider adding non-fatal cancers and non-cancer radiological effects (e.g., acute radiation syndrome, dermal erythema, opacification of the eye, temporary impairment of fertility, etc.), especially for "short-term" risks. Morbidity risk coefficients (i.e., fatal plus non-fatal cancer risk) are higher (more conservative) than mortality risk coefficients (i.e., fatal cancer risk) for radionuclides. Provide additional text detailing the above information. (DD)			
188.	**Pg. B-24, paragraph 3.** Because short-term human health risk (i.e., accident and non-accident) is evaluated for the 10 retrieval cases, it is not clear what has been excluded from analysis. Provide additional text either including this information in the analysis or explaining why is was omitted. If it is included, adjust the risk calculations. If not, provide a discussion of how exclusion affects uncertainty and adjust the uncertainty analysis accordingly. (DD)(DH)			

189.	**Pg. B-24, paragraph 4.** It may be possible that subsurface leaks at the base of the tank result in an atmospheric release for volatile COCs (even in the "short-term"). Provide additional text discussing this potential scenario. (DD)			
190.	**Pg. B-26, paragraph 3.** State that radiological dose is determined for the "involved worker" too, presuming this is the case. (DD)			
191.	**Pg. B-27, paragraph 2.** Which ERPGs are used (-1, 2, or 3)? Provide additional clarifying text. (DD)			
192.	**Pg. B-27, paragraph 4.** Note that this paragraph has some inconsistencies with Figure B.3.2 (i.e., text says noninvolved workers are exposed via inhalation and external exposure, while Figure B.3.2 indicates only inhalation; text says public exposed via inhalation, external exposure, and food, while Figure B.3.2 indicates inhalation and food only). Provide an explanation and corrections as needed to the RPE. (DD)			
193.	**Pg. B-28, paragraph 4 and 5.** The text states that a hazard index (HI)<1.0 is acceptable but is silent on acceptable cancer risk here. (DD)			
194.	**Pg. B-28, paragraph 8.** The statement that "…this scaling approach introduces an added degree of uncertainty; however, this added uncertainty is acceptable for this scoping level RPE because additional analysis will be performed following tank waste retrieval…" is unacceptable. The uncertainty introduced by using the scaling approach will likely not change following the retrieval. No reason is provided as to why this uncertainty should not be quantified at this time. Provide additional text/information that			

	quantifies the uncertainty related to scaling groundwater concentrations from AX to C tank farms. (DD)(DH)			
195.	**Pg. B-29, paragraph 1.** As there is at least 10 years of RCRA groundwater monitoring data for the C Tank Farm, including geologic logs for the four RCRA groundwater monitoring wells, it would seem a good yardstick for comparison to validate the model used. No mention is made of such an activity. Provide additional text justifying why this was not done and include corrections. (JC)			
196.	**Pg. B-29, bullet 1.** It is not clear that the contaminant inventory in the vadose zone is specific to C or AX Tank Farms, or whether it includes leaks and spills from ancillary equipment and not just waste that escaped containment from the tanks. (see comments B-24, Sect 3.3.4, B-19-21, Sect B 3.3, B-5, Sect B.2.1) (JC)(DH)			
197.	**Pg. B-30-31, section B.3.6, last paragraph.** It appears that the waste inventory for AX Farm was scaled to C Farm, when there is specific data available for C Tank Farm. The text states: "…a scaling approach is considered appropriate for this evaluation given that there are no new vadose zone characterization data..." Provide additional text detailing the information available for C Farm along with an explanation as to why it was not used for this RPE. Also explain what the statement "…waste retrieval performance of the remaining C-Farm tanks is uncertain." has to do with a scaling approach. The same can be said of any tank retrieval at this point in Hanford history. (see comment B-12, paragraph 4, B-28, paragraph 8) (JC)(DH)			
198.	**Pg. B-30, paragraph 3.** Although "cumulative risk" from nearby sites is not considered here, this type of analysis will ultimately be needed for assessing regional risk on the Hanford site (e.g.,			

	Composite analysis for low-level waste disposal in the 200 area plateau of the Hanford site, PNNL-11800; Modular risk analysis for assessing multiple waste sites, PNL-SA-24239). (see comment B-2, paragraph 1)- (DD) (DH)			
199.	**Pg. B-31, paragraph 3.** This list of COCs (radionuclides and non-radionuclides) appears short, given the complex and uncertain disposal history (e.g., metal waste, U plant waste). It is stated that selection of COCs is based on the screening analysis in DOE/RL-98-72 (AX Tank Farm). Detail the justification for this approach (including the assertion that these COCs contribute 95% of the groundwater pathway long-term risk) and acknowledge the associated uncertainty. For example, if a more comprehensive array of pathways were evaluated, would additional COCs be added? (see comment for p. B-13, bullet 1) (DD)			
200.	**Pg. B-32, paragraph 3.** Provide rationale for estimating scaling factors by "linear approximation." (DD)			
201.	**Pg. B-32, paragraph 4.** Note that DOE/EIS-0189 (TWRS/EIS) evaluates Native American and recreational shoreline/land user exposure scenarios, in addition to residential farmer and industrial scenarios. It may be of benefit to evaluate all of these scenarios for Tank Farm C, as well. (see comment for p. B-14, para 2, last bullet) (DD)			
202.	**Pg. B-33, paragraph 2.** It is stated that the industrial worker scenario represents "non-remediation workers." Explain why long-term risk was not evaluated for "remediation workers" as well. (DD)			
203.	**Pg. B-33, paragraph 5.** Describe URF methodology in more detail.			

	For example, state whether or not URF methods use toxicity factors (e.g., cancer slope factors, reference doses) from EPA's IRIS/HEAST. In addition explain the use of URF methodology in PNNL's Multimedia Environmental Pollutant Assessment System (MEPAS) software. Evaluation of LCFs (fatal cancers) for short-term human health risks vs. ILCRs (fatal and non-fatal cancers) for long-term risks is somewhat inconsistent. Provide additional text to clarify the inconsistencies. (DD)			
204.	**Pg. B-34, table B.3.2.** The COCs listed here are the same COCs listed as COCs to be evaluated (p. B-31) and largely those COCs which have leaked at Tank Farm C (see Table B1.1). They do not include all COCs listed in Tank C-104 inventory (Tables B1.2 and B1.3), Tank AY-101 supernate (Tables B1.4 and B1.5), Tank C-104 inventory which may leak (Table B1.6), or Tank C-104 inventory which might comprise the residual "heel" (Table B1.7). Explain why this was not included or provide text evaluating additional COCs listed in these tables. According to DOE/EIS-0189 (TWRS/EIS), Cr is chromate ion (i.e., Cr+6) which has an inhalation cancer slope factor. Thus, Cr should also be evaluated for cancer risk (in addition to non-cancer HQ), since the industrial worker scenario considers inhalation of shower water, as a groundwater-based pathway. Revise the RPE to include this missing information. (see comment p. B-33, para 2) (DD)			
205.	**Pg. B-34, paragraph 2.** Equation B.2 makes no distinction among non-carcinogens, non-radionuclide carcinogens, and radionuclides. All three types of COCs should be summed and presented separately			

	due to differences in derivation methods (i.e., hazard index for non-carcinogens, ICLR for non-radionuclide carcinogens, and ICLR for radionuclides). Revise the text to correct the above concerns. The text refers to "Equation B.1." This referral should be to "Equation B.2." Correct the text. (DD)			
206.	**Pg. B-35, paragraph 1.** Re Equation B.1, please see comment for p. B-34, para 2. (DD)			
207.	**Pg. B-35, paragraph 3.** This risk allocation is useful for cancer risk but does not address non-cancer hazards. Provide a separate "hazard index budget" for non-carcinogens with an HI threshold of 1.0. (DD)			
208.	**Pg. B-35, section B.3.6.5, next to last sentence.** The estimated waste in tank C-104 is expressed as a percentage of total waste in the C Tank Farm. Does this include tank inventory only, or does it also include inventory/leaks from ancillary equipment and the inventory in the vadose zone from previous leaks? Provide text to clarify and correct this concern. (JC)			
209.	**Pg. B-36, paragraph 2.** Provide rationale/citations for the 100 mrem/y chronic and 500 mrem acute dose standards in the USDOE intruder scenario. (DD)			
210.	**Pg. B-36, table B.3.3.** Why do the radionuclides in this table not include all of those listed in Tables B1.1, B1.6 and B1.7 (i.e., Tank C-104 leak and heel inventory data), as well? Should units for "unit dose factor" be expressed per time (i.e., mrem/Ci-y)? Provide corrections/explanations regarding the above concerns. (DD)			

211.	**Pg. B-36, paragraph 4.** The USDOE intruder scenario considers radionuclides only. Explain how non-radionuclides are evaluated for this scenario. (DD)			
212.	**Pg. B-37, paragraph 3.** Revise text to state that dose (mrem/y) from each radionuclide is summed to calculate dose to a particular receptor. (DD)			
213.	**Pg. B-38, paragraph 2.** Because the NRC scenario assumes intrusion 500 y after waste disposal and the USDOE assumes intrusion 100 y post-tank closure, the two scenarios are not strictly comparable. Explain the discrepancy and include the NRC scenario. (DD)			
214.	**Pg. B-38, bottom of page.** States that the proposed tank farm closure will be done under CERCLA. Tanks will be closed using WAC 173-303-610. Explain and corrected the text. (JC)			
215.	**Pg. B-41, last line.** It appears this citation should be 40 CFR 193. Please check and correct as necessary. (JC)			
216.	**Pg B-49, paragraph 2.** It is stated that example retrieval cases are not intended to provide a means to "relax" regulatory requirements. Furthermore, the strategy should be designed to minimize retrieval leaks and residual volume in the tanks. As such, determining a risk-based threshold for "allowable" leak volume is only one part of the strategy. The other critical part is to minimize leaks and volumes (consistent with the ALARA principle in radionuclide regulation). In this regard, however, ALARA should not only consider long-term human health risk but also short-term risks to workers during the retrieval process. Provide additional text reflecting the above			

	concerns. (DD)			
217.	**Pg. B-51, bullet 1 in section B.4.2.** There is no agreement from Ecology that vadose zone contamination from past leaks is not to be remediated. This is a modeling assumption only. Provide additional text for clarification. (JC)			
218.	**Pg. B-54, paragraph 2.** Re subsurface leaks; revise text to include a short-term atmospheric scenario. (see comment for p. B-24, para 4) (DD)			
219.	**Pg. B-56, paragraph 1.** Re LCFs; (see comment for p. B-24, para 2 and Pg. B-54, paragraph 2). (DD)			
220.	**Pg. B-56, paragraph 4.** If the non-radioactive chemical concentrations in the residual tank waste are the same for all cases, why is ICLR not the same for all cases (similar to the situation for hazard index)? Provide additional clarifying text. (DD)			
221.	**Pg B-57 to B-59, tables B.5.2 and B.5.3.** Why do radiological risks present population (and MEI) risks, while chemical risks present only MEI risks? Provide additional text explaining this discrepancy and correct the tables as necessary. (DD)			
222.	**Pg. B-60, paragraph 2.** State the basis for the distribution coefficients (Kd values) listed for Groups 0, 1, and 2. (DD)			
223.	**Pg. B-60, table B.5.4.** Re footnote "d," note that the revised MCL for total U is 0.030 mg/L (Fed Reg. 12/7/00). Correct the text. (DD)			
224.	**Pg. B-61, table B.5.5.** Note that the modeled groundwater MCL for nitrate is exceeded in "Case 2," resulting from tank residual waste			

	and composite source terms. (DD)			
225.	**Pg. B-62, paragraph 2.** Although the cancer risk associated with a 15 mrem/y total effective dose equivalent (TEDE) exceeds 1E-5, this dose is conservative, relative to the 100 mrem/y recommendation by the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection (NCRP) for the general public and 5000 mrem/y for workers. It is important to recognize that derivation of these dose limits are based on a "linear no-threshold" (LNT) model, and that conclusive evidence of radiation effects is lacking below about 5000 mrem (U.S. General Accounting Office, 2000, Radiation standards: Scientific basis inconclusive and EPA and NRC disagreement continues, GAO/RCED-00-152, Report to the Honorable Pete Domenici, U.S. Senate, Washington, DC.). (DD)			
226.	**Pg. B-62, section B.5.3.1.1.** C-104 is classified as a sound tank, but that does not preclude leaks from cascade and/or transfer lines such as may have occurred between tanks C-104 and C-105. This is not a valid assumption. Please correct and provide revised text. (JC)			
227.	**Pg. B-63 and B-64, tables B.5.6 and B.5.7.** As displayed, ICLR apparently combines cancer risk from radionuclides and non-radionuclide carcinogens. In a strict sense, this is inappropriate due to differences in derivation methods (e.g., radionuclide slope factors are central estimates and are based primarily on epidemiological studies, whereas non-radionuclide carcinogens are upper bound estimates and are based mainly on animal studies). Assuming that HI>1 and ICLR>1E-5 comprise thresholds of concern, the following exceedances are noted. For the industrial worker for the C Tank Farm Total, note that HI>1 for Case 2 for residual waste			

	and composite source terms. For the residential farmer for Tank C-104, HI>1 for Cases 2, 8, and 9 for residual waste and composite source terms. For the residential farmer for C Tank Farm Total, there are many exceedances (HI>1 and ICLR>1E-5) for retrieval leakage, residual waste, and composite source terms. In particular, ILCR and HI thresholds are exceeded for all cases for the residual waste and composite source terms for C Tank Farm Total for the residential farmer scenario. Explain how an allowable leak of 36,000 gallons does not exceed risk levels in light of the above mentioned exceedences. Provide additional clarifying text and correct any related risk conclusions as necessary. (DD) (DH)			
228.	**Pg. B-65 and B-66, figures B.5.1 and B.5.2.** It is difficult to easily determine what each "Series" represents. Label Series 1 and 2 as Industrial Worker and Residential Farmer, respectively. (DD)			
229.	**Pg. B-65, paragraph 1.** Assuming a 20 yr. exposure duration for the industrial worker, a 1.1E-7 risk corresponds to an annual dose of 0.0092 mrem/y (not 0.018 mrem/y). Correct the text and adjust related risk calculations as necessary. (DD)			
230.	**Pg. B-66, paragraph 1.** There appears to be some errors with numbers here. For example, the max ICLR for the farmer for tank C-104 (composite) is listed as 3.5E-6, although Table B.5.7 and Figure B.5.4 lists the corresponding ICLR as 2.9E-6. Correct the text and adjust related risk calculations as necessary. (DD)			
231.	**Pg. B-68, paragraph 4.** If risks are 15-20% lower using water as the retrieval fluid, why not use water (rather than DST supernate) for all tanks? This reduction in risk should be weighed against the increased risk associated with generating additional waste volume			

	using water. Provide text with an analysis of the risk of using water compared against the use of supernatant. Include a discussion of the use of water towards the end of retrieval with respect to diluting the residual waste remaining in the tank and waste leaking to the soil. (DD) (DH)			
232.	**Pg. B-70, table B.5.8.** It is surprising how similar results are between MTCA vs. HSRAM (DOE/RL-91-45), considering differences in exposure pathways analyzed. Explain the similarity in results. (DD)			
233.	**Pg. B-71, table B.5.9.** Five of 10 cases exceed the chronic dose limit (100 mrem/y) for the post-driller resident, specified in the table footnote. Explain how a 36,000 gallon risk-based leak loss is justified considering these exceedences. (see comment pages B 63-64) (DD)			
234.	**Pg. B-75, paragraph 3.** Re long-term risks, cite Tables B.5.6 and B.5.7. In contrast to what is stated for the industrial worker, HI>1 for case 2 for the C Tank Farm Total with the composite source (see Table B.5.6). (see comment for pages B-63-64, Tables B.5.6 and B.5.7). Explain the discrepancies and provide corrected text. (DD)			
235.	**Pg. B-75, paragraph 5.** Explain why Cases 8 and 9 fail the NRC standard for Class C LLW disposal, even with grout stabilization. (DD)			
236.	**Pg. B-75, paragraph 7.** Explain how 250,000 gallons of waste contains 89 kg Pu. It would help to state that 1% of the tank waste volume is 2630 gallons. (DD)			
237.	**Pg. B-77, paragraph 5.** Performance measures for Tank C-104 appear to be driven by long-term human health risks to the residential			

	farmer (see Table B.5.7), in addition to human intruder and NRC waste classification measures. Provide rationale for not including the long-term human health risk for performance measures. Note that for Tank Farm C as a whole, exceedances are noted for long-term human risks (Table B.5.6 and B.5.7) and groundwater impacts (Table B.5.5). Describe how these exceedances are accounted for in the performance measures. Also describe how these exceedances are factored into the leak loss calculation for C-104 assuming the 360 cu. Ft. residual goal is met. (DD) (DH)			
238.	**Pg B-78, including figure B.6.1.** It is important to note that statements on "allowable" retrieval leaks and residual volumes (estimated from Figure B.6.1) only apply to the USDOE inadvertent human intruder post-driller resident scenario. Explain in detail how the curve in Figure B.6.1 was constructed. In addition, provide additional text describing the effect of adding other risk scenarios to the risk estimate. (DD) (DH)			
239.	**Pg. B-78, paragraph 1.** It appears that 93 inches is the maximal amount of grout that could be used, since residual waste volume should be <2700 gallons. Provide an explanation. (DD)			
240.	**Pg. B-78, paragraph 2.** The conclusion drawn is unacceptable, due to the lack of inclusion of key pathways/scenarios, and contaminant inventory including leaks/spills from ancillary equipment and any inventory present in ancillary equipment. In addition, uncertainties related to scaling and a lack of an uncertainty analysis do not promote confidence in the RPE conclusions. Revise the text to include the missing data. (JC) (DH)			

241.	**Pg. B-79, paragraph 1.** Provide more detail for the calculation showing that a risk budget for tank C-104 of 1.3E-6 and a 2700 gallon residual tank waste volume results in a leakage volume of 36000 gallons for the residential farmer scenario. It is unclear how this conclusion is reached (see comment for p. B-83, Figure B.6.2). Note that the past leak ILCR is 6.8E-7 for the residential farmer (Table B.5.7) for the seven leaking tanks at C farm. The past leak ILCR of 2.0E-8 for C tank farm applies to the industrial worker (Table B.5.6). (DD)			
242.	**Pg. B-79, paragraph 2.** As the text states, the long-term human health risks and groundwater impacts are cumulative for the tank farm. It appears that groundwater impact was assessed for the entire C Tank Farm (Table B.5.5) and long-term human health risks were evaluated for both Tank C-104 and for the entire C Tank Farm (Tables B.5.6, B.5.7, and B.5.8). Were the data provided in Tables B1.10 through B1.14 used to compute the source term (i.e., past leaks, retrieval leaks, tank waste residual volumes) for the entire C Tank Farm? Provide additional text clarifying the above concerns. (DD)			
243.	**Pg. B-80, paragraph 2, bullet 1.** Why is an "administrative control dose" (500 mrem/y) assigned to the involved worker MEI, rather than a modeled dose for this scenario? Is this presumably more conservative? Provide additional text to answer these questions. (DD)			
244.	**Pg. B-81, paragraph 1.** With the potential for VOCs and ammonia in tank waste, was the air pathway (i.e., inhalation) evaluated in the short-term routine chemical risk scenario? Figure B.3.2 indicates			

	that inhalation was evaluated. Provide details on the above air pathway concerns (DD)			
245.	**Pg. B-81, section B.6.2.2.1.** The statement is made that groundwater impacts would all be below Drinking Water Standards. Provide additional text detailing where this is measured? (JC)			
246.	**Pg. B-83, figure B.6.2.** This figure is not particularly transparent and the conclusions hinge on its accuracy. Provide additional text answering the following concerns: Is the following relationship correct for Case 1 for tank C-104 for the residential farmer scenario in order to determine (x,y) pairs to be plotted? (3.6E-7 ILCR/8000 gallons)(x gallons leaked)+(9.1E-8 ILCR/2700 gallons)(y gallons residual)=1.3E-6 ILCR If x=1 gallon, then y=2.7E4 gallons (not 3.6E4 gallons, as shown in the figure). Is the calculation close just by coincidence or is this how the curve was constructed and the delta is due to rounding error? This analysis considers ILCR (due to non-radionuclide and radionuclide carcinogens), as a function of retrieval leak loss volume and residual tank waste volume. Hazard index (non-carcinogens) should also be evaluated for Tank C-104 and Tank Farm C (as a whole). Explain how this figure was constructed. (see comment for Pg. 3-5 figure 3-2) (DD) (DH) (JC) (SD)			
247.	**Pg. B-83, paragraph 3.** Describe how the ILCR (2.1E-6) is calculated for the industrial worker scenario for tank C-104 with no retrieval efforts. Explicitly state that the Washington state cancer risk standard is the MTCA site risk standard of 1E-5. (DD)			

	Pg. B-84, paragraph 3. Re the composite source term for the 10 retrieval cases, Tank C-104 fails MTCA criteria only for hazard index (HI) for the residential farmer scenario (cases 2, 8, and 9), while Tank Farm C (as a whole) exceeds both the MTCA 1E-5 cancer risk and HI=1 thresholds for the residential farmer scenario for all 10 cases (Table B.5.7). Tank Farm C also exceeds the HI threshold for the industrial worker scenario for case 2 with the composite source term (Table B.5.6). In terms of long-term human health risk, it appears that a major conclusion for this RPE is that although Tank C-104 may present little risk, Tank Farm C (as a whole) presents unacceptable risks with all 10 of the retrieval cases examined for the residential farmer scenario. Provide additional text describing how the risk conclusions are affected when the missing scenarios are incorporated. Revise the risk calculations. In addition, include pathways related to the missing future failed cover scenario (i.e.: air inhalation direct contact/ingestion) in the revised risk calculations. (DD) (DH)			
248.	**Pg. B-84, paragraph 5, bullets 2 and 3.** These bullets (describing exceedances of the 100 mrem/y chronic dose) are redundant. (DD)			
249.	**Pg. B-85, paragraph 1, bullet 2.** State that this 10 inch grout option assumes linearity between depths of grout vs. residual waste concentrations. (DD)			
250.	**Pg. B-85, paragraph 4.** The MEI dose at the site boundary (is this the noninvolved worker?) from Tank C-104 is listed as 1.8E-8 ram/y. Table B.5.2 lists the noninvolved worker dose as 1.8E-8 ram (not per year). Provide explain this possible discrepancy.			

	Note that the ICRP dose of 0.1 ram/y applies to the general public. (DD)			
251.	**Pg. B-86, paragraph 2.** The texts states, "No exceedance of long-term human health risk occurs for tank C-104 and the C tank farm in the industrial worker scenario." Actually, HI is exceeded in case 2 for the industrial worker for the composite source term for C tank farm (Table B.5.6). Provide additional text for clarification. (DD)			
252.	**Pg. B-86, paragraph 3.** Table B.5.9 lists the acute dose as 500 mrem/incident (not per year) as stated in paragraph 3. Provide additional text explaining this discrepancy. (DD)			
253.	**Pg. B-86, paragraph 4.** Pu and Am concentrations in Tank C-104 exceed NRC Class C LLW limits (Table B.5.10). The text as submitted is not clear on this issue. Provide additional text to better explain this issue. (DD)			
254.	**Pg. B-88, paragraph 2.** Excluding a quantitative uncertainty analysis, it would be helpful if uncertainties were tabulated, grouped by category (e.g., source term, exposure, transport models/scaling effects, toxicity, cumulative risk, etc.), and qualitatively described as conservative or non-conservative with respect to risk. (DD)			
255.	**Pg. B-88, section B.6.3, paragraph 2.** Provide an estimated schedule for future updates of the C Tank Farm RPE. (JC)			
256.	**Pg. B-88, paragraph 3.** Re the waste site intruder considered the "constraining performance measure," please see comment for p. B-77, para 5 (first paragraph). (DD)			
257.	**Pg. B-88-90, section B.6.3.** Perhaps the constraining performance			

	measure would change if the future failed cover scenario and related exposure pathways were considered. Not incorporating this scenario adds to existing uncertainties with this RPE. Provide additional text either describing why this scenario and resulting pathways were not considered or describe the affect on this RPE when they are incorporated. (DH)			
258.	**Pg. B-88, last paragraph.** This RPE excludes past leak losses from ancillary equipment and inventory in ancillary equipment. Therefore, the statement made that this RPE is based on the best available data is misleading. Correct the text to reflect the above concerns. (JC)			
259.	**Pg. B-89, paragraph 3, sentence 1.** Provide additional text to justify the exclusion of ancillary equipment from this analysis, and describe and/or reference the plans to acquire this information. (JC)			
260.	**Pg. B-89, paragraph 4.** If a sensitivity analysis demonstrated 2.5 orders of magnitude variation in risk (as a result of changing exposure assumptions), collecting more site-specific data on exposure parameters is warranted. The need for more data to reduce uncertainty was clearly documented several years ago in the formal comments for the AX Farm RPE. It appears that no additional AX or C Farm specific data has been gathered or incorporated since that time. The same would apply (albeit to a lesser extent) to source term and transport parameters. Provide additional text discussing and detailing the above concerns. (DD)			
261.	**Pg. B-90, paragraph 4.** The text states that for AX tank farm (DOE/RL-98-72) it was concluded that additional data collection would not appreciably reduce "overall uncertainty." This conclusion appears to conflict with results of the sensitivity analysis (see comment for p. B-89, para 4). For C tank farm, "model uncertainty"			

	may be large, relative to "parameter uncertainty." For example, scaling results (i.e., model uncertainty) from the AX tank farm RPE (DOE/RL-98-72) to the C tank farm RPE would seem to comprise one of the largest sources of uncertainty. Provide an uncertainty analysis for C-Farm. (DD) (DH)			
262.	**Pg. B-90, paragraph 2.** A "relatively coarse" grid spacing parameter is used to evaluate contaminant concentrations for C Farm. The text states: "Because the AX RPE was a scoping-level analysis, a local scale model of the tank farm was not developed." The text goes on to say that the S Farm modeling approach would yield higher groundwater and long-term risks. Provide a detailed discussion of the differences between the two models, including estimates of the effect on the risk numbers and also an estimate of the additional uncertainty realized by the use of the C Farm approach vs. the S Farm approach. State why the S Farm approach was not used for the C-104 RPE. The explanation(s) provided in the C-104 RPE are insufficient. (DH)			
	Attachment B1			
263.	**Pg. B1-1, assumption #2.** Specify the rationale for sluicing with average DST supernate for all C farm tanks, except C-104 (which will use DST AY-101 supernate). (DD)			
264.	**Pg. B1-3, section B1.2.0.** What is meant by the term "past leak data"? Does it include waste leaked from various tanks in C Farm? As C-104 is listed as "sound", what would be used? Does this term			

	include other wastes that could have leaked from ancillary equipment at any time during operation of tanks in C Farm? Provide additional text to answer the above questions. (JC)			
265.	**Pg. B1-6, paragraph 1.** As described, the maximum volume of retrieval liquid should be 827300 gallons, not 735000 gallons (i.e., 840000+46000-58700=827300 gallons). However, there seems to be some confusion over the "solids" volume stated here for Tank C-104 (i.e., 58700 gallons), since p. B1-5 (para 1) specifies "sludge" volume for Tank C-104 as 263000 gallons. Do "solids" vs. "sludge" differ? Regardless, the retrieval liquid volume would be reduced if tank C-104 contains 263000 gallons of waste (i.e., 840000+46000-263000=623000 gallons of retrieval liquid available). Provide additional text to clarify these issues and, if corrections are made, adjust risk calculations and related text in the F&R and RPE. (DD)			
266.	**Pg. B1-8, table B1.3.** Are these radionuclides decayed to present levels? The inclusion of Ru-106 with a half life of 1 year in tanks that haven't operated for over 20 years is puzzling. Provide clarification. (JC)			
267.	**Pg. B-1-13, paragraph 1.** There is an obvious trade-off between using DST supernate vs. water, as the waste retrieval fluid. Using DST supernate generates no new waste volume but introduces additional COCs which may potentially leak during retrieval. On the other hand, using water generates new waste volume but introduces no additional COCs. Compute and discuss the risk of each scenario. In addition, discuss and compute the risk of a third scenario that uses supernatant for the initial stages of retrieval but switches to water for the later stages. (see comment for pg. B-68, para 4). (DD)			
268.	**Pg. B1-13, paragraph 3.** Because methods used to calculate an			

	average composition for DST supernate are largely qualitative, the associated uncertainty would be expected to be large. Provide an estimate of this uncertainty. (DD)			
269.	**Pg. B1-15, table B1.9.** Why are concentrations for radionuclides in DST supernate listed in g/L, rather than Ci/L? Ci is the stated convention (pg. B1-2, para 2). Either discuss or provide corrections to the text. (DD)			
270.	**Pg. B2-2, section D.2.0.** C Farm is northwest of AX Farm. Correct the text. (JC)			
271.	**Pg. B2-2, section D.2.1.** The cited reports (ARH-LD-128 and ARH-LD-132) are by Price and Fecht. C Farm was excavated in 1943-44. The text implies that side wall sampling was conducted at C-Farm excavation around the time the cited reports were generated which is highly unlikely. What side wall mapping was performed in the excavation? Provide additional details, including an explanation referencing the document(s)/report(s) directly related to the actual side wall samples/data. (JC)			
272.	**Pg. B2-8, paragraph 2.** C Farm will eventually be characterized in a manner similar to S and SX Farms. Will the revised data be input into this and future analyses after the work is performed? Is there an insertion point for such data for these analyses in the future? Provide additional text answering the above questions. (JC)			